Centre for Languages and Literature
Master Thesis 30hp (SPVR01)
English Language and Linguistics

Effects of visual feedback on the temporal aspects of argumentative writing

Vesna Mirkoska

Supervisors:

Dr Carita Paradis

Dr Victoria Johansson

Lund, August 2012

Abstract

The effects of visual feedback in writing have mainly been investigated in the context of L1 handwriting and findings generally point to the detrimental effects of visual suppression, in terms of lower quality of the text, shorter clauses and lack of coherence. An investigation of visual feedback effects in computer-based L2 text production has not been undertaken yet. More specifically, findings indicate that visual feedback in L2 provides a release for the limited working memory in L2. In addition, while producing argumentative text, links need to be established between arguments. This makes the role of visual feedback critical. Given the relationship established between pause duration and working memory demands, suppression of visual feedback is expected to influence the temporal patterns of text production. Against this backdrop, the present exploratory study investigated the effect of visual feedback on the temporal variables of pause duration, pause location, pause frequency, and pause distribution as well as the aspects of fluency during the production of English L2 argumentative texts. In a within-subjects study, 14 English L2 participants produced argumentative texts in a condition with visual feedback and in a condition with restricted visual feedback. Data were collected with ScriptLog, a keystroke logging programme. 28 texts were coded for pauses on three levels: meta-textual level (text, movement, editing), textual (Introduction, Arguments for and against and Conclusion) and syntactic (clause and phrase). Two analyses were performed based on two pause location definitions. The first analysis defined location of the pause before the specified units, whereas the second defined location after the designated units. An exception to the dual analysis was the textual level. Results of the paired t-test(s) show that when visual feedback is restricted, frequency and duration scores for pauses at movement locations increase significantly. At editing locations, however, frequency and duration scores significantly decrease. Second, writers spend significantly less pause time in the introductory part but pause more while they produce arguments against. Third, results indicate that frequency scores are significantly higher at clause final and phrase internal locations. Finally, while fluency remained constant, wasted characters were lower in the restricted feedback condition. To conclude, manipulating visual feedback alters the temporal aspects of L2 writing but does not necessarily produce detrimental effects.

Key words: visual feedback, pause, argumentative text production

Acknowledgments

I would like to thank my supervisors, Dr Carita Paradis and Dr Victoria Johansson for their unreserved support and patience during the writing of this thesis. Without their fruitful comments and guidance, this work would not have been possible.

I would also like to thank many other friends and colleagues who repeatedly read and commented on the versions of this paper. I would like to thank Vesna, Alexander and Nataccia for their helping hand.

Finally I would like to thank Ms Åsa Wikström who always resolved all my administrative issues.

Contents

List of Tables

List of Figures

1. Introduction

Visual feedback during writing, or the access to the emerging text, has mainly been investigated in the context of handwriting (e.g. Hull & Smith 1983; Olive & Piolat 2002). On one hand, findings suggest that visual feedback is only required to decrease the demands of motor transcription on working memory during handwriting. On the other hand, results of several studies converge on the observation that visual feedback is a necessary component during composition since its suppression has detrimental effects on the final written product. In particular, studies have reported lower quality of the text, reduced clause length and lack of coherence.

However, visual feedback from the computer screen while writing has not received attention in research. In this context, no attempt has yet been made to approach the effects of visual feedback from a temporal perspective. More specifically, research has not investigated the effects of visual feedback and visual suppression through pause location, pause duration, pause frequency, pause distribution, and fluency in writing. In addition, while researchers investigating visual feedback have used argumentative writing tasks, which range from generating arguments supporting a thesis (Hull & Smith 1983) to generating pro and con arguments on a certain topic (Olive & Piolat 2002), it may be argued that while producing pro and con arguments, the reliance on visual feedback may be critical. This is due to the need to examine how opposing arguments are related (Nussbaum & Schraw 2007:61). In this context, studies demonstrate a persistent deficiency in integrating arguments and counterarguments. Furthermore, although visual feedback studies have concentrated on L1 writing, the reliance on visual feedback might be more pronounced in the L2 context. Specifically, Broekkamp and van den Berg (1996) argue that access to the text in L2 writing provides the writer with a series of facilitation procedures to cope with the limited capacity of working memory, which is a constraining factor for L2 writers. Moreover, links have been established between working memory and temporal variables of writing, in that increased duration of pauses is associated with greater demands on working memory. Therefore, considering the memory constraints as well as findings that indicate that writing in a second language is less fluent, reflected in fewer words, lower accuracy or more errors, as well as lower effectiveness expressed in lower holistic scores (Silva 1993), it may be strongly assumed that restriction of visual feedback while composing a pro and con

argumentative text in a second language is a challenging task that may affect the temporal variables of writing.

In view of the aforesaid discussion, the present study attempts to explore the effects of visual feedback on the temporal variables of pause location, duration, frequency, and distribution, as well as the temporal aspects of fluency, while composing a pro and con argumentative text in English as a second language. The effects will be explored in an experiment designed as a within-subject study with two conditions namely, producing text with visual feedback and producing text with restricted visual feedback. The restricted feedback will be obtained by reducing the writing window size and allowing only the emerging line of written text to be immediately accessible. However, scrolling line-by-line and movement with the arrows of the keyboard will be enabled. 14 participants will compose two pro and con argumentative texts on the basis of two elicitation video materials. Pauses will be recorded with ScriptLog, a keystroke logging programme that captures and records the writing activity as well as the pausing events. Identified pauses will be analysed on three levels: meta-textual, textual, and syntactic. First, duration and frequency of pauses on the meta-textual level will be analysed on the basis of three activities designated as basic namely, 1) pauses that occur at locations for text production, 2) movement in the text, 3) editing, as well as 4) pauses that relate to any combination between the three activities. Second, the distribution of pauses will be analysed on the basis of four categories which constitute the textual level: 1) Introduction, 2) Arguments for, 3) Arguments against, and the 4) Conclusion. Third, pause duration and frequency will be analysed on the syntactic level, which consists of pauses in 1) clause context and pauses in 2) phrase context.

With regard to the location for coding of the pause, the present investigation defines the location before and after the designated units. The motivation to apply two principles in defining the location stems from the discussion by Spelman Miller (2006) who argues that location has mainly been defined before designated units. In this context, Spelman Miller (2006:26-9) asserts that by defining location in terms of a position before a certain unit there is a danger of associating the pause with forward-planning. Moreover, she alerts to the fact that most of the recent discussions refer to pausing in terms of forward-planning. However, pauses may be associated with processes other than forward-planning. For instance, look-back or re-reading

previously produced text may also occur while pausing (Spelman Miller 2006:29). Therefore, by incorporating two separate methods of coding which analyse pauses both before and after specified units, the present study attempts to obtain a more comprehensive perspective on the pausing behaviour of English L2 writers. However, the study makes no assumption that pauses before designated units are used solely for the purpose of forward-planning or that pauses which follow the units have a function of re-reading or editing. The reason for taking a reserved stance rests on several observations already raised in research. First, it has been acknowledged that the concepts of planning, translating and reviewing are difficult to define in unambiguous terms (Spelman Miller 2006:152; Severinson & Kollberg 1996:166). Second, even if pauses refer to any of those processes, distinguishing planning from re-reading for the purpose of idea generation, from reflective processes which include problem-solving, decision-making and inferencing, as well as from the other components of text generation and reviewing, remains an open empirical question at present (Spelman Miller 2006:153). Third, assuming that pauses can be reliably associated to any of those processes, the technique used in the present experimental design does not permit any empirical testing of such proposals.

In designing the study as described above, the aim is to examine whether restricted visual feedback increases pause duration and frequency at the designated meta-textual and syntactic units as well as in the segments where arguments are produced. An additional objective is to explore if under conditions of restricted visual feedback writing fluency decreases while burst increases. If any effects are found in these directions, it may be argued that restricting the access to the text while writing imposes high demands on working memory resources, as reflected in higher frequency and duration of pauses across the three levels, as well as in a dip of fluency and increase in burst.

To conclude, the study is motivated by two observations. From a specific standpoint, visual feedback effects on the temporal patterns of English L2 argumentative writing might offer clues as to the working memory capacity of this particular cohort of writers. In addition, results may reveal syntactic as well as argument-related concerns of this group. From a more general perspective, composing a high-quality argument in writing is deemed critical to academic success (Kuhn 2005). Importantly, it has been recognized that "the problems of writing an

argumentative text have not yet been properly investigated" (van Eemeren & Grootendorst 1999:61).

Having established the basic postulates of the present investigation, the introductory part concludes with the layout of the thesis. The thesis extends over seven Sections. Each Section, with the exception of the Introduction, begins with a concise outline of the discussion and concludes with a summary of the most relevant points. The Introduction is followed by definitions of the key terms. Section two discusses the theoretical background and contains five Subsections. The first Subsection presents findings related to visual feedback in writing. An overview of relevant pause studies as well as a brief discussion of working memory in writing is provided in the second Subsection. The third Subsection presents findings in regard to the production of argumentative text. A brief overview of English L2 studies pertinent to the present investigation is provided in the fourth Subsection, although each Section incorporates findings from L2 studies. It must be noted that the majority of findings discussed throughout the thesis relate to L1 studies due to the lack of relevant research in the field of L2. The L2 aspect is introduced in each discussion to the extent that relevant studies were identified. The theoretical background concludes with an overview of real-time techniques in writing with particular emphasis on keystroke logging. The scope and hypotheses are discussed in Section three. Methodological issues are contained in Section four and results are presented and discussed in Sections five and six respectively. The conclusion summarizes the results and the main discussion points and briefly addresses the limitations and benefits of the study and the recommendations for further research.

1.1 Definition of key terms

This Subsection defines the key terms of the present study. Where applicable, each definition adopted for the purposes of the present study is preceded by a brief discussion of existing definitions in research. First, a definition of visual feedback in writing is provided. Next, the Subsection specifies the usage of pause duration, pause frequency, pause distribution, as well as fluency in writing. Further, argumentative writing is defined for the purposes of the study. Lastly, real-time computer techniques in writing are defined. The final part contains miscellaneous definitions of terms that occur throughout the thesis.

1.1.1 Visual feedback

The term visual feedback in writing has come to be used to refer to the possibility to monitor the emerging text while writing. By the same token, visual suppression, or preventing writers from interacting with the text, has been accomplished by using 'magic ink' and carbon paper on which participants write with an empty ballpoint pen (e.g. Gould 1980; Atwell 1981). In effect, such manipulations with visual feedback imply that writers have no opportunity to interact with previously produced text.

Visual feedback, for the purposes of the present study, will be defined as the unrestricted access to the emerging text while writing on a computer window. Suppression of visual feedback, however, will be understood in a different manner. Access to the text will be restricted to the emerging line but scrolling line-by-line and movement with the arrows on the keyboard will be enabled.

1.1.2 Pauses in writing

Current research faces difficulties in qualifying a pause in writing. Wengelin (2006:110) recognizes that a strict operational definition remains a challenge in the relevant scientific community and observes that very few studies actually address the issue. In addition, Wengelin (2006) emphasizes that pause definitions usually serve the specific research aims only.

To illustrate, a selection of pause definitions is provided to represent the use of this concept in writing research. Matsuhashi (1981:114) proposed that pauses are "moments of physical inactivity during writing", that "offer observable clues to the covert cognition processes which contribute to discourse production". Chanquoy, Foulin and Fayol (1996:36) suggest that pauses, and especially their duration and frequency variation, may indicate "modulations of the cognitive cost required by the operations in the production". In Wengelin (2006:111) a pause is defined as "a transition time between two keystrokes which is longer than what can be expected for the time needed to find the next key". Lastly, Spelman Miller (2006:19) proposes that in the investigation of planning, pausing provides insight into the "allocation of attentional resources during composition". In this context, even the cut-off values for pause analysis selected by researchers may reflect an implicit interpretation of the purpose of pauses. For instance, Wengelin

(2006:111) suggests that if the focus is on the planning of a sentence, excluding short pauses, which are more frequent within words, is a useful strategy.

Bearing in mind that the function of pauses is poorly specified in writing research (Alves, Castro & Olive 2008), and various definitions are found in the literature, this paper defines the concept according to the aims of the present investigation. A pause, for the purposes of the present study, will be referred to as inactivity in writing greater than or equal to 2 seconds, that precedes i.e. follows a designated meta-textual and syntactic unit or is found within a designated textual category.

1.1.3 Pause duration and frequency

This Subsection defines the temporal variables of the study on which statistical tests will be performed. It defines pause duration and frequency and uses the 2-s criterion in order to enable comparability with earlier studies (e.g. Wengelin 2006; Chanquoy, Foulin & Fayol 1996).

Total duration is the sum of all pauses occurring in the text. Total duration^{c} is the sum of all pauses, belonging to particular category, identified according to the specified meta-textual, textual and syntactic criteria. Relative duration^{c} is the fraction of total duration^{c} in the total duration, expressed in percentage. Total number of pauses is the sum of the number of pauses that occur in the text. Simple frequency is the sum of the number of pauses, belonging to particular category, identified according to the specified meta-textual, textual and syntactic criteria. Relative frequency is the fraction of the simple frequency in the total number of pauses, expressed in percentage.

In addition to the variables specified above, this Subsection defines the other parameters on which subsequent statistical testing will be executed. Total median duration is the numerical value separating the higher half from the lower half of values of all pauses occurring in the text. Median duration^{c} is the numerical value separating the higher half from the lower half of values of all pauses within the particular category, identified according to the specified meta-textual, textual and syntactic criteria. Total mean duration is the sum of all pauses occurring in the text, divided by number of pauses that occur in the text. Mean duration^{c} is the sum of all pauses within a particular category, identified according to the specified meta-textual, textual and syntactic criteria, divided by the number of pauses within that category.

1.1.4 Fluency and burst

Firstly, fluency and burst in writing are viewed as temporal phenomena and are defined differently in research. Studies of written fluency have deployed a variety of measures ranging from counting words, clauses, sentences, T-units to averages of the number of words per clause, sentence, T-unit, error-free clause or error-free T-unit in a text, as well as number of characters per minute (Chenoweth & Hayes 2001; Spelman Miller, Lindgren & Sullivan 2008). Second, burst has been defined as the number of words between pauses or revisions (Spelman Miller 2006; Chenoweth & Hayes 2001) as well as the number of typed characters divided by the (number of revisions + number of pauses) in Spelman Miller, Lindgren and Sullivan (2008).

In the present context, the definition of fluency is adjusted from Spelman Miller, Lindgren and Sullivan (2008). Fluency is defined as both an online and an offline measure. The online measure is the number of characters (subsequently deleted characters are maintained) produced per minute. To obtain the figure, the total typed characters in the linear file were divided by total task time. The offline measure of fluency takes the number of characters in the final edited text (without deleted characters) and divides it by total task time. Concerning the definition of burst, in this thesis, it will refer to the number of typed characters (including subsequently revised characters) produced between pauses. The reason why calculations are done on the basis of characters instead of words is the fact that defining word in computer-based analysis is difficult. In addition, including characters that may not have survived in the final text in the calculations rests on the interpretation adopted in the study that writers were productive despite subsequent revisions.

1.1.5 Argumentative writing

Argumentative writing is usually defined according to the specific assumptions grounded in different argumentation models. For instance, according to Newell et al. (2011) argumentative writing involves a thesis, supportive evidence, and assessment of warrants connecting to the thesis, the evidence and the situation constituting an argument. Alternatively, Andriessen and Coirier (1999) define argumentative texts as pieces of written discourse in which an attempt is made to settle issues concerning a controversial topic with the purpose of modifying another person's opinion concerning the issue. To illustrate further how the term argumentation is

understood, few examples are provided below. To begin with, argumentation is considered as a "continuum ranging between two poles. The first pole involves evidence for a conclusion and the second pole is regarded as an action aimed at modifying beliefs or behavior of a certain audience" (Coirier, Andriessen & Chanquoy 1999:3). Furthermore, Perelman and Olbrechts-Tyteca (1969:14) suggest that argumentation uses "discourse to influence the intensity of an audience's adherence to certain theses". Besnard and Hunter (2008:3) propose that "Argumentation is a process by which argument and counterarguments are handled". Finally, Voss, Wiley and Sandak (1999:34) claim that "arguments are presented for persuasion or sometimes for resolution". The issue of defining and delineating argumentation and argumentative text is further complicated by the fact that a range of genres (e.g. testimonials, letters, reports, speeches, sermons) may function as arguments (Newell et al. 2011). In this context, Newell et al. (2011:274) assert that argumentation remains "poorly defined or perhaps overly defined due to the specific assumptions related to research, theoretical work, as well as teaching and learning approaches". Considering the above discussion, it may be observed that defining argumentative writing is far from straightforward. The terms argumentation, argument, argue, etc. may be used in different contexts and reflect different concepts.

For the purpose of this study, the following terms are defined: argument for, argument against, argumentative writing, text, argumentative text and integrated response. Argument for will be used to mean a statement in support of the assigned topic whereas argument against will refer to a statement which opposes the topic. Argumentative writing will refer to the process of written production of arguments for and arguments against. Text is defined as a stretch of linked statements which form an overall structure (Andriessen & Coirier 1999). Argumentative text is referred to as text which incorporates but is not limited to arguments for and against the assigned topic. An integrated response will refer to argumentative text which contains both arguments for and against the topic.

Lastly, throughout the thesis, terms such as pro and con arguments and argument and counterargument will occur due to different usage of these terms in studies reported here. In addition, the writing task in the present experiment uses the terms arguments for and arguments against to mean pro and con arguments, that is, argument and counterargument respectively.

1.1.6 Real time techniques in writing

The real-time computer-aided approach to studying the writing process may be defined as observing and analyzing the process of writing by means of recording activities performed on the writing window (Latif 2008). Among the available techniques is keystroke logging, which enables the capture of actions while writing on a computer which includes keyboard presses, cursor movements, scrolling, temporal events i.e. pauses in the process, etc.

1.1.7 Miscellaneous definitions

L2 refers to the term second language and, where required, it will be specified when the L2 context is English. In addition, despite the distinctions made between English as a Second Language (ESL) and English as Foreign Language (EFL) speakers (Sasaki 2004; New 1999), no such criteria were considered in the present study. Finally, all references to L2 or ESL in the theoretical background as well as in the discussion are adopted from the respective studies.

The terms planning, translating and reviewing refer to three writing processes that occur in the models of writing (e.g. Flower & Hayes 1980). In this context, complex definitions and interpretations of the three processes have been suggested in the literature (see Hayes 1996; Spelman Miller 2006). However, throughout the thesis, when such terms occur, they are defined and interpreted within the framework of the study that is being discussed.

The experimental conditions will be referred to as the normal condition or the big window and the restricted visual feedback condition or the small window.

With this part, the Subsection that defines key terms of the present study concludes, and the discussion resumes with the theoretical background for the present study.

2. Theoretical background

Section two discusses the background literature of the present study and extends over five Subsections. Visual feedback in writing is discussed first. The second Subsection reviews the most relevant pause-related studies. Third, findings pertaining to the written production of arguments are presented. English L2 studies in the context of the present investigation are

discussed in the fourth Subsection. The Section concludes by addressing real-time computer-aided techniques of writing.

2.1 Visual feedback in writing

This Subsection provides an overview of studies that concentrate on visual feedback in writing. Given that studies that investigate visual feedback in computer-based writing are scant, findings are mainly discussed in terms of handwriting or writing on digitizer tablets. In addition, findings concerning the effect of the screen size on task performance are also addressed, as they were deemed pertinent to the present study.

To begin with, the impact of visual feedback on the processing demands of writing has mostly been investigated in the context of handwriting with pen and paper, or recently, on digitizer tablets with an electronic pen (Olive & Piolat 2002). Visual feedback from the computer screen, however, has not been an explicit focus of writing researchers. Therefore, the findings presented in this Subsection refer only to studies focusing on visual feedback in handwriting and any extensions in the context of keyboarding should be interpreted with care, since research indicates that the handwriting and typing differ in their demands of the particular skill or require different skill levels (Weintraub, Grill & Weiss 2010).

The effect of visual feedback in handwriting has been accounted for by two approaches. On one hand, visual feedback is assumed to erase motor programmes already executed from working memory decreasing thereby the processing demands of motor transcription (low-level process). For instance, studies report that when visual feedback is suppressed, the quality of handwriting decreases. More specifically, in case of adult writers using an inkless pen, lack of visual feedback resulted in less accurate letter formation and incorrect text alignment (Olive & Piolat 2002). According to the second account, access to the written trace is assumed to facilitate high-level writing processes. To illustrate, by using a secondary task, Olive and Piolat (2002) investigated the effect of suppression of visual feedback during handwritten text composition on the processing demands and coordination of high- and low-level processes. In their study, the writing processes of planning, translating and reviewing were defined as high-level processes. The first activity was defined as formulation of language which involves planning or retrieval of information from long-term memory, organisation of the content and goal setting. In the process

of translation, products of planning are transformed into sentences. Finally, reviewing requires critical reading of the text and detection of errors or other problems (Olive & Piolat 2002). Low-level writing processes were defined as motor execution processes. In short, Olive and Piolat (2002) asked participants to respond to an auditory probe while writing pro and con arguments on a given topic. The study demonstrated that visual feedback is only required for motor transcription and not for high-level processes during composing. However, when visual feedback was suppressed, and processing demands of motor execution increased, writers could not activate high- and low-level processes concurrently and activated a serial strategy instead.

Other lines of research manipulated visual feedback in order to investigate the importance of re-scanning or re-reading of the emerging text. In particular, studies which examined the effects of 'blind' writing (denying writers the possibility to re-read the emerging text) report detrimental effects on the final text. In contrast to this, studies have observed only selective effects, depending on the complexity of the writing task.

To illustrate, a selection of three studies described in Hull and Smith (1983) is presented in a summarized form below. In the study by Atwell (1981), college students, classified as remedial and average writers, composed for 10 minutes in two conditions, 'normal' writing, with pen and paper and 'blind' writing, with worn-out ballpoint pens on top of carbon paper. Results showed that the lack of visual feedback distorted coherence, particularly in the case of remedial writers. However, the subjects produced partial or limited texts and the effect on whole text was not obvious. Further, Teleman (1981) had 12-13-year-old Swedish schoolchildren listen to a short fable which was then re-told in writing, under visible and invisible ink conditions. Although Teleman (1981) could not find significant differences between the conditions, he observed that texts and sentences were slightly shorter when produced in invisible ink. However, as pointed by Teleman (1981), participants were provided with both content and text structure, which made the test of any recursive activity inadequate when it comes to a more complex writing task. Finally, Gould (1980) had his subjects compose business letters with a wooden stylus on top of carbon paper, which prevented their re-reading. Gould (1980) found no differences in quality, amount of time spent composing, or the number of proofreading changes between the 'invisible' writing and either dictating or 'normal' composing. However, critics attribute the lack of any differential to the genre which is assumed to be well internalized.

In respect to the effects of the complexity of the written task, Britton et al. (1975) as cited in Kellogg (2001:177) observed that persuasive tasks are more difficult to produce without visual feedback in comparison to narrative tasks. In this context, the study of Hull and Smith (1983) explored the re-reading and planning behaviour of writers producing persuasive essays supporting a single position. The study hypothesized that the frequency of either extensive planning or extensive re-reading while writing persuasive texts is expected to be higher, since the conclusion rests on the presented ideas. Results showed that texts written in invisible ink had shorter clause lengths and were of lower overall quality in comparison to controls. Apart from visual feedback in writing, one line of research is particularly important to this study, given the present experimental design. Specifically, findings concerning the effects of screen size on task performance as well as document navigation are addressed next.

Studies have explored the effect of window size on reading and learning performance. Bruijn, de Mul and van Oostendorp (1992), investigated the effect of screen size of 12 inch (23 lines) compared to 15 inch (60 lines) and text layout which was either well or ill structured on the learning of a text. The researchers assessed both amount of information retained and efficacy of learning, which was measured by learning time and cognitive effort by means of a secondary task. Their findings show that screen size affected only the time required for learning. Specifically, participants using the 15 inch screen needed 10 to 15% less time to learn compared to their counterparts in the 12 inch screen. One relevant observation in the study was that in the small screen condition readers made more movements in the text. The results, however, did not reach statistical significance, which Bruijn, de Mul and van Oostendorp (1992) interpreted as an adaptive strategy that participants used to overcome the restricted visual feedback. Moreover, participants paid attention locally for a longer period of time and scrolled line-by-line instead of jumping far into the text.

Other relevant findings are related to studies that investigated page navigation, which includes scrolling and paging. Early studies of reading a text from a computer screen suggest that scrolling line-by-line has a detrimental effect on task performance. To illustrate, the total time required to read a given passage was less for the non-scrolled text than for the text scrolled at a preferred rate (Kolers, Duchinsky & Ferguson 1981 cited in Mills & Weldon 1987:344). In addition, a study by Oléron and Tardieu (1978), cited in Mills and Weldon (1987:345), explored

the effect of scrolling on the recall of text presented on the screen. The results revealed that when text was scrolled as a block, recall was significantly better than when the text was scrolled sentence-by-sentence.

Research has also suggested that reading from computer screens reduces working memory capacity for reading by reallocating resources to document navigation, which involves either scrolling or paging. In regard to the two methods of page navigation, scrolling demands more from the user (Wästlund, Normander & Archer 2008).

To summarize, visual feedback in handwriting is assumed to either erase motor programmes executed from working memory decreasing thereby the processing demands of motor transcription or facilitate high-level writing processes, by virtue of having constant access to the written trace. Studies have investigated the effect of visual feedback in correlation to re-reading a text. Several studies that required writers to produce text with an inkless pen or worn-out ballpoint pens on carbon paper observed that suppression of visual feedback affected the coherence of text. Similarly, findings concerning visual feedback in a persuasion writing task indicate that clauses were shorter and overall quality was lower, when visual feedback was suppressed.

Findings concerning screen size effects on task performance indicate that participants using a smaller screen require more time to learn from a given text and make more movements in the text. More specifically, findings concerning recall of text, that participants were required to scroll sentence-by-sentence or as a block, indicate that recall deteriorated in the sentence-by-sentence condition. Studies also report that working memory resources are allocated to page navigation, with scrolling being more demanding from the user than paging.

Upon discussing the main findings concerning visual feedback in writing the discussion resumes by introducing the temporal variables of composing and their relationship with working memory.

2.2 Temporal variables in writing

This Subsection discusses findings concerning the study of pauses in writing. In addition, it addresses findings related to fluency in writing. Taking into account the scarcity of L2 research in this field, the findings discussed below draw upon L1 studies. The L2 aspect is represented to

the extent that relevant studies were identified. The first part presents a selection of studies that illustrate several research concentrations of pausological studies of writing. Specifically, pause location, duration and frequency along with pause distribution on macro-level are discussed briefly. Where findings were available, an attempt was made to discuss the aforesaid aspects from the three identified approaches to pause analyses, namely, syntactic criteria, micro-context criteria and discourse criteria. The second part reviews the link between pause duration and working memory and presents two influential models of working memory in writing.

Pause location, pause duration, pause frequency and pause distribution on a macro-level are frequent variables in the research of temporal aspects of the writing process. To begin with, pause location has mostly been approached in terms of syntactic criteria (Spelman Miller 2006:135). Syntactic categories which serve as a basis for pause analysis generally include T-units (e.g. Matsuhashi 1981) as well as paragraphs, sentences, clauses, phrases and words (e.g. Schilperoord 1996; Chanquoy, Foulin & Fayol 1996). Researchers specify the units to various degrees and apply definitions relevant to their research criteria. To illustrate, in Spelman Miller (2006:133) the categorization of word classes is extended so as to provide a more sensitive characterization of pause location, and includes among others, noun phrase, verb phrase, adjective, subject, object, etc. Similarly, studies which have investigated pause patterns for clauses have focused on coordinate and subordinate clauses (e.g. van Hell, Verhoeven & van Beijsterveldt 2008).

In connection to the syntactic categories discussed above, Matsuhashi (1981) produced the seminal study of pauses which analysed planning processes in writing on the basis of T-units. In a videotaped experiment, Matsuhashi (1981) included four participants who wrote on a pad with a pen, and analysed pause duration before T-units and within T-units before words, phrases and clauses across three discourse types (reporting, generalizing and persuading). Results showed that writers pause longest before T-units which begin paragraphs. In that context, Matsuhashi (1981:130) argued that pauses at paragraph openings "provided the writer time to review what has already been written as well as time to plan ahead for the next section of the text". In addition, pauses located within T-units prior to words, phrases and clauses were found to be long as well. Matsuhashi (1981) proposed that the presence of long pauses within T-units suggests that writers have not completed all planning before starting to write the sentence. In addition, in

an informal analysis, Matsuhashi (1981) observed long pauses before nouns and verbs. Pauses before nouns were attributed to planning time required for selecting the best concept or naming the objects chosen for inclusion, whereas pauses before verbs were assumed to reflect lexical decisions regarding the predicate and its reconnection to the subject.

Other analyses of pause duration from a syntactic perspective report a positive correlation between pause duration and paragraph, sentence, clause, phrase, and word. To illustrate, Chanquoy, Foulin and Fayol (1996) conducted video recorded experiments with ten participants and analysed pause duration before paragraph, sentence, clause, phrase, and between words. Chanquoy, Foulin and Fayol (1996:39) reported that the mean duration was highest before paragraphs, sentences, and clauses (17.3, 12.7 and 2.8 seconds respectively). In the same vein, Schilperoord (1996) analysed pause duration before paragraph, sentence, clause, constituent, and word from a corpus of twenty texts (professionals dictating letters) produced offline by six participants. Schilperoord (1996:29) observed that the average pause length was highest before paragraphs, sentences and clauses (8.272, 2.611 and 0.763 seconds respectively).

Studies that investigated pause duration in a L2 context report that pause duration is generally longer in L2 compared to L1 writing. For instance, Spelman Miller (2006) included 10 L1 writers and 11 L2 writers who produced a descriptive essay (defining and classifying ideas) and an evaluative essay (presenting aspects of argument). Spelman Miller (2006) investigated pause duration of L2 and L1 writers in terms of potential and actual (produced) units of language, so as to account for the evolving status of language and the temporary status of online data. For that purpose, Spelman Miller (2006) introduced the term 'potential completion point' which represents units that may or may not survive in subsequent modifications of the text. The location of the pause was characterized according to which (possibly) completed structural unit (character, word, clause, and sentence) preceded the pause. In short, Spelman Miller (2006:149) reported that pause length is greater in texts produced by L2 writers at all locations, and especially at paragraph and clause/sentence locations. Similarly, Hall (1990) examined revision in four ESL writers and reported that L2 writers spent on average 40 out of 90 minutes assigned for the writing task pausing, in comparison to L1 writers who paused only 23 minutes on average.

Furthermore, the location of pauses has been approached from a micro-context perspective. A micro-context is defined as the type of characters (e.g. full stop, letter) surrounding the transition, subject to our interest (Wengelin 2006:114). In this method, temporal events are recorded before and after characters and spaces (Wengelin 2006). In this framework, Wengelin (2006) analysed pause duration and frequency in a micro-context across different age groups, ranging from 4th graders to university students, and observed no differences between sentence and word related pauses. The non-effect was interpreted as a potential consequence of the pause criterion as well as a result from the automatic micro-context analysis, which is not sufficiently fine grained to distinguish between words, phrases or other syntactic structures (Wengelin 2006:120).

Next, pause location may also be characterized from a discourse perspective. In the study by Spelman Miller (2006:132) discussed above, apart from the syntactic location, pauses were also tracked at "discoursally significant junctures" which have a role in "introducing, maintaining and developing" the topic in the discourse. Spelman Miller (2006:135-6) establishes the concept framing device or "an element or structure (single word, phrase or clause) which serves to establish the starting point of a message at the clause/sentence level". The framing device considers the potential discourse function of certain units, principally from the categories of nominal phrases in subject or adjunct position and also conjuncts and disjuncts. Although for the purposes of this review, an explanation of the framing device categories along with the respective results are not considered, one finding pertaining to L2 writers is worth mentioning. Namely, in contrast to L1 writers, L2 participants pause considerably longer at such locations (Spelman Miller 2006:146). In a similar context, Matsuhashi (1981) reported differences in pause length across three discourse types (reporting, generalizing and persuading essays). In particular, Matsuhashi (1981) observed that the mean duration of pauses was shortest in reporting texts. She suggested that pauses are extended in persuasive and generalization tasks in comparison to reporting, because reporting requires linear ordering of content, whereas persuasive and generalization texts require matrix-like global overview.

Pause frequency is another variable investigated in the context of writing. Pause frequency may be affected by several factors such as the study criterion, the typing speed and the design of the writing task. First, frequency can be manipulated by the research criterion in that, if the

criterion is lowered, the pause frequency will increase. Second, typing speed is a significant factor that influences how frequently writers might stop in the writing process. This compromises the comparison of pause frequencies across individuals, a problem which may be circumvented by obtaining relative distributions across individuals or groups. From a micro-context perspective, apart from the pause duration discussed above, Wengelin (2006) analysed pause frequencies as well. Wengelin (2006:121) reports that micro-contexts before words and before sentences were generally more predictive of pauses than micro-contexts after words and after sentences. Third, pause frequencies are contingent upon the design of the writing task. To illustrate, Wengelin (2006) observed that genre did not produce significant effects but a picture-elicited narrative triggered higher percentage of pauses, possibly due to time required to look at the picture while writing. In relation to L2 writers, the study by Spelman Miller (2006), introduced above, observed that L2 writers pause more frequently than their L1 counterparts at all syntactic locations. Furthermore, the study by Hall (1990) discussed before, reported that the average number of L2 pauses while drafting a text was 41 compared to 28 pauses during the L1 drafting stages.

Another aspect which has been examined is pause distribution on a macro-level. Such global distribution of pauses during the writing session is usually obtained by arbitrarily dividing the text and analysing pause patterns. To illustrate, macro-level distribution has been subject to studies that investigated the interaction between pause time distribution and genre of the writing task. For instance, Johansson (2009) examined pause time distribution between narrative and expository texts. For the purposes of appropriate interpretation of the findings discussed here, a narrative text in the study was defined by "a linear pattern where one event follows the next according to a temporal and logical structure" (Johansson 2009:44). Expository text was defined as having "no natural chronological or temporal structure where "…writers may start with any argument" (Johansson 2009:44). To obtain the pause time distribution, Johansson (2009) divided the texts in five equal temporal segments each constituting 20% of the total time spent on the task, excluding the last pause. It was observed that despite the equal total pause time for both genres, a striking difference occurred in the global distribution of total pause duration. Specifically, the pause time curve of the narrative texts was much more U-shaped than that of the expository texts, indicating that the narrative texts had much pausing in the initial segment and at

the final stage, where reading or editing might have occurred. By contrast, the expository texts showed a flatter curve. In Segment 1 the pause time was somewhat higher, which was interpreted as an initial planning phase. But the pause proportion remained relatively high in Segments 2 and 3 as well. It is important to note that no age differences between groups (10-, 13-, 17- year-olds and university students) were reported for this study.

Finally, in reporting findings related to fluency in L2 writing, a caveat is necessary as to the different operational definitions of fluency and fluency-related terms in research. For instance, Spelman Miller, Lindgren and Sullivan (2008) use the terms fluency and burst and define them as number of characters per minute and number of typed characters divided by the (number of revisions + number of pauses) respectively. Results show that the average fluency scores of first, second and third year English L2 students were 34.3, 42.4 and 55.4 respectively. Findings concerning burst indicate that the scores for first, second and third year students were respectively 4.94, 6.55 and 9.38 on average. Further, Spelman Miller (2006) uses the term productivity and defines it as the number of words produced between two pauses. The results of the study indicate that although productivity is generally lower in English L2 writers, productivity following framing device pauses is high. A final example is the study of L2 writers by Chenoweth and Hayes (2001) where fluency is defined as the number of words written per minute and burst as the number of words written between pauses or revisions. Results show that students wrote an average of 10.75 words per minute and produced 2.41 words between pauses.

Having discussed the temporal variables subject to this investigation, it must be emphasized that some of the findings related to pause duration bear a close relation to the concept of working memory in writing. More specifically, it is presumed that the average pause duration before paragraphs, sentences and clauses is high due to the larger demand on working memory. The effect has been reported in a study by Ransdell, Levy and Kellogg (2002), which combined a dissociation task with pause analysis. Results show that a heavy load on working memory introduced with the secondary task increased the frequency and duration of pauses at such junctures. In this regard, it is necessary to clarify the role of working memory in writing. For that purpose, the second part of this Subsection addresses the relationship between working memory and writing through two influential models.

2.2.1 Working memory in writing

In regard to writing, two models have made significant contribution in accounting for the relationship between working memory and writing. Kellogg's (2008) model of working memory in writing embeds the multicomponent memory model (Baddeley 2007) and specifies the demands on the specific components. According to Kellogg (2008), the central executive, which is an attentional component, coordinates the complex interaction among the writing processes of planning, generation and reviewing and monitors the transitions between the processes. In addition, the executive capacity is required to maintain active representations of what the text actually says and what the writer intends to say (Kellogg 2008). Moreover, the availability of executive attention is considered as a major constraint on the development of writing skill. Furthermore, the separate visual, verbal and spatial components of working memory have been found to process different aspects of writing. To dissociate between verbal, visual and spatial demands researchers create interference (secondary) tasks. To illustrate, an interference task that disrupts the verbal component may be responding to syllables, a visual secondary task may require responses to alternating shapes, and a spatial one may ask for responses to change of position of an item. Findings in this context indicate that verbal working memory supports phonological, ortographic, syntactic, and grammatical encoding. The visual component is reported to be activated when images of referents are retrieved (Kellogg, Olive & Piolat 2007). Spatial working memory is assumed to have a role in representations of the text as a spatial display (Hayes 1996:19). Studies, however, indicate that composing a text mainly requires verbal and visual working memory, and to a lesser extent, spatial working memory (Kellogg 2008).

The second model developed by McCutchen (2011) rests on an adapted capacity theory of comprehension put forward by Just and Carpenter (1992) to account for developmental and individual differences in writing skill. It is important to observe that McCutchen (2011) also relies on the definition of working memory devised by Baddeley (2007). In this model, lack of fluent text production has implications arising from the limited capacity of working memory. Concerning text production, two kinds may be distinguished, namely, transcription and text generation. On one hand, transcription includes spelling and motor skills involved for handwriting and typing. On the other hand, text generation subsumes content selection, lexical retrieval and syntactic processes. Working memory resources are assumed to be shared between the two systems. In respect to transcription, despite findings that transcription imposes higher

working memory costs for children than for adults, studies have shown that if adult participants are asked to write in cursive upper-case letters, which disrupts their fluent transcription processes, adults' texts result in shorter sentences and are of lower quality (Alves, Castro & Olive 2008). In theory, the lack of fluency in transcription should decrease the working memory resources and affect other aspects of writing. In reference to text generation, working memory span predicts structural complexity of text and is correlated to text quality. In this context, studies of activation of both processes in handwriting and typing reveal significant differences. On one hand, Olive and Kellogg (2002) assume that concurrent activation of both processes in handwriting occur only when motor transcription is automated. In their study, adult writers were able to activate both processes concurrently (parallel strategy) only when writing under conditions of practiced cursive scripts. When required to write in unpracticed cursive script, such simultaneous activation of the two processes did not occur. In the study, children were unable to activate the processes concurrently and adopted a serial strategy instead. The study by Alves, Castro and Olive (2008), on the other hand, investigated the distribution of the writing processes of planning, translating and revising and motor execution, while slow and fast typists produced a narrative text and responded to random auditory probes. Alves, Castro and Olive (2008) report that writing processes were activated in parallel, irrespective of typing skill. This was interpreted as being an effect of differences in achieving parallel processing in typing from achieving it in handwriting. It was, however, observed that slow typists produce lower-quality texts, but the findings were restricted only to lexical level, as no differences were found in syntactic complexity or creativity.

Concerning the process of developing writing, McCutchen (2011) argues that both factors of transcription and text generation pose demands on working memory resources, especially in the case of novice writers. However, some working memory resources are also required in the case of skilled writers. When it comes to the progression from novice to skilled writing, the role of long-term memory is deemed crucial in this model. In particular, when writers gain domain-specific expertise and fluent production, which allows them to retrieve knowledge from long-term memory, working memory load may be lessened. In fact, the ability to capitalize on long-term memory resources is what distinguishes skilled writers from novices who remain constrained by the limited working memory capacity. As opposed to working memory, long-term

memory is limited only by the nature of the processes that build the retrieval structures and the extent of knowledge stored. In particular, sentence constructions (including interaction among lexical choice and syntax) can be influenced by earlier text choices stored in long-term memory, by genre and audience constraints, topic knowledge, etc. But, access to and coordination of such multiple sources becomes operational only when processing shifts from working memory to long-term memory (McCutchen 2011).

Regarding the aspects of working memory and second language writing, interest has started to rise only recently. More specifically, in Wen's (2012) review only one study focusing on the relationship between working memory and writing in a second language was identified (e.g. Abu-Rabia 2003).

To summarize, this Subsection provided an overview of findings concerning pause location, duration frequency and distribution on a macro-level. Where available, findings were presented from a syntactic, micro-context and discourse approach. Results from different methodologies point at the same organizing principle of pause patterns, namely, the tendency of pauses to occur more frequently and last longer at higher syntactic units, such as paragraph and clause. Findings indicate also that pause patterns differ between different genres. More specifically, pause duration in narrative text shows a U curve whereas pause time in expository text is distributed more evenly. Pause research in L2 context confirms the tendency of L2 writers to pause longer and more frequently at all syntactic as well as discourse based locations, compared to their L1 counterparts. In regard to pause duration, it is assumed that longer pauses imply larger demands on working memory. The models by Kellogg (2008) and McCutchen (2011) are two most influential models accounting for the role of working memory in writing. Kellogg (2008) proposes that writing processes draw upon verbal, spatial and visual components differentially, with the central executive manipulating the processes of planning, translating and reviewing. Empirical studies in this context report that writing draws mainly upon verbal and visual working memory whereas the effect of spatial working memory is less clear. In theory, however, spatial memory is required in maintaining the spatial layout of the text as well as in the pre-writing planning phase. McCutchen's (2011) account of working memory in writing proposes that working memory resources are shared between transcription and text generation. The load that the two pose on working memory may be lessened when writers achieve a level of

skill that allows them to transcend the limits of working memory and capitalize on long-term memory resources. Text choices, knowledge of genre, audience, and topic expertise stored in long-term memory may be manipulated when processing shifts from working memory to long-term memory. Finally, studies on working memory and writing in L2 context have begun to emerge only recently and relevant literature reviews have identified only one such study so far.

Following this summary, the Subsection below addresses the written production of arguments and counterarguments.

2.3 Written production of arguments and counterarguments

This Subsection reviews findings concerning the written production of arguments and counterarguments. Although focus is on writing argumentative texts, some findings from verbal production of arguments are also discussed.

The production of arguments and counteraguments has mainly been investigated in verbal discussions. Therefore, the issue will first be approached within this research framework. To start with, studies that explored argument counterargument production in verbal discussions report opposing findings in relation to their retrieval. On one hand, findings persistently show deficient performance in producing integrated verbal responses which address both arguments for and against a certain topic. For instance, Kuhn (1991) cited in Santos and Santos (1999:78), explored argumentative skills in respect to social and urban issues. The study demonstrated that participants readily provided explanations for the issues under discussion and were highly confident of the correctness of their theories. However, participants in this study performed poorly when prompted to think of alternative standpoints and consider evidence that conflicted with their own theories. A similar conclusion was reached by Stein and Miller (1993a), cited in Santos and Santos (1999:83), whose participants were reluctant to produce reasons that would weaken their own position. Similarly, in experiments with engineering students who were resolving ethical problems related to their profession, Jonassen and Cho (2011) observed that students who responded to another's argument generated more counterarguments and higher quality counterarguments than students who constructed counterarguments to their own argument. On the other hand, Coirier, Andriessen and Chanquoy (1999:6) argue that the problem is not the capacity to produce complex argumentation but "to write it".

In terms of written production of arguments and counterarguments, the findings reported below make no specific reference to argument and counterargument integration but refer to the production of arguments in general. First, studies show that effective argumentation skills are often poor (Nussbaum & Schraw 2007), with lack of support for reasons and poor organisation being among the identified weaknesses. Deficiencies in writing arguments are attributed to the cognitive demands imposed on the writer and the absence of a schema for written argument (Nussbaum & Schraw 2007). A schema is a concept employed in psychology and includes the "knowledge relevant for guiding the structuring of information" (Piolat, Roussey & Gombert 1999:118). Second, an explanation of the difficulty in integrating arguments and counterarguments is proposed in the connectionist-based models of thought within the cognitive consistency theoretical framework (Simon & Holyoak 2002). In the experiments reviewed by Simon and Holyoak (2002) participants tended to achieve global coherence, that is, accepting one set of arguments in their totality while rejecting the rival set. By analogy, it may be argued that integrating arguments for and against in writing disturbs the tendency for such cognitive consistency. In other instances, the deficiency of integrating opposing arguments is attributed to working memory capacities. In that respect, logical relations between arguments in argumentative texts must be observed throughout the process of writing. Hence, the first arguments must be stored in working memory so as to be consulted while articulating arguments that follow, loading thereby the working memory resources (Andriessen & Coirier 1999). Lastly, individual factors might be a hindrance, as being able to generate opposing arguments to one's theory requires one to think critically about one's theories (Kuhn 2005).

In addition, research demonstrates that the generation of counterarguments is sensitive to a range of factors. First, research shows that the setting where arguments are produced is a significant aspect to be considered. For instance, the studies of Santos (1993 1995), cited in Santos and Santos (1999:80), report some differences in the way participants conducted the pro-con comparison in naturalistic and experimental settings. One significant finding pertains to the nature and frequency of counterarguments in the two settings. Whilst participants in the experimental session generated counterarguments to their own positions, most of the time, such counterarguments were virtually absent in the naturalistic setting. One explanation provided by

Santos (1993 1995) was that in naturalistic settings, the primary goal of participants was to make their views prevail over opposing ideas presented by other participants.

Furthermore, the representation of the opponent or the audience is reported to affect the use, frequency and type of counterarguments. The effect was observed by Santos (1996), cited in Santos & Santos 1999:81), in her 'Devil's advocate experiment'. The experiment engaged participants of Christian faith who had to produce arguments for and against capital punishment. Participants who found out that their opponent was also Christian represented themselves as less of opponents.

Next, prior knowledge in a specific field, which serves as a discussion topic, may also affect the production of counterarguments. To illustrate, Kuhn (1991), cited in Santos and Santos (1999:78), examined the extent to which prior knowledge improves argumentation and the generation of counterarguments in particular. Kuhn (1991) observed that experience in a certain field may make it more difficult to think in opposing ways. Based on her study, where the group of philosophers produced the most balanced responses compared to other designated groups, Kuhn (1991) claims that it is possible to gain expertise in the reasoning process itself independent of any particular content to which the reasoning skill is applied.

In addition, the capacity of generating counterarguments has been shown to be sensitive to "task instruction" (Coirier, Andriessen & Chanquoy 1999:7). To illustrate, participants whom researchers explicitly asked to consider counterarguments increased counterargument generation, compared with a control group. Furthermore, it was observed that instructing participants to generate either pro or con reasons first resulted in students producing more arguments for the side presented first at the expense of the other (Nussbaum & Schraw 2007).

In summary, theorists argue that written and verbal production of arguments and counterarguments is challenging. In the case of writing, studies report that argumentative writing is poorly organized and characterized by immature language. The difficulty of producing counterarguments is attributed to the lack of an argumentative schema, the heavy load on working memory and the tendency for cognitive consistency. Importantly, several factors affect the production of counterarguments. Firstly, experimental settings are conducive to markedly better performance than naturalistic settings. Secondly, the representation of the opponent and any shared beliefs between the discussants might influence the frequency, type and use of

counterarguments. Thirdly, prior knowledge in a certain field might negatively influence the acknowledgment of opposing theories. Finally, task instruction exerts its effect on the generation of responses that address both arguments for and against. In particular, participants' responses may reflect the balance or the lack of balance in the experimental instructions. In addition, the order of presentation of arguments for or against primes participants to produce more arguments on the side presented first.

Having discussed the written production of arguments, the next Subsection presents a selection of English L2 studies relevant to the present context.

2.4 English L2 writing

This Subsection briefly addresses findings from English L2 writing research pertinent to the present investigation. The selection of studies is representative of research related to composing in English whilst the wider L2 writing context is not considered.

In one of the landmark studies on English L2 writing within the process framework, Raimes (1987) explored the writing strategies of ESL writers and compared it to findings related to L1 writing. Raimes (1987) recorded four remedial and four non-remedial (skilled) ESL writers in a think-aloud composing and reported that skilled writers interacted with the text as it emerged on paper more than the less skilled writers (Raimes 1987). Moreover, skilled writers planned, re-read the emerging text and edited more than their non-skilled counterparts (Raimes 1987). Concerning re-reading of the emerging text, ESL writers used it as a platform for generating new ideas rather than as a point for editing. In addition, Raimes (1987) compared the findings with L1 focused studies and concluded that ESL writers are more concerned with expressing content rather than error correction.

Furthermore, the study of Phinney and Khouri (1993) explored the effects of English proficiency and computer writing experience. Four advanced ESL writers were videotaped while they used a computer to write and revise a paper on an assigned topic. The writers were selected for English proficiency (high vs. low) and computer writing experience (one semester vs. two or more semesters). The results indicated that experience with the computer was a stronger factor than writing proficiency in determining computer writing strategies. The two inexperienced computer users spent less time revising, made more surface changes, and used the computer

functions less than the experienced computer users. In posttaping interviews, the experienced users also showed a greater concern for content than did the inexperienced users, who indicated apprehension about using the computer and concern for correctness.

Finally, studies of pause patterns in writing which incorporate the ESL aspect have observed differences in pause duration and frequency in L2 writers. Although such findings been discussed in detail (see Subsection 2.2), some of the findings will be summarized here as well. In her keystroke logging study of pauses, Spelman Miller (2006:136) analysed pauses on the basis of syntactic (following a paragraph, sentence, clause, phrase and word) and discourse units i.e. following "an element or structure (single word, phrase or clause) which serves to establish the starting point of a message at the clause/sentence level". The results indicated that L2 writers pause longer and more frequently at all syntactic locations, especially at paragraph and clause locations. Moreover, L2 writers paused significantly longer at the discourse units. Similarly, Hall (1990) reports longer and more frequent pauses for L2 writers compared to L1 writers as well.

In sum, studies investigating the writing process in English L2 context report that skilled writers re-read the emerging text and edit more than their non-skilled counterparts. Next, early studies of writing on a computer observed that experience with the computer was a decisive factor for the writing strategies adopted by participants. Finally, studies of temporal aspects of writing indicate that English L2 writers pause longer and more frequently at specified syntactic locations as well as discourse-based units.

With this discussion, the main pillars of the present investigation have been introduced, and the final Subsection briefly addresses the techniques for investigating writing.

2.5 Techniques for investigating writing

The present Subsection provides a brief overview of techniques for investigating the writing process. The discussion begins by introducing real-time computer-aided techniques. In this context, more attention is paid to the keystroke logging technique and areas of application in writing. In addition, the review presents few software programmes developed for the purpose of logged data analysis. The Subsection concludes by addressing secondary and triple tasks as methods of investigating writing.

In the first place, two real-time computer-aided techniques have been applied to investigate the writing process, namely recording window activities with a camera and using software to record keystroke logging. Real-time computer-aided observations of the writing process have an important advantage. The benefit is that the data collection process is less obtrusive in comparison to think-aloud protocols, retrospective interviews or questionnaires. For instance, in think-aloud protocols writers are encouraged to voice what they are doing and thinking while writing. This may be disturbing as the writers' thoughts may be blocked by the difficulty of speaking and writing at the same time. Similarly, retrospective recalls may not reflect the actual process of writing (Lifang 2008).

More specifically, keystroke logging programmes have several advantages. First, the logging software provides a possibility to examine writing strategies in detail and quantify them. Second, the composition process may be replayed and data saved as log-files may be used for multiple analysis from different researchers (Latif 2008).

The main criticism of keystroke logging methods is connected to data interpretation. Internal cognitive processes behind the writing activity are not visible in this method and data interpretation is only indirect (Spelman Miller 2006:152). Moreover, Latif (2008) alerts to the fact that analyses of logged data lack valid taxonomies and categorizations that are consistent with introspective and retrospective data.

Keystroke logging has been used to analyse the writing process from several perspectives. First, the writing process has been analysed as a whole, which includes analyses of pausing, text production, editing, cursor movements, scrolling, and combinations of such activities. In addition, studies have used keystroke logging to investigate revision during writing. Finally, the keystroke logging method has also been used to explore the temporal aspects of writing, such as pauses and production rate. For the purposes of logged data analysis, several programmes have been developed. S-notation, Progression Analysis and LS Graph are examples of logged data analysis programmes. In short, S-notation simplifies the analysis of revision activities, Progression Analysis provides progression of the writing process in several episodes and LS-graph provides multilayered graphic presentation of logged data. Additionally, an upgraded version of the LS-graph, which relies on Geographical Information Systems software or GIS, helps identify the time and location of various cognitive processes and represents them spatially

and visually. Furthermore, researchers have used logged data to raise writers' awareness of the composing strategies. By replaying logged data, at least two benefits are achieved. The first benefit is that retrospective accounts about composing while watching the logged file are less intrusive than thinking aloud while composing (Ransdell 1995 cited in Latif 2008:42). The second benefit is reported by studies that replay sessions of the logged data and help participants approach the writing task differently. In particular, raising writer awareness about non-surface revisions is reported as an advantage (Lindgren & Sullivan 2003 cited in Latif 2008:42). Recently, keystroke logging and eye tracking have been combined to produce a more comprehensive representation of the writing process (Alamargot et al. 2006; Johansson et al. 2008).

Lastly, in order to investigate working memory demands in writing, researchers mostly employ secondary tasks (Kellogg 2008). Namely, secondary tasks use a resource-demanding interference task during the process of writing and may take many forms such as monitoring characters or shapes displayed alongside the text on the screen, auditory reaction time probes, music or unrelated speech, repeating a single syllable or memorizing digits, words and shapes. The basic assumption is that if there is an overlap between cognitive processes, the secondary task will affect the writing process, as reflected in the response time (Kellogg 2008). By extension, the triple task technique offers additional insight into the course and cost of the writing process (Olive, Kellogg & Piolat 2001). The task involves measuring the allocation of memory resources by observing reaction times to secondary tasks, while writers are also asked to think aloud and categorize the contents of memory during writing (Olive, Kellogg & Piolat 2001).

In sum, real-time computer-aided techniques for exploring writing have advantages over other techniques such as think-aloud protocols or retrospective interviews. Specifically, data collection is less obtrusive. The keystroke logging method, in particular, gives the possibility to quantify data and store it for multiple analyses. Among the limitations of the method is the fact that data may only be interpreted indirectly, and there is still inconsistency in taxonomies and categorizations in the analyses of logged data. Logged data have been used to investigate the writing process as a whole, the revision activities and temporal variables such as pauses and production rate. Special software exists for analysis such as LS-graph, Progression Analysis and

S-notation. Only few studies in the L2 context are reported to have used real-time computer-aided techniques and keystroke logging in particular. Finally, the writing process has been explored in the context of working memory by means of secondary and triple tasks. Secondary tasks measure the response time while writers compose and respond to various secondary tasks which involve syllables, shapes, unrelated speech and similar, whereas triple tasks complement the secondary tasks with a think-aloud protocol. The summary concludes the theoretical background and is followed by a definition of the scope and hypotheses of the present study.

3. Scope, context, and hypotheses

The scope of the study is delimited to the quantitative analysis of temporal variables in text production without regard to qualitative criteria of text evaluation listed in Leki, Cumming and Silva (2008): content (coverage of topic, detail, and appropriateness to genre), range (grammatical structures and vocabulary), complexity (sentence structure and paragraph organisation), as well as accuracy (grammar, sentence structure and discourse organisation, spelling, punctuation). The context of the study is L2 writing on an undergraduate and graduate level. More specifically, the study concentrates on argumentative writing within language degree programmes. The context was determined by several factors. First, undergraduate and graduate students of Linguistics were easily accessible, which made the recruitment more efficient given the limited timeframe. Second, researchers have already implied that the context of writing an argumentative text in language degree programmes has been left largely unexplored (Newell et al. 2011). Third, studies have also indicated that the ability to integrate opposing arguments and think divergently is important for developing critical thinking skills, which are important for academic success (Newell et al. 2011).

Four hypotheses are formulated despite the exploratory nature of the present study. Each hypothesis is briefly motivated below.

3.1 Hypothesis 1: meta-textual level

Frequency and duration of pauses will be higher at locations involving movement but lower at locations involving editing in the restricted visual feedback condition.

The first hypothesis is motivated by the assumption that writers will spend more time and pause more frequently at locations involving movements, because they need to interact with the text and specifically, to establish links between arguments in the text. Pauses at editing locations will decrease both in time and frequency, because reduced exposure to the text will prompt less editing activity. Additionally, moving back and forth in the text will impose an additional attentional cost, which may affect the pause variables at editing locations.

3.2 Hypothesis 2: textual level

Frequency and duration of pauses will be higher while arguments against are produced in the restricted visual feedback condition.

The assumption is that links between arguments for and arguments against need to be established, in order to produce a coherent text. However, this integration process will be slowed when visual feedback is restricted. More specifically, writers might find it easier to produce the arguments for since they will have been produced in the elicitation materials, but in order to produce arguments against, writers will either have to keep the statements previously produced active in working memory and thus pose high demands on the resources, or use more pause time to revisit the previous statements. In any of these two scenarios, writers will require more time to generate the arguments against. Alternatively, despite any effect of the elicitation materials, writers may have strong opinions against the topic, which might make the production of arguments for more arduous. Hence, significant differences may occur in the Arguments for category as well.

3.3 Hypothesis 3: syntactic level

Frequency and duration of pauses will be higher at clause location in the restricted visual feedback condition.

The hypothesis is motivated by the assumption that writing on a small window which incorporates one line may have an effect on the pausing behaviour for syntactic locations. More specifically, in an attempt to avoid movement in the text, writers will pause longer and more frequently at clause locations so as not to refer back frequently. Alternatively, writers may want to pause at clause locations, since this juncture may act as a point of planning or revising at multiple levels of the message.

3.4 Hypothesis 4: fluency

Fluency will decrease in the restricted visual feedback condition whereas burst will increase.

The final hypothesis presumes that writers will be less fluent when visual feedback is restricted. However, it is expected that they will produce more characters between pauses as an adaptive strategy to the restricted visual feedback.

Having defined the scope of the study as well as the hypotheses the following Section provides a detailed account of the method used in this investigation.

4. Method

The Section provides a detailed overview of the main parameters of the study, the experimental procedure and the coding methods. It extends over several Subsections which discuss details concerning participants, experimental conditions, elicitation materials and writing tasks, experiment set-up and procedure, as well as data preparation and coding methods.

4.1 Participants

A total of 14 participants participated in the present study. Eleven participants were summoned from the Centre for Languages and Literature in Lund University while three were from the Department of Languages and Literatures in Gothenburg University. The inclusion criterion was not having English as a native language and being a student at the Centre/Department. Data on participant background were collected by means of a questionnaire created with Google Docs. The questionnaire (Appendix A) was sent by e-mail during the first experimental session and responses were obtained after the completion of the session. Information reproduced in the Subsection is partial and a detailed overview of responses is contained in Appendix B.

In the study, 8 participants out of 14 had Swedish as their first language and the remaining 6 were native speakers of Icelandic, Persian, Italian, Finnish, Russian and Estonian. The mean age of participants was 24.7 (SD=2.75). In terms of gender representation, care was taken to balance the distribution, but female participants prevailed (eight female and six male participants). The average duration of university education in English was 2.97 years (SD=1.94).

Five of the participants were master students at the Centre for Languages and Literature and six were undergraduate students at the Centre for Languages and Literature in Lund. Three participants were undergraduate Language and Literature students at Gothenburg University. A detailed overview of participant age, gender, L1 and total years of university education in English is provided in Table 1.

Table 1 Overview of participant age, gender, l1 and total years of university education in English.

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**M (SD)**
Age	23	23	23	27	28	25	23	25	30	28	26	23	21	21	24.7 (2.75)
Gender	f	F	f	m	f	f	f	m	m	f	m	f	m	M	
L1	E	P	S	S	I	S	S	It	S	R	F	S	S	S	
Edu. in English	4	4	2	0.25	7	2	1.5	4	3	6	4	1.5	1.5	1	2.97 (1.94)

Note: E=Estonian, S=Swedish, I=Icelandic, It=Italian, P=Persian, F=Finnish, R=Russian.

The questionnaire asked also for participants' subjective assessment of skills in writing, reading, and listening, as well as the frequency of the three activities during the normal course of studying. For the present purposes, a limited subset of results related to writing skills will be considered. In summary, 41% of the participants write in English often while 29% write very often. Furthermore, 35% rarely experience problems and 18% have problems with writing sometimes. In addition, 29% rarely experience difficulties with grammar and 29% have problems with grammar sometimes. Lastly, 35% of the participants rarely experience spelling difficulties whereas 24% have spelling difficulty sometimes. Finally, all participants but one responded that they have been formally taught how to write argumentative essays.

4.2 Conditions

The study was designed as a single factor, two-level within-subjects study. Manipulating the access to the writing window i.e. the visual feedback constituted the independent research variable, while temporal phenomena, namely, pause duration, pause location, pause frequency, and pause distribution, as well as fluency and burst, constituted the dependent variables.

Two conditions of the independent variable were established by manipulating the size of the window. In the normal visual feedback condition, participants wrote on a writing window customized according to the following parameters in ScriptLog: 800 pixels width x 800 pixels height. The writing window size resembled a word document customized according to the following parameters: width = 17.5 cm; height = 14.5 cm; left, right, bottom and up margins equal to 0 cm. In the restricted visual feedback condition, the writing window size was reduced to 800 pixels width x 100 pixels height. The window size resembled a word document customized according to the following parameters: width =17.5 cm; height = 0.5 cm; left, right, bottom and up margins equal to 0. Figures (6) and (7) in Appendix C illustrate the window sizes.

In addition, in the restricted visual feedback condition, the writer was only able to see the emerging line of text. However, scrolling line-by-line as well as moving in the text with the arrows on the keyboard was made possible, and participants were informed of the option. In the current version of the software, participants could use the edit functions of cut, copy and paste. In both conditions, the font was set to small. A step-by-step customization of ScriptLog for the present experimental design is included in Appendix C.

4.3 Elicitation materials

Two documentary excerpts were used as elicitation materials. The reason elicitation materials were used was to reduce the variance caused by background knowledge, and stimulate the participants for the writing task. First, the choice of the two topics was restricted by availability and access to such documentaries. Second, some of the themes in the two documentary excerpts had to be potentially interrelated, so as to assuage the difference in the elicitation materials and thus diminish any differential effects on the writing task. In the restricted visual feedback condition, the documentary excerpt discussed the prospects of prolonging human life and presented reasons that mainly supported the topic. The documentary used for the normal condition presented consequences of overpopulation and measures to hinder population growth. It also discussed reasons that mainly supported the topic. That the choice of the documentaries was acceptable was shown after the first writing session, where some participants discussed the disadvantages of prolonging life and mentioned overpopulation as a potential problem.

4.4 Writing task

The aim of the writing task was to produce an argumentative text in both conditions. The prompt for the restricted visual feedback condition was as follows: Write an essay discussing arguments for and against prolonging human life. In the normal visual feedback condition, the following prompt was used: Write an essay discussing arguments for and against controlling population growth/birth rate control.

30 minutes were allotted for the writing task. The task duration was selected on the basis of two suppositions. First, previous studies of reading during writing have suggested that that the probability of re-reading and text generation co-occurring is highest during the first 30 minutes of a writing session which lasts 90 minutes in total (Breetvelt, van den Bergh & Rijlaarsdam 1996). Second, text generation was found to decrease slowly after the first 30 minutes (Breetvelt, van den Bergh & Rijlaarsdam 1996:16). Therefore, it was expected that most effects from the interaction with the text would be visible within the time range of 30 minutes.

4.5 Experiment set-up

The majority of experimental sessions were conducted in the computer room at the Humanities Lab in the Centre for Languages and Literature, Lund University. In addition, two sessions were also organized within the premises of the Department of Languages and Literatures at Gothenburg University. At Lund University, ScriptLog was accessed and customized on the computers selected for the participants beforehand. All computers were logged in with the experimenter's account, in order to enable data recording and collection on one location. The documentaries were played on a projector screen, and lights were off while the participants were watching the clips. During the writing session light was adjusted. At Gothenburg University, a quiet computer room with four computers was booked for the two sessions. The same procedure was followed as in Lund. ScriptLog was accessed from the experimenter's personal files and customized for the participants. The experimenter logged in with an account from the Central Library within the Humanities building. Since the computer room had no projector, participants watched the documentaries on the computers with headphones. The computer room was exposed to daylight and lights were not switched on. Participants were asked not to leave the experiment room while the experiment was in progress.

4.6 Procedure

Prior to the experiment, a pilot study was conducted which resulted in some readjustments to the original design. In particular, the elicitation prompt was reformulated to be more concise (explicit use of the expression *arguments for and against* was suggested), and it was decided that the experimenter will start and stop the ScripLog sessions for each participant, in order to avoid confusion and possible anxiety from using new software.

Experimental sessions were spread across a period of one month due to participant availability. Participants (N = 14) were welcomed in the computer room within the Centre for Languages and Literature in Lund as well as in a computer room at the Department in Gothenburg. Participants were completely counterbalanced, with seven participants writing with restricted visual access to the text while the other half wrote with normal access to the text. The reverse procedure was performed in the second experimental session. Details of the experimental protocol along with forms concerning ethical research requirements are a supplement to this paper (Appendix D).

First, the participants were welcomed and seated on the selected computers. They were informed that there is a consent form on their desk that they need to read and sign. After having read and signed the form, participants were informed that they would watch a short documentary for 10 minutes and then write for 30 minutes. Once the documentary was over, participants were informed that they would write for 30 minutes on a topic related to the documentary. Prior to the writing session, they were also informed that they would be using a very simple word processor which contains some functions of an MS Word document. In the restricted visual feedback condition, they were informed that they would write on a window, which allows them to see the last produced line. They were also informed that they can use the mouse to scroll or use the arrows on the keyboard to see the already produced text. Once the explanatory part was completed, the experimenter introduced the respective prompts. The prompt stayed on the projected screen throughout the writing session. Participants were explicitly asked to give equal weight to arguments for and arguments against while producing the text. When the session started, they were informed that they could write for 30 minutes, and that they would be notified five minutes before time expires. The experimenter administered the technical aspects of the

experiment by starting the recording in ScriptLog for each participant. The experimenter also stopped the keystroke logging programme at the end of each session. Upon closure of the first experimental session, each participant filled out an electronic questionnaire created in Google Docs which was sent during the writing session. Refreshments were offered after both writing sessions. As compensation for taking part in the experiment, participants received a cinema ticket.

4.7 Data collection and preparation for analysis

Data were collected through the keystroke logging software ScriptLog. In the present study, an upgraded version of the programme was used. However, the software was under development and it was only used for data collection, while the entire analysis was performed in Excel.

28 linear files (14 from the restricted visual feedback and 14 from the normal visual feedback condition) were obtained from ScriptLog. A linear file contains the entire writing activity along with subsequently deleted items from the final edited text. In the linear file, text production, deletion, movement, pauses, and similar activities are observable. Table 2 illustrates the set of keys occurring in the linear files of the present study.

Table 2 Keys occurring in the linear files and their description.

Keys	**Description**
UP, DOWN	movement of cursor up and down in the text by using the arrows
HOME	primarily used to return the cursor to the beginning of the line
END	primarily used to put the cursor at the end of the line
RIGHT, LEFT	movement with the cursor left and right using the arrows
RETURN	carriage return (when a writer decides to start a new line usually appears at paragraph

	opening)
BACKSPACE	deletion (backward)
DELETE	deletion (forward)

To illustrate the representation of the recorded writing activity in a linear format, an excerpt from an authentic linear file is provided in example (1) alongside the corresponding final text. The example shows the activity performed in the production of a single sentence. The writer makes several typos, moves up and down in the text and edits already produced text. For comparison, please consult the final text below. The linear files were fed into Excel where the coding was performed. The decision to use Excel was due to the fact that the study was primarily an exploratory one. In that respect, one of the strong points with Excel is the flexibility in terms of rearranging categories and adding new functions ad hoc, which is of utmost importance in an exploratory study. Moreover, although quite demanding, such a method enabled a very sensitive and discriminate approach to categorizing and subsequently interpreting pauses.

(1) If n<BACKSPACE1>one could suff<BACKSPACE1><BACKSPACE1>ddenly continue from the<BACKSPACE1>at point <4,734>onwardf<BACKSPACE1>s and <4,469>life life to th<BACKSPACE9><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1>ve life to the fullest for many years after retiring <BACKSPACE1><2,281>, it might <UP1><DOWN1><6,437><UP1><DOWN1><UP1><DOWN1><11,594>mean<2,609><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><4,468>ha<BACKSPACE1>seriously<3,062><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1>provide a whole new e<BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><2,469>prospect of life t 0<BACKSPACE1><BACKSPACE1>o manyp<BACKSPACE1> pepl<BACKSPACE1><BACKSPACE1>p<BACKSPACE1>ople.

(Linear representation, P11, male, 26, L1 Finnish, small window)

If one could suddenly continue from that point onwards and live life to the fullest for many years after retiring, it might provide a whole prospect of life to many people.

(Final edited text, P11, male, 26, L1 Finnish, small window)

4.8 Pause categories

This Subsection presents the coding categories developed for the purposes of the present study. Pauses are coded on the basis of writing activity or meta-textual location, text structure or textual location, and syntactic location. Two principles were applied in the coding process. In the first system, pauses are coded before specified units. Pauses in the second system are coded after the specified units.

First, the meta-textual coding approaches pauses according to the performed writing activity. The writing activity may range from text production, editing, movement, and any combination between the three activities. In applying the two principles, pauses before and after the writing activity were coded.

Second, the textual coding consists of four categories which reflect the text structure: 1) Introduction, 2) Arguments for, 3) Arguments against, and 4) Conclusion. The two principles, however, are not applied to the distribution of pauses on this level of coding.

Third, on the level of syntactic units, the categories of clauses and phrases were established. The motivation to distinguish between clauses and phrases in the production of argumentative text stems from findings that indicate that the complexity of expository writing resides at the phrase level rather than at the level of clause combinations (Biber et al. 1999:93). According to the first coding system, the following categories were established on the syntactic level: 1) pauses before clauses that initiate paragraphs or paragraph initial pauses, 2) pauses before clauses or clause initial pauses and 3) pauses before phrases or phrase initial pauses. According to the second system, the following pause categories were established: 1) pauses after clauses that complete a paragraph, or paragraph final pauses and 2) pauses after clauses or clause final pauses. Pauses after subordinators, coordinators and linking adverbials were classified as 3) clause internal pauses. Pauses after phrases were categorized as 4) phrase final, whereas pauses within a phrase were classified as 5) phrase internal pauses.

To conclude, the three levels of coding according to the two coding principles are explained and exemplified in more detail below. First, the meta-textual coding based on the two principles is discussed. Next, the coding performed for text structure is presented and finally, categories according to syntactic location, based on the two principles, are described and exemplified. Each example is extracted from the linear files and may contain errors performed

by the writer. In addition, examples are complemented with the respective excerpts from the final edited texts.

4.8.1 Meta-textual coding

In order to obtain a global perspective on the distribution of the writing activity, seven meta-textual categories were established, as a combination of writing activity that involves movement, editing and text production.

In practice, in the context of the first and the second principle, all pauses before/after writing activity which contains the following keys (UP, DOWN, LEFT, RIGHT, RETURN) were identified as pauses before/after movement respectively. Next, pauses before/after writing activity that contains only the (BACKSPACE) and (DELETE) keys were classified as editing pauses. Finally, pauses before/after uninterrupted text production were categorized as pauses before/after locations involving text production. The remaining categories are products of the combinations between the three basic categories. Table 3 provides a detailed illustration of the seven categories and illustrates how the pause is coded according to the two principles. The first column shows the writing activity which occurred before the pause shown in the third column. The second column classifies the pause according to the second principle. The fifth column contains the writing activity that follows the same pause while the classification of the pause according to the first principle is provided in the fourth column. It may be observed that depending on the approach, one and the same pause may be attached to different writing activities.

Table 3 Meta-textual coding of pauses according to the first and the second coding principle.

Writing activity	Category	Pause	Category	Writing activity
Pause after writing activity	II principle ←		→ I principle	Pause before writing activity
<RETURN1><RETURN1>	movement	<32.890>	movement	<UP7><UP1><UP1><UP1><UP1><UP1><UP1><UP1><UP1><UP1><UP1><UP1><UP1><UP1><DOWN1><DOWN1><DOWN1><DOWN1>
<BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1>for more than	text production and editing	<2.344>	movement and editing	<LEFT1><LEFT1><LEFT1><LEFT1><LEFT1><LEFT1><BACKSPACE1><BACKSPACE1>.<LEFT1><LEFT1><LEFT1><LEFT1><LEFT1><LEFT1><LEFT1><LEFT1><END1><LEFT1><LEFT1><RIGHT1><END1><RIGHT1><RIGHT1><RIGHT1><RIGHT1><RIGHT1><RIGHT1><RIGHT1><DELETE1>.
fueled <BACKSPACE1>,	text production and editing	<2.938>	text production	segregation between the ones that want eternal life
<RIGHT1><RIGHT1><RIGHT1><RIGHT2><RIGHT1><RIGHT1><RIGHT1><RIGHT1><LEFT1><RIGHT1>light<END1><LEFT1><LEFT1><LEFT1><LEFT1>could <END1>	movement and text production	<3.266>	text production and editing	<BACKSPACE1><BACKSPACE1>, right? We have change<BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1>done som <BACKSPACE1><BACKSPACE1> much arl<BACKSPACE1><BACK

				SPACE1>lready, why not this?
new beginning.	text production	<2.656>	movement and text production	With the esecularisation<LEFT1><LEFT1><LEFT1>
<LEFT1><END1>	movement	<2.532>	editing, text production and movement	<LEFT1><LEFT1><LEFT1><END1><LEFT1><LEFT1><LEFT1>makes ple<BACKSPACE1><BACKSPACE1>eople wha<BACKSPACE1><BACKSPACE1>ant to avio<BACKSPACE1><BACKSPACE1>oid it at all costs. The

(Small window, P9, male, L1 Swedish)

4.8.2 Textual coding

Four pause categories were established on the textual level: 1) Introduction, 2) Arguments for, 3) Arguments against, and 4) Conclusion. Examples (2), (3), (4), and (5) illustrate the coding approach. Each example contains the pause duration expressed in seconds, the writing activity and the appropriate coding category. In example (2), the writer begins by writing the introduction to the argumentative text. The production is interspersed with editing events (notation BACKSPACE) and the writer completes the paragraph by pressing the carriage return key (notation RETURN). Example (3) shows the production of an argument for within one paragraph. The writer first moves in the text (notation UP, DOWN, RIGHT, LEFT) and starts the new paragraph by pressing the carriage return key (notation RETURN). The production contains two editing events (notation BACKSPACE). Example (4) shows the production of an argument against within one paragraph. The writer starts the new paragraph by pressing the carriage return key (notation RETURN). The production is interspersed with editing events (notation

BACKSPACE) and the writer completes the paragraph by pressing the carriage return key (notation RETURN). In the final example (5), the writer starts the conclusion of the text.

(2)	<68.733>	tHIS <BACKSPACE5>This essay deals with <BACKSPACE11>will offer arguments for and agains prolonging	introduction
	<2.531>	human life. At first, I will offer some arguments for human <BACKSPACE6>prolonging human life, which will be followed by arguments against prolonging human life	introduction
	<4.109>	. Then I will conclude with my p<BACKSPACE31>	introduction
	<2.547>	Then I will conclude by weighing the options against each other and see which	introduction
	<2.546>	seems to s<BACKSPACE13>	introduction
	<2.516>	<BACKSPACE1>at conclusion I will <BACKSPACE7>s<BACKSPACE1>will come out of this question.<RETURN2>	introduction

This essay will offer arguments agains prolonging human life. At first, I will offer some arguments for prolonging human life, which will be followed by arguments against prolonging human life. Then I will conclude by weighing the options against each other and see what conclusions will come out of this question.

(Small window, P5, female, L1 Icelandic)

(3)	<5.843>	<UP3><DOWN2><RIGHT3><LEFT31><RETURN2><DOWN1><UP1><BACKSPACE1><DOWN1><UP2><DOWN1><RETURN1><DOWN1><RIGHT24><RETURN2>	Arguments for
	<2.140>	Another is<BACKSPACE2>	Arguments for
	<2.125>	argument that supports prolonging life is that people	Arguments for
	<2.219>	<BACKSPACE6>scientists, and ev<BACKSPACE2>	Arguments for
	<2.735>	the avarage human for that matter, will have longer time to improve	Arguments for
	<3.187>	nature, regarding recycling	Arguments for
	<2.156>	and maybe even produce materials that do not	Arguments for
	<4.859>	damage the ozone layer or	Arguments for
	<4.172>	anything else concerning nature and the animals found in it.	Arguments for

	<8.281>	<RETURN2>The biggest problem I see with prolonging life is overcrowding earth with	Arguments for

Another argument that supports prolonging life is that scientists, and the average human for that matter, will have longer time to improve nature, regarding recycling and maybe even produce materials that do not damage the ozon layer or anything else concerning nature and the animals found in it.

(Small window, P5, female, L1 Icelandic)

(4)	<8.281>	<RETURN2>The biggest problem I see with prolonging life is overcrowding earth with	Arguments against
	<3.421>	people.	Arguments against
	<4.890>	Most li<BACKSPACE2>habitable countries will	Arguments against
	<2.938>	turn out to be over populated, and	Arguments against
	<3.937>	we humans would need to find other planets to live on, which	Arguments against
	<2.360>	<BACKSPACE5>hich might take a lot of time to plan, <BACKSPACE2> and do for <BACKSPACE5>, and will most like <BACKSPACE1>ly be very costly.	Arguments against
	<7.578>	<RETURN2>	Arguments against

The biggest problem I see with prolonging life is overcrowding earth with people. Most habitable countries will turn out to be over populated, and we humans would need to find other planets to live on, which might take a lot of time to plan and do, and will most likely be very costly.

(Small window, P5, female, L1 Icelandic)

(5)	<15.765>	<RETURN2>For me, the arguments and r<BACKSPACE1>the results from	Conclusion
	<2.547>	<BACKSPACE5><LEFT16>against <RIGHT16>from prolonging life outweigh the arguments against,<BACKSPACE1>. It would be	Conclusion

For me, the arguments against and the results from prolonging life outweigh the arguments against.

(Small window, P5, female, L1 Icelandic)

4.8.3 Syntactic coding

4.8.3.1 Pauses at paragraph locations

For the purposes of the present study, a paragraph is defined as a distinct section of the written text, indicated by a new line or indentation. Although a carriage return (<CR> or <RETURN>) signals a new paragraph in the linear file, the final edited text was used as the only reliable indicator for identifying pauses at paragraph locations. Paragraph initial and paragraph final pauses are identified in the two systems respectively.

In the context of the first principle, pauses before clauses that initiate a paragraph are classified as paragraph initial. According to the second principle, pauses after clauses that complete a paragraph are assigned as paragraph final. Example (6) illustrates both paragraph initial and a paragraph final pause. The example contains the duration of the pause in seconds and the writing activity. In example (6) the pause with duration of <8.281> seconds is before a clause that begins a new paragraph and is thus classified as paragraph initial pause. However, the second principle requires that the pause is categorized as paragraph final, since it follows a clause that completes a paragraph.

(6)

<2,140>	Another is<BACKSPACE2>
<2,125>	argument that supports prolonging life is that people
<2,219>	<BACKSPACE6>scientists, and ev<BACKSPACE2>
<2,735>	the avarage human for that matter, will have longer time to improve
<3,187>	nature, regarding recycling
<2,156>	and maybe even produce materials that do not
<4,859>	damage the ozone layer or
<4.172>	anything else concerning nature and the animals found in it.
<8.281>	<RETURN2>The biggest problem I see with prolonging life is overcrowding earth with

Another argument that supports prolonging life is that scientists, and the avarage human for that matter, will have longer time to improve nature, regarding recycling and maybe even produce materials that do not damage the ozone layer or anything else concerning nature and the animals found in it. ¶The biggest problem I see with prolonging life is overcrowding earth with…

(Small window, P5, female, L1 Icelandic)

4.8.3.2 Pauses in clause context

For the purposes of the present study, a clause is defined as a "unit structured around a verb phrase" (Biber et al. 1999:120). Since no difference was made between dependent and main clauses, all clauses were coded and analysed.

According to the first principle, pauses before clauses are classified as clause initial pause. More specifically, pauses that occur immediately before and after a delimiter (full stop, question mark, comma, etc.) are both recorded as clause initial. In addition, pauses that precede coordinating conjunctions such as *and*, *but, or,* etc. which "link clauses that have the same syntactic role" (Biber et al. 1999:80) and subordinating conjunctions such as *that, in order to*, *if, because, since,* etc. which "introduce dependent clauses" (Biber et al. 1999:85), are analysed as clause initial pauses.

In the context of the second principle, pauses after clauses are categorized as clause final. In addition, pauses that occur immediately before and after a delimiter are both recorded as clause final. Clause internal pauses are pauses that occur after coordinating conjunctions and subordinating conjunctions. Pauses after linking adverbials such as *nevertheless, thus*, *first, further,* etc., although distinguished from coordinating conjunctions, are analysed as clause internal, because they "express the connection between clauses" (Biber et al. 1999:133).

To explain the two coding principles in practice, example (7) illustrates how a pause is coded as clause initial, clause internal and clause final. According to the first principle, the pause with duration of <4.266> seconds is coded as clause initial. The same pause, in the context of the second principle, follows the subordinator *that* and is thus coded as clause internal. According to the first principle, the pause with duration of <3.125> seconds is coded as clause initial, but in the context of the second principle, it follows a clause, and is therefore coded as clause final. In example (8), the pause that lasts <2.843> seconds is coded as clause initial, according to the first principle, and as clause final, according to the second.

(7) <3.656> <UP1><DOWN1><DOWN1>In order tfor such a long life to be useful, we would have to make sy<BACKSPACE1>ure that the procentage spent in every life cycle<BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1><BACKSPACE1>period would be as long as it is today. That would, for example, mean that

<4.266> a teenager could be 170 years old!

<3.125> We would also make sure to be able to stay fertile

In order for such a long life to be useful, we would have to make sure that the percentage spent in every life period would be as long as it is today. That would, for example, mean that a teenager could be 170 years old! We would also make sure to stay fertile

(Small window, P6, female, L1 Swedish)

(8) <2.421> <LEFT1><RETURN2>We also have opportunity to improve living contiit<BACKSPACE4>ditions

<2.843> if we were to live longer.

We also have opportunity to improve living conditions if we were to live longer.

(Small window, P5, female, L1 Icelandic)

4.8.3.3 Pauses in phrase context

The second syntactic unit for pause location is the phrase. In the context of the present study, coding was performed for verb phrase, noun phrase and a prepositional phrase. Each phrase type can consist of the head minimally (Biber et al. 1999:96). The verb phrase contains a "main verb, either alone or accompanied by one or more auxiliaries" (Biber et al. 1999:99). A noun phrase consists of a "noun either alone or accompanied by determiners and modifiers" (Biber et al. 1999:97). A prepositional phrase consists of "a preposition and a complement, most typically in the form of a noun phrase, wh-clauses or ing-clauses" (Biber et al. 1999:103).

In the context of the first principle, pauses before phrases are classified as phrase initial pauses. According to the second principle, pauses after phrases are classified as phrase final and pauses within phrases as phrase internal. The phrase internal pause can be located between the

determiner and the head, in a noun phrase, the main verb and its auxiliaries, in a verb phrase and between the preposition and a phrase complement, in a prepositional phrase.

Examples (9), (10) and (11) show a phrase initial/internal pause, phrase internal and phrase final pause respectively. According to the first principle, the pause with the duration of <3.406> seconds in example (9) is categorized as phrase initial (noun phrase). The second principle requires that the pause is classified as phrase internal (prepositional phrase). A phrase internal pause (<2.468>) between a main verb and an auxiliary (verb phrase) is provided in example (10). The pause (<9.313>) in example (11) is classified as (noun) phrase final pause.

(9) <5.219> hevily burdened by
<3.406> the older generation.
…heavily burdened by the older generation…

(Big window, P4, male, L1 Swedish)

(10) <2.391> babies and therefore they will
<2.468> see a decrease of
…babies and therefore they will see a decrease of…

(Big window, P4, male, L1 Swedish)

(11) <38.890> The fifth argument
<9.313> in support of the controlling
The fifth argument in support of controlling…

(Big window, P5, female, L1 Icelandic)

4.9 Statistical analyses

A paired t-test was performed in order to analyse the data. Paired t-tests are suitable for within-subjects experimental designs under which repeated measure of the variables is conducted. In the present study, the paired t-tests were performed in Excel by using the in-built function TTEST. The hypotheses that are tested are as follows:

– Null hypothesis: $H_0 : \mu 1 = \mu 2$

– Alternative hypothesis: $H_1 : \mu 1 \neq \mu 2$ (two-tailed test)

For a given significance level α, the comparison of p to α permits a decision about an eventual rejection of the null hypothesis. If:

- $p \leq \alpha$, the null hypothesis H_0 is rejected in favour of the alternative hypothesis H_1;
- $p > \alpha$, the null hypothesis H_0 is not rejected.

An alpha level of $\alpha = .05$ was used for all paired t-tests. In addition, the analysis was performed by excluding the first and final pause from all files. Finally, tests were performed on the parameters specified in Subsection 1.1, Subsubsection 1.1.3.

5. Results

This Section presents the results of the paired-t tests conducted for the purpose of investigating visual feedback effects on the temporal aspects of argumentative writing. Results of the paired t-tests are reported only for significant findings and extend over four Subsections. The first Subsection provides an overview of results concerning the meta-textual level. Results from the textual analyses are presented in the second Subsection. The third Subsection presents the findings related to the syntactic coding. Results on fluency measures are reported in the final Subsection. Throughout the Section, the abbreviations BW, which stands for Big Window, and SW, which stands for Small Window, will be used to refer to the writing window in the normal visual feedback condition and the restricted visual feedback condition respectively. The presentation of findings begins with an overview on the level of meta-textual pause location.

5.1 Meta-textual coding

The first hypothesis proposed that frequency and duration of pauses will be higher at locations involving movement, in the restricted visual feedback condition, and at locations involving editing, in the normal visual feedback condition. The results of the analysis support the hypothesis. Figures 1 and 2 illustrate the differences in relative frequency between conditions.

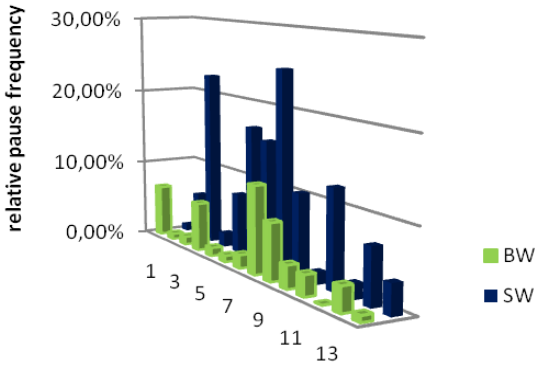

Figure 1 Relative frequency of pauses at locations involving movement (*N* = 14). Relative frequency is higher in the restricted visual feedback condition.

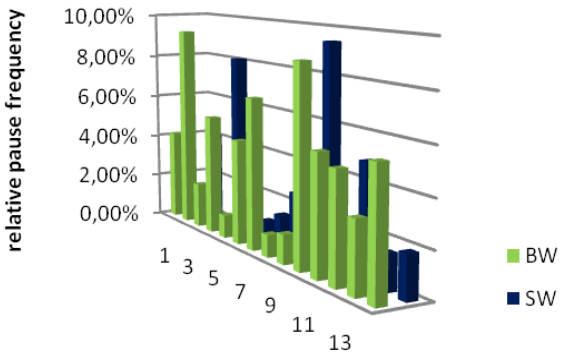

Figure 2 Relative frequency of pauses at locations involving editing (*N* = 14). Relative frequency is lower in the restricted visual feedback condition.

Results related to total duration[c] scores for pauses before the designated categories show statistically significant differences in two categories, namely, movement and movement combined with text production. Table 4 shows the results of the analysis, which are discussed in more detail below. The analysis indicates that the score for total duration[c] of pauses before movement is significantly higher in the restricted visual feedback condition (*M* = 66.99) than the score in the normal condition (*M* = 24.90), *p* = .01. The score for total duration[c] of pauses before movement combined with text is significantly lower in the restricted visual feedback condition (*M* = 17.98), than the score for the normal condition (*M* = 29.02), *p* = .02.

Relative pause duration[c] scores for pauses before movements is significantly higher in the restricted visual feedback condition (*M* = 10%) compared to scores in the normal condition (*M* = 3.42%), *p* = .01. Relative duration[c] scores for pauses before movement combined with text are also significantly higher in the normal condition (*M* = 4.50%) compared to the restricted visual feedback condition (*M* = 2.86%), *p* = .02.

Results concerning the total duration scores[c] for pauses after the designated units show statistically significant differences for locations involving movement and text combined with editing.

The total duration[c] scores for pauses after movement are significantly higher in the restricted visual feedback condition (*M* = 72.77) compared to the normal condition (*M* = 31.05), *p* = .01. Total duration[c] scores at locations after text combined with editing are significantly

lower in the restricted visual feedback condition (M = 241.49) in comparison to scores in the normal condition (M = 309.80), p = .02

Scores on relative pause duration[c] after the designated units show statistically significant differences in the categories of movement, editing and text combined with editing. The scores for pauses after movement are significantly higher in the restricted visual feedback condition (M = 10.69%) than in the normal condition (M = 4.01%), p = .01. Relative duration[c] scores for pauses after editing are significantly lower in the restricted visual feedback condition (M = 2.96%) compared to the normal condition (M = 6.12%), p = .05. Similarly, relative duration[c] scores for pauses after text combined with editing are significantly lower in the restricted visual feedback condition (M = 36.18%) compared to the normal condition (M = 44.49%), p = .03.

Table 4 Average scores for total and relative duration across the seven meta-textual categories between conditions and across two coding methods.

	TEXT	MOVE	EDIT	TEXT MOVE	TEXT EDIT	MOVE EDIT	TEXT MOVE EDIT
p value tot duration[c]	0.18	0.01	0.13	0.02	0.13	0.76	0.47
average BW	260.30	24.90	37.88	29.02	291.59	5.49	48.85
average SW	289.25	66.99	18.80	17.98	259.37	4.28	41.44
difference	41.44	-42.09	19.08	11.04	32.22	1.21	7.41
p value tot duration*[c]	0.09	0.01	0.06	0.41	0.02	0.46	0.49
average BW	238.34	31.05	47.27	25.89	309.80	7.37	52.28
average SW	299.67	72.77	21.29	19.65	241.49	4.38	44.80
difference	-61.33	-41.73	25.98	6.24	68.41	2.99	7.48
p value rel duration*[c]	0.29	0.01	0.10	0.02	0.13	0.96	0.43
average BW	36.47%	3.42%	5.25%	4.50%	42.43%	0.76%	7.18%
average SW	39.29%	10.00%	2.62%	2.86%	38.24%	0.79%	6.20%
difference	-2.81%	-6.58%	2.63%	1.64%	4.18%	-0.03%	0.98%
p value rel duration*[c]	0.13	0.01	0.05	0.45	0.03	0.65	0.62

average BW	33.00%	4.01%	6.12%	3.80%	44.49%	1.06%	7.51%
average SW	39.75%	10.69%	2.96%	2.96%	36.18%	0.78%	6.68%
difference	-6.75%	-6.68%	3.16%	0.84%	8.31%	0.28%	0.83%

*Note:** total durations scores for pauses coded after the designated seven categories. TEXT = text production, MOVE = movement activity, EDIT = editing activity.

Results related to simple frequency scores for pauses before the designated categories show statistically significant differences in three categories, namely, movement, editing and text and editing. Table 5 provides an overview of the results discussed below. The analysis shows that the simple frequency score for pauses before movement is significantly higher in the restricted visual feedback condition (M = 11.36) than the score in the normal condition (M = 3.93), p = .02. However, the score for simple frequency of pauses before editing is significantly lower in the restricted visual feedback condition (M = 3.21) than the score in the normal condition (M = 5.50), p = .03. Simple frequency scores for pauses before text combined with editing are also significantly lower in the restricted visual feedback condition (M = 44.00) than in the normal condition (M = 53.57), p = .01.

Relative frequency scores observe the statistically significant differences in the three categories outlined for the simple frequency scores. Results show that relative frequency scores for pauses before movement are higher in the restricted visual feedback condition (M = 9.51%) compared to the normal condition (M = 3.32%), p = .01. Relative frequency scores before editing only and text combined with editing are significantly lower in the restricted visual feedback condition (M = 2.76% and M = 38.22% respectively) compared to the normal condition (M = 4.63% and M = 46.74% respectively), p = .02 and .01 respectively.

Results concerning the simple frequency scores for pauses after the designated units show statistically significant differences for locations involving movement, editing and text combined with editing. Since the categories and the scores follow the pattern discussed above, the results will be presented in a summarized form. In short, results show that simple frequency scores after movement are higher in the restricted visual feedback condition (M = 11.29) compared to the normal condition (M = 3.86), p = .02. Simple frequency scores after editing and text combined with editing are significantly lower in the restricted visual feedback condition (M = 3.21 and M = 43.93 respectively) compared to the normal condition (M = 5.36 and M = 53.57 respectively),

p = .04 and .01 respectively.

In reference to relative frequency scores, results indicate that scores after movement are higher in the restricted visual feedback condition (M = 9.54%) compared to the normal condition (M = 3.27%), p = .01. Relative frequency scores after editing and text combined with editing are significantly lower in the restricted visual feedback condition (M = 2.78% and M = 38.50% respectively) compared to the normal condition (M = 4.51% and M = 46.92% respectively), p = .03 and .01 respectively.

Table 5 Average scores for simple and relative frequency of pauses across the seven meta-textual categories between conditions and across two coding methods.

	TEXT	MOVE	EDIT	TEXT MOVE	TEXT EDIT	MOVE EDIT	TEXT MOVE EDIT
p value simple frequency	0.07	0.02	0.03	0.57	0.01	0.88	0.56
average BW	40.79	3.93	5.50	3.64	53.57	0.86	8.64
average SW	46.29	11.36	3.21	3.36	44.00	0.79	7.79
difference	-5.50	-7.43	2.29	0.29	9.57	0.07	0.86
p value simple frequency*	0.10	0.02	0.04	0.37	0.01	0.75	0.50
average BW	40.57	3.86	5.36	3.64	53.57	0.86	8.64
average SW	45.79	11.29	3.21	3.21	43.93	0.71	7.64
difference	-5.21	-7.43	2.14	0.43	9.64	0.14	1.00
p value rel frequency	0.08	0.01	0.02	0.74	0.01	0.85	0.71
average BW	34.69%	3.32%	4.63%	3.08%	46.74%	0.65%	6.89%
average SW	39.29%	9.51%	2.76%	2.95%	38.22%	0.73%	6.55%
difference	-4.61%	-6.19%	1.87%	0.12%	8.52%	-0.07%	0.35%
p value rel frequency*	0.09	0.01	0.03	0.50	0.01	0.98	0.63
average BW	34.64%	3.27%	4.51%	3.09%	46.92%	0.65%	9.92%
average SW	39.22%	9.54%	2.78%	2.84%	38.50%	0.64%	6.46%
difference	-4.58%	-6.27%	1.73%	0.25%	8.41%	0.01%	0.46%

*Note:** total durations scores for pauses coded after the designated seven categories. TEXT = text production, MOVE = movement activity, EDIT = editing activity.

To summarize, participants spent more time pausing before or after movement in the text when visual feedback was restricted. However, less time was dedicated for pauses before a combination of movement and text. In addition, participants spent less time after editing and after a combination of text and editing in the restricted visual feedback condition. In terms of frequency of pausing, participants made more frequent stops both before and after movements in the restricted visual feedback condition. Finally, less frequent pauses were made before and after editing and a combination of text and editing, when visual feedback was restricted.

5.2 Textual coding

The second hypothesis proposed that frequency and duration of pauses will be higher when arguments against are produced in the condition with restricted visual feedback. The results support the hypothesis but also reveal additional insights. Figure 3 provides a quick overview of the distribution of relative pause frequency across the introductory part, the parts where arguments for and against are produced and in the conclusion of the text.

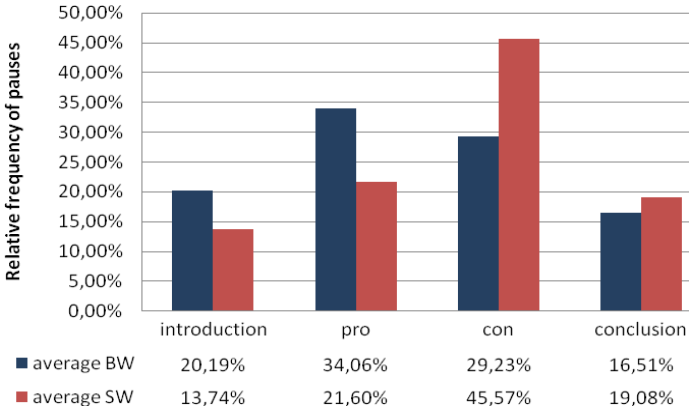

Figure 3 Relative frequency of pauses across the four textual categories. Significant differences occur in the category Introduction and the category Arguments against (con).

Table 6 and Table 7 display the significant findings related to duration and frequency scores respectively. The results show that total duration[c] of pauses in the Introduction is significantly lower (M = 96.95) in the restricted visual feedback condition compared to the scores in the normal condition (M = 138.03), p = .05. A marginal statistical difference (p = .06) occurs in the total duration in the category Arguments against. The total duration[c] scores are higher in the restricted visual feedback (M = 308.90) compared to the normal condition M = (186.90). Relative duration[c] scores are significantly higher in the category Arguments against (M = 44.78%) in the restricted visual feedback condition compared to the normal condition (M = 28.40%), p = .03.

Table 6 Total and relative duration of pauses across the four textual categories.

	TOT	INTRO	PRO	CON	CONCL
p value tot duration[c]	0.45	0.05	0.25	0.06	0.66
average BW	652.55	138.03	217.05	186.90	110.57
average SW	677.07	96.95	144.05	308.90	127.22
difference	-24.52	41.09	73.05	-122.01	-16.65
p value rel duration[c]		0.07	0.15	0.03	0.95
average BW		19.35%	32.73%	28.40%	19.52%
average SW		13.21%	22.07%	44.78%	19.93%
difference		6.14%	10.65%	-16.38%	-0.42%

Note: TOT = total, INTRO = Introduction, PRO = Arguments for, CON = Arguments against, CONCL = Conclusion.

Furthermore, simple frequency scores are significantly lower in the Introduction category (M = 15.36) in the restricted visual feedback condition in comparison with the normal condition (M = 22.93), p = .01. Relative frequency scores are also significantly lower in the Introduction category (M = 13.74) in the restricted visual feedback condition compared to the normal condition (M = 20.19%), p = .01. The relative frequency scores in the category Arguments against are significantly higher in the restricted visual feedback condition (M = 45.57%) than in the normal condition (M = 29.23%), p = .04.

Table 7 Simple and relative frequency of pauses across the four textual categories.

	TOT	INTRO	PRO	CON	CONCL
p value simple frequency	0.65	0.01	0.09	0.06	0.40
average BW	110.71	22.93	36.93	33.79	17.07
average SW	113.07	15.36	23.86	51.36	22.50
difference	-2.36	7.57	13.07	-17.57	-5.43
p value rel frequency		0.01	0.08	0.04	0.65
average BW		20.19%	34.06%	29.23%	16.51%
average SW		13.74%	21.60%	45.57%	19.08%
difference		6.45%	12.46%	-16.34%	-2.57%

Note: TOT = total, INTRO = Introduction, PRO = Arguments for, CON = Arguments against, CONCL = Conclusion.

In summary, there are two significant findings regarding duration and frequency of pauses on this level of analysis. Namely, participants spend less time pausing and pause less frequently in the introduction when access to the text is restricted. However, participants pause more frequently and spend more time while generating arguments against under conditions of restricted visual feedback.

5.3 Syntactic location

Results from the paired t-test at the level of syntactic location are reported for simple and relative frequency scores at final clause location, average values for phrase internal locations and median values for phrase internal and verb internal locations. Median values are also reported for phrase initial pauses.

5.3.1 Paragraph

Scores pertaining to clauses that begin paragraphs do not show any significant differences between conditions (p = .91) and no description is therefore provided.

5.3.2 Clause

The third hypothesis proposed that duration and frequency of pauses will be higher at clause location in the restricted visual feedback condition. The results support the hypothesis only

partially. A statistically significant difference between conditions was observed only for the frequency variables at clause final positions. Table 8 provides an overview of the significant findings. Results indicate that the simple frequency scores for pauses after clauses in the restricted visual feedback condition were significantly higher (M = 34.00) than scores in the normal condition (M = 27.57), p = .0. Similarly, relative frequency was significantly higher in the restricted visual feedback condition (M = 29.64%) compared to the normal condition (M = 24.34%), p = .02. The findings indicate that when visual feedback is restricted, participants pause more frequently after they have completed a clause.

Table 8 Average frequency scores at clause final location between conditions.

	Simple Frequency	Relative Frequency
	Clause Final	Clause Final
p value	0.01	0.02
average BW	27.57	24.34%
average SW	34.00	29.64%
difference	6.43	-5.30%

5.3.3 Phrase

Results in the phrase context show statistically significant differences for median[c] scores at phrase internal location. Table 9 provides an overview of the findings. At the level of individual phrase categories, the median value[c] of a verb internal phrase is statistically significant between conditions. The median value[c] is significantly higher (p = .04) in the restricted visual feedback condition (M = 4.73) compared to the normal condition (M = 3.52). Next, at the level of collapsed phrase values, the median[c] shows a statistical significance (p = .04) for phrase internal pause locations between conditions. Scores are significantly higher in the restricted visual feedback condition (M = 3.73) in comparison with the normal condition (M = 3.24). The average duration[c] scores for phrase internal location show a marginal statistical significance (p = .07) and observe the same trend of higher values in the restricted visual feedback condition. Finally, a marginal statistical significance (p = .08) occurs in the median[c] value for phrase initial pause locations. In short, when visual feedback is restricted, the average pause is significantly higher at phrase internal locations, and especially verb internal locations.

Table 9 Median and average scores at phrase internal and phrase initial location.

	Median Phrase initial	Average Phrase internal	Median Phrase internal	Median Verb internal
p value	0.08	0.07	0.04	0.04
average BW	3.27	4.92	3.24	3.52
average SW	3.63	5.44	3.73	4.73
difference	-0.35	-0.52	-0.49	-1.2

In summary, the results of the syntactic coding indicate that when visual feedback is restricted, participants pause more frequently at clause final locations and make longer pauses, on average, at phrase internal locations.

The concluding part of this overview presents a subset of findings from the normal visual feedback condition, in order to connect the present study with previous research. The overview is limited to results from the normal condition, because it is assumed that writing conditions are more comparable to those provided to participants in studies reported in the theoretical background. In short, researchers of L1 writing have observed that the average pause is longer before paragraph, clause, phrase, etc. in a descending order of duration (Chanquoy, Foulin & Fayol 1996; Schilperoord 1996). In the same vein, Matsuhashi (1981) reported longest pauses before paragraph openings. The results of the present study replicate the findings obtained in the context of L1 writing. Figure 4 illustrates the average pause length at paragraph, clause and phrase locations.

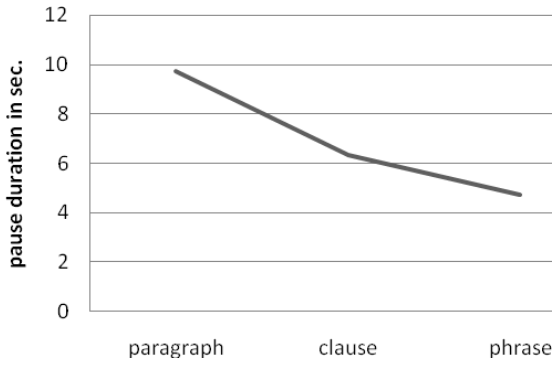

Figure 4 Mean pause duration as a function of syntactic location.

More specifically, the average pause before clauses that begin paragraphs was 9.72 seconds, pauses before clauses lasted 6.36 seconds, on average, and pauses before phrases were, on average, 4.74 seconds long. In this respect, L2 writing may observe the same organizing principles already observed by L1 researchers.

5.4 Fluency and burst

The fourth hypothesis proposed that more characters will be produced between pauses in the restricted visual feedback condition. Table 10 provides an overview of the findings. Results did not reach statistical significance concerning the production of characters between pauses (M = 39.15 and 37.58 for the normal and the restricted visual feedback condition respectively, p = .50). Therefore, the hypothesis was not supported. In addition, fluency measured as the number of characters per minute was secured both online and offline, but results did not reach any statistical significance. A marginal significance was observed for the characters produced in the linear files, with the production being significantly lower in the restricted feedback condition (M = 124.97) than in the normal condition (M = 134.68) p = .07. Nevertheless, scores on offline fluency did not reach statistical significance between conditions (p = .56).

Table 10 Average scores for burst, online fluency, offline fluency, wasted characters and percentage of wasted characters.

	Burst	Fluency online	Fluency offline	Wasted char.	% Wasted char.
p value	0.50	0.07	0.56	0.01	0.06
average BW	39.15	134.68	112.36	22.32	16.64%
average SW	37.58	124.97	109.11	15.86	12.73%
difference	1.57	9.71	3.25	6.46	3.92%

The average score for wasted characters, however, was significantly lower in the restricted visual feedback condition (M = 15.86) compared to the normal condition (M = 22.32), p = .01. Figure 5 illustrates the percentage of wasted characters between the two conditions.

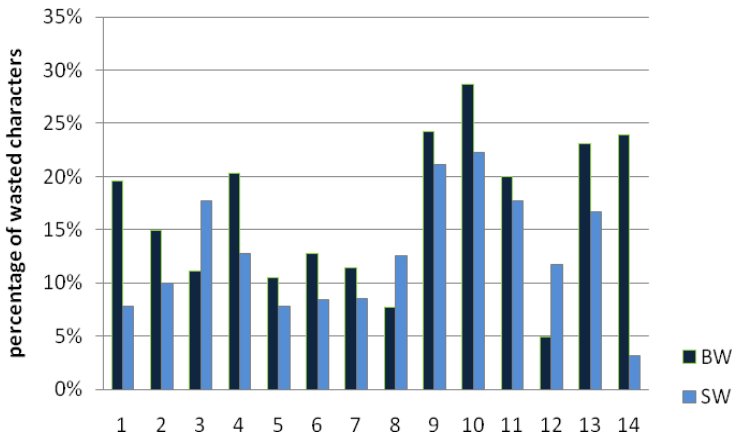

Figure 5 Percentage of wasted characters between conditions (*N*=14). The percentage of wasted characters is lower in the restricted visual feedback condition.

To summarize, results did not reach statistical significance in terms of burst and offline fluency between conditions. A marginal difference occurred in the online fluency between conditions. However, participants wasted significantly less characters when visual feedback was restricted.

This overview concludes the presentation of results, and the following Section resumes by discussing the significant findings of the study.

6. Discussion

Interpretations of results provided in this Section remain tentative, since the function of pauses is not readily observable from keystroke logging data. However, wherever feasible, attempts have been made to connect the present findings with interpretations reviewed in the theoretical background. In addition, given the exploratory nature of the study, other explanations of the findings are also offered.

In the context of the meta-textual analysis, results indicate that when visual feedback is suppressed, writers spend more time pausing and pause more frequently before or after making movements in the text. One potential explanation for this pattern of more frequent pauses and higher pause time before or after movement in the text rests on the nature of the writing task. To elaborate, the frequency of re-reading while producing argumentative texts is expected to be

higher, since the conclusion rests on the presented ideas, and the need to relate arguments for and against is more pronounced (Hull & Smith 1983; Nussbaum & Schraw 2007). Therefore, when access to the text is restricted, memorizing and potentially generating many interlinked statements probably become too costly for working memory resources. Consequently, in an attempt to establish links between statements, writers resort to increased movement activities, which might have the function of re-reading. In a similar context, when visual feedback is restricted, pause time before locations that involve a combination of movement and text production decreases. Depending how the function of the pause is approached, two interpretations may be suggested. The first one is that the pause may have been used for movement within the text and insertion of additional units, which may be classified as an editing activity. In that respect, it appears that writers would spend less time at editing activities. The second interpretation suggests that, if while pausing, movement occurred for the purpose of re-reading and generating text in parallel, some trade-off between the processes of movement, re-reading and text production may have occurred. This may have prompted writers to avoid re-reading and generating text in parallel, which, in its turn, was reflected in reduced pause times. Taking into consideration the forthcoming discussion on editing and its relationship with movement activities, it is rather difficult to support an alternative scenario, in which writers would be more efficient in simultaneously juggling reading, editing and text production and hence would save time when writing on a small window.

When visual feedback is suppressed, frequency scores and relative duration for pauses before and after locations involving editing are significantly lower. The findings may be connected to the study by Piolat, Roussey and Thunin (1997), which investigated revision strategies of participants, who used the Page and Scroll functions to move through the text. Although the size of the reading window remained the same between the two conditions, the results of Piolat, Roussey and Thunin (1997) show that coherence revisions by Page users (50%) were significantly higher than revisions performed by Scroll users (31%). In the context of the present study, scrolling and moving the cursor with the arrows may have been an additional burden, which influenced the editing capacity of writers. Moreover, it may be argued that writers were diverted from their routine operations, when visual feedback was restricted. More specifically, studies report that more skilled L2 writers were found to edit habitually throughout

the writing process (Raimes 1987). In addition, Chenoweth and Hayes (2001:96) suggest that the strategy "write it down, even if flawed, and revise it later" is an effective writing technique, which improves fluency in L2 writers. Therefore, the pattern in the normal condition may be interpreted as a strategy that L2 writers would use while writing in standard conditions. However, given the additional costs attached to the process (having restricted access to the text and the cost attached to movement), writers might have diverted from the usual strategy.

Furthermore, the pause pattern at locations involving movement and editing may be explored in the context of working memory resources. More specifically, when visual feedback is suppressed, attentional resources need to be allocated to increased movements in the text (Piolat, Roussey & Thunin 1997). Once attentional resources are allocated to managing movements, the pool of resources becomes further depleted, and visible effects occur in the reduced pause time and frequency dedicated to editing. However, although writers pause less frequently and dedicate less time at locations related to editing, the result may be a more effective writing strategy. To elaborate the matter further, the following line of reasoning is proposed. First, while a marginally higher number of characters are produced in the normal condition, no statistically significant difference is observed in the total amount of characters (in the final edited text) across the two conditions. Subsequently, no statistical difference is observed for the measure of offline fluency (characters in final edited text produced per minute) between conditions. The finding is in line with the results by Hull and Smith (1983) who report no effects upon fluency, when visual feedback is disrupted. However, writers waste significantly more characters, on average, in the normal condition (17%) compared to the restricted feedback condition (13%). Consequently, it may be argued that more pause time for editing on the big window results from ineffective allocation of working memory resources. Consistent with the present reasoning, Chenoweth and Hayes (2001:93) have observed that increased experience with L2 is associated with "decrease in the frequency of revision and increase in the number of words that are accepted and written down".

As a result of the aforesaid discussion, the proposal of shared resources between editing and movement may be elaborated even further. Namely, it may be proposed that although resources are depleted for editing and possibly allocated to movement, the activity of movement in the text may rely upon different working memory resources. While movement itself may

generate attentional disruption (Piolat, Roussey & Thunin 1997), it might draw upon resources from the spatial component, for instance. Hence, despite its attentional requirements, drawing upon the spatial component, movement would cause less interference in the verbal component. Thus, with diminished editing, the central executive may deploy the remaining resources of the verbal component more effectively in the process of content generation.

Additional support to the proposed line of reasoning may come from several sources. Firstly, studies have proposed that during revision the L2 writer may become "temporarily 'blind' to the demands other than the one focused on" (Broekkamp & van den Bergh 1996:180). Similarly, Stevenson, Schoonen and de Glopper (2006:224) suggest that "a resource squeeze" occurs when writing in a foreign language. It stems from the "extra attention to lower-level revision processes" and "affects the resources available for other processing components, such as conceptualizing" (Stevenson, Schoonen & de Glopper 2006:224). Lastly, studies have demonstrated that verbal concurrent tasks affect the short-term storage of verbal information but not that of visuospatial information. By the same token, maintenance of visuospatial information is disrupted by concurrent visuospatial tasks but not by verbal tasks (Cocchini et al. 2002; Sala, Rama & Courtney 2003). Certainly, such tentative explanations should be corroborated or disconfirmed by qualitative investigations of the texts as well as experiments which employ secondary tasks.

On the second level of analyses, two significant findings were observed. On one hand, when visual feedback is suppressed, writers spend less time and make relatively less frequent stops in the introductory part of the text compared to the normal condition. On the other hand, when visual feedback is suppressed, results show relatively higher pause time and frequency when producing arguments against. In the first case, one explanation might be that having understood that they would not be able to have a full representation of the text in front of them, writers were prompted to write more quickly, not stopping so often and spending less time pausing, in order to be sure that they have produced sufficient text. The pattern may also be a consequence of the writing task. More specifically, the topic for the restricted visual feedback condition may have been more stimulating, and writers did not have to spend much time planning what to write.

In the second case, the reason writers spend relatively more time pausing and produce relatively more frequent pauses while producing arguments against may have been due to some effect between the elicitation materials, and the need to establish links between the opposing arguments in the text. Specifically, the materials presented arguments that supported the theme, and as a consequence, writing arguments against the topic may have claimed more pause time, especially because of the need to establish them in connection to the more easily produced arguments for. In particular, the finding may be interpreted in the context of increased pauses at locations involving movements, when visual feedback is restricted. Pauses at such locations may have been used for re-reading of already produced arguments for.

Furthermore, although a detailed investigation of argument production was not within the scope of the study, a preliminary analysis was conducted concerning the degree of integration of arguments for and against across conditions and participants.

In terms of producing an integrated response, the present study observes that almost 65% of the participants managed to integrate both positions. From the remaining participants, four were inconsistent in their integrated responses, producing either arguments for or arguments against in the normal condition, or only arguments against, when visual feedback was suppressed. However, these participants did manage to include both positions in either of the conditions. Only one participant did not provide integrated responses in both writing sessions. However, it may be argued that the results are a product of the experimental setting in the sense that under such conditions the "frequency of generating opposing arguments to one's own increases" (Santos & Santos 1999:80). It may also be observed that while writing on the small window, the rate of integration was higher compared to the big window. In particular, 86% of the participants provided an integrated response to the writing task when writing on the small window, whereas only 78% of the participants integrated the opposing positions when writing on the big window. Table 11 provides a general insight into the production of arguments in the 28 texts. It shows that five participants are not integrating arguments for and against in the text, across the two conditions. In addition, the table indicates that more integrated responses are produced in the restricted visual feedback condition.

Table 11 Production of arguments for and arguments against across the two conditions; the dark squares denote absence of the specific argument.

		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14
BW	For		■					■							
BW	Against								■		■				
SW	For							■							■
SW	Against														

In an attempt to explain the decreased ability to produce integrated responses in the normal condition, several interpretations will be explored. Given that the explanations rest on observations which have not been subjected to statistical testing, the interpretation provided below should be considered with care.

On one hand, the decreased ability to integrate opposing arguments in the normal condition may be due to some extraneous variables not accounted for in the present study. For instance, the elicitation materials in the normal condition may have been more difficult to comprehend or perhaps less interesting, which may have led participants to economize, draw upon their own opinions, and attend only to one aspect of the topic. On the other hand, it may also be argued that participants hold strong opinions, which interfered with the production of arguments against their own position (Jonassen & Cho 2011).

Apart from the factors discussed above, this deficiency of integrating opposing arguments may be tentatively explained by working memory capacity. In that respect, however, participants would be expected to have more difficulty integrating opposing arguments when visual feedback is restricted. The findings are counterintuitive in a sense that, as already discussed, almost 90% of writers managed to produce integrated responses when writing on the small window.

To explain the discrepancy between the conditions, the improved integrative capacity when visual feedback is restricted may be linked to the discussion on pause patterns at movement and editing locations. More specifically, when the writing window is big, editing operations might engage the attentional component in a way that reduces its capacity for "complex binding and integration of information" (Repovs & Baddeley 2006:13). However, such integration of information may be crucial in the process of integrating arguments. By contrast, when visual

feedback is restricted, the resources for editing are depleted and possibly allocated to movement. However, given that movement may rely upon the spatial component, it would cause less interference in the verbal component. Thus, the central executive may deploy the resources of the verbal component more effectively for the purpose of generating and integrating arguments.

Furthermore, the results from the syntactic analyses reveal that when visual feedback is suppressed, writers pause more frequently at clause final positions. In addition, the average pause at phrase internal positions is longer, in particular within verb phrases. First, more frequent pauses at final clause locations may result from the writing window size. Namely, the writing window was customized to allow for immediate access to the emerging line, and writers had to scroll or use the arrows to move back and forth in the text. Assuming that such movements might have been quite demanding (Wästlund, Normander & Archer 2008), writers would decide to pause at clause completion points, in order to economize on the consuming activity of movement and reduce the need to revisit the clause. The function of such pauses may have been to monitor the already produced text as well to generate the subsequent text. Certainly, such junctures do not preclude constructing the message on multiple levels in parallel. In addition, the results may be tentatively associated with the study of Bruijn, de Mul and van Oostendorp (1992) who investigated reading strategies between big and small screen conditions. Bruijn, de Mul and van Oostendorp (1992) observed that while reading on the small screen, participants paid attention locally, for a longer period of time, and scrolled line-by-line instead of jumping far into the text. By analogy, the increased frequency of pauses at final clause locations may be considered as local allocation of attention and interpreted as an adaptive strategy that participants employ to overcome the constraints of the restricted visual feedback.

Finally, higher average scores at phrase internal locations may be interpreted through findings pertaining to standard writing conditions as well as through results obtained from pauses in speech. First, Matsuhashi (1981) has already observed that writers pause following a function word of a phrase which, in the context of her study of planning, is interpreted as an indicator that semantic and lexical planning is still not complete before starting the phrase. Second, studies of pauses in speech (Fox Tree & Clark 1997) which investigated the use of THE (pronounced as ‘thuh’ with the reduced vowel schwa) and THIY (pronounced with a nonreduced vowel) report that hiatuses after THIY contain a filler, hedge, pause or editing expression 58% of the time. Fox

Tree and Clark (1997) argue that such use of the determiner in speech is prospective in the repairs it signals. Accordingly, the specific pronunciation of *the* in fact signals suspension of speaking, in order to deal with an unspecified problem. In most cases, however, the problems involve word retrieval and choice of nominal (Fox Tree & Clark 1997). Although the tendency in these two accounts is to assign a forward-planning function of pauses, it may be proposed that pauses after a determiner or an auxiliary in writing have a function of retrieving the intended lexical item under standard writing conditions, at least in most of the cases. By extension, when visual feedback is suppressed, the phrase internal pause lasts longer, possibly due to the lack of exposure to the previously produced text, which may result in two potential effects. On one hand, it may have been difficult for writers to readily reconnect the potential phrase with nearby syntactic elements, while maintaining coherence with distant units which were not readily accessible. On the other hand, immediate access to previously used phrases might have provided some facilitation in retrieving subsequent units.

Findings from neuroimaging studies, albeit from the investigation of speech production, may shed some light on the present results. Specifically, neuroimaging studies of pauses between clauses demonstrated that pauses of this type were associated with activation in the right inferior frontal gyrus, which was associated with memory search. The same region was activated in subjects who listened to grammatically incorrect sentences and had to repair them. Pauses within clauses were found to be of shorter duration than pauses at clause boundaries. In addition, they were associated with activation in the superior and middle temporal gyri bilaterally, areas previously implicated in lexical retrieval and error correction, whereas pauses occurring at grammatical junctions were not (Kircher et al. 2004).

7. Conclusion

In conclusion, the findings supported the majority of hypotheses and demonstrated that manipulation of the visual feedback results in altered temporal patterns during L2 writing. However, given the lack of qualitative assessments of the texts, no proposals could be put forward as to the effects of the increased pause time and frequency on the quality of the final edited text.

To summarize, results from the meta-textual analysis show that when visual feedback is restricted, participants allocate more pause time and pause more frequently before or after locations involving movement and less pause time before locations involving a combination of movement and text. Moreover, when visual feedback is restricted, participants spend less time after locations involving editing and after a combination of text and editing, and pause less frequently at locations before and after editing and a combination of text and editing. It is proposed that when visual feedback is restricted, working memory resources are allocated to movement activity, and visible effects occur in the reduced capacity for editing. However, it appears that writers waste a lower percentage of characters in the restricted visual feedback condition and their effectiveness in writing is higher. Thus, it may be argued that when resources are allocated to movement, they draw upon the spatial component and interfere less in the verbal component. In that manner, the central executive may deploy the resources of the latter more effectively.

Secondly, the results from the textual analyses indicate that, when visual feedback is restricted, participants spend less time pausing and pause less frequently in the introductory part of the text. By contrast, pause time and frequency were found to increase while writers generate arguments against. Decreased duration and frequency in the introductory part might result from two potential factors. Not having a representation of the text as it enfolds on the writing window, writers would be prompted to accelerate the production, in order to secure that they would produce sufficient text at the end. Thus, pause events would diminish. Alternatively, pause events might have decreased, since writers may have been more stimulated by the elicitation materials used for the restricted visual feedback condition. Furthermore, the increase in pause time and frequency in the category arguments against may have resulted from the need to establish the opposing arguments in connection to the more easily produced arguments for.

Thirdly, the results from the syntactic analyses indicate that, when visual feedback is restricted, participants pause more frequently at clause final locations and make longer pauses, on average, at phrase internal locations. Pauses at clause final locations may be interpreted as a point where multiple levels of the message are constructed. In addition, editing and re-reading operations might occur at this juncture. Alternatively, the effect may be an adaptive strategy used by writers to overcome the restrictions of the one-line writing window. More specifically, in

order to economize on frequent re-examination of the clauses, writers would decide to control the already produced clause before they continue. The longer average pause at phrase internal locations, under conditions of restricted visual feedback, may result from the difficulty in embedding potential phrases with surrounding syntactic structures, as well as from the effect of reduced exposure to previously produced phrases, which in the normal condition may have facilitated the production of subsequent phrase units.

Fourthly, the results concerning fluency measures did not reach statistical significance between conditions, with the exception of the percentage of wasted characters, which appeared to be lower in the restricted visual feedback condition. This finding was interpreted as an increase in effectiveness, at least in terms of the characters produced.

However, there are a number of factors that may affect the validity of the obtained results and thus limit the generalizability of the present study. Firstly, an inherent risk in the within-subjects design that is difficult to assuage is related to learning. Namely, participants were drawn from the same pool and their mutual contact between experimental sessions was inevitable. Another source of variance is the fact that not all writers share the same native language (Spelman Miller 2006:155). Next, it has been reported that extraneous variables such as political background, personality type, metaknowledge of specific discourse requirements and even the emotional or non-emotional nature of the writing task exert strong influence during text production in L2 writing (Leki, Cumming & Silva 2008:110-12). Furthermore, concerning gender variance, studies indicate that gender differences in communication styles are weak, inconsistent, and often statistically swamped by other factors such as personality, geographic upbringing, culture, and situational dynamics (Nussbaum & Schraw 2007). Another factor is the type of manipulation of the writing medium. Studies of visual feedback during writing usually use pens with empty ballpoints or make characters invisible in computerized experiments. It may be assumed that each of these conditions exerts differential effects on the writing process and the issue of what constitutes visual suppression still awaits a more precise definition. In addition, some studies indicate that consideration of arguments is a function of order of presentation. For instance, students produce more arguments for the side presented first, at the expense of the other. Accordingly, the one-sided content of the video material might have triggered more arguments on the respective side, given time pressure (Nussbaum & Schraw 2007). Additionally,

individual factors such as motivation, fatigue and anxiety may compromise the outcome. Subjects may rely on rehearsed responses, or may decide to economize their effort and reduce the cognitive burden, given the pressures of timed response (Spelman Miller 2006:140). Finally, somewhat ignored issues are the type of keyboard used and the time allotted to the task. More specifically, some participants may make many typos and thereby generate many editing events solely by virtue of interaction with the specific keyboard. In regard to the timed writing task, it may well be the case that pause patterns are affected to a large extent by the allotted time rather than some invariable cognitive activity.

Notwithstanding the possible limitations, the study demonstrated several effects that merit further investigation. A closer examination of pause duration and frequency variables at movement and editing locations by means of secondary tasks may reveal some interesting insights in respect to the allocation of working memory resources. Moreover, the observation that participants waste a lower percentage of characters, when visual feedback is restricted, might also be investigated further and complemented with qualitative assessment of the texts, which would confirm or discard the proposal put forward in the present study. Follow-up investigations may also look more closely into the pause patterns generated while producing opposing arguments and explore the process of constructing arguments in relation to background knowledge or elicitation effects. Moreover, further studies might combine keystroke logging and eye tracking techniques in order to observe how writers establish links between written arguments. In addition, going beyond the polarization of the pro and con writing task, potential investigations may examine the interplay between working memory capacity and building complex arguments which are not readily classified on one side of the pole. Having the above in mind, three potential benefits arise of the present study. Firstly, the study is a first exploratory investigation of visual feedback effects on the temporal aspects of computer-based writing, at least compared to published research. As such, it may serve as an encouragement to further explore the potential benefits of manipulating visual feedback for L2 writers, rather than focus on the detrimental effects of visual suppression. The second benefit is related to educational practices in L2 contexts. Specifically, if qualitative evaluations of the text reveal that quality scores are higher for texts written on the small window, it may have vast implications on the approach to teaching writing. In particular, it may affect the strategies of developing effective L2

writing techniques in terms of working memory allocation. The final benefit pertains to the focus on writing argumentative texts. With its modest contribution, the study hopes to contribute to the knowledge base concerned with the problems of writing an argumentative text which have not been extensively explored.

References

Abu-Rabia, Salim. 2003. The influence of working memory on reading and creative writing processes in second language. *Educational Psychology* 23:210-222.

Andriessen, Jerry & Pierre Coirier. eds. 1999. Preface. *Foundations of argumentative text processing*. Amsterdam: Amsterdam University Press.

Alamargot, Denis., David Chesnet, Christophe Dansac & Christine Ros. 2006. Eye and pen: A new device for studying reading during writing. *Behavior Research Methods* 38(2):287-299.

Alves, Alexandre R., São Luís Castro & Thierry Olive. 2008. Execution and pauses in writing narratives: Processing time, cognitive effort and typing skill. *International Journal of Psychology* 43:969-979.

Atwell, Michael. 1981. *The evolution of text: The interrelationship of reading and writing in the composing process*. PhD thesis, Indiana University.

Baddeley, Alan. 2007. *Working memory, thought and action*. Oxford and New York: Oxford University Press.

Besnard, Philippe & Anthony Hunter. 2008. *Elements of argumentation*. Cambridge: MIT Press.

Biber, Douglas., Stig Johansson, Geoffrey Leech, Susan Conrad & Edward Finegan. 1999. *Longman grammar of spoken and written English*. Essex: Pearson Education Ltd.

Breetvelt, Iris., Huub van den Bergh & Gert Rijlaarsdam. 1996. Rereading and generating and their relation to text quality: An application of multilevel analysis on writing process data. In Gert Rijlaarsdam, Huub van den Bergh & Michel Couzijn (eds.) *Theories, models and methodology in writing research*. Amsterdam: Amsterdam University Press, 10-20.

Britton, James., Tony Burgess, Nancy Martin, Alex McLeod & Harold Rosen. 1975. *The development of writing abilities*. London: Macmillan, 11-18.

Broekkamp, Hein & Huub van den Bergh. 1996. Attention strategies in revising a foreign language text. In Gert Rijlaarsdam, Huub van den Bergh & Michel Couzijn (eds.) *Theories, models and methodology in writing research*. Amsterdam: Amsterdam University Press, 170-181.

Bruijn, David de., Sjaak de Mul & Herre van Oostendorp. 1992. The influence of screen size and text layout on the study of text. *Behaviour and Information Technology* 11(2):71-78.

Chanquoy, Lucile., Noel J. Foulin & Michele Fayol. 1996. Writing in adults: A real-time approach. In Gert Rijlaarsdam, Huub van den Bergh & Michel Couzijn (eds.) *Theories, models and methodology in writing research*. Amsterdam: Amsterdam University Press, 36-43.

Chenoweth, Ann N. & John R. Hayes. 2001. Fluency in writing: Generating text in L1 and L2. *Written Communication* 18(1):80-98.

Cocchini, Gianna., Robert H. Logie, Sergio Della Sara, Sarah E. MacPherson & Alan D. Baddeley. 2002. Concurrent performance of two memory tasks: Evidence for domain specific working memory systems. *Memory & Cognition* 30:1086-1095.

Coirier, Pierre., Jerry Andriessen & Lucile Chanquoy. 1999. From planning to translating: The specificity of argumentative writing. In Jerry Andriessen & Pierre Coirier (eds.) *Foundations of argumentative text processing*. Amsterdam: Amsterdam University Press, 1-28.

Eemeren, Frans H. van & Rob Grootendorst. 1999. From analysis to presentation: A pragma-dialectical approach to writing argumentative texts. In Jerry Andriessen & Pierre Coirier (eds.) *Foundations of argumentative text processing*. Amsterdam: Amsterdam University Press, 43-59.

Flower, Linda & John R. Hayes. 1980. The dynamics of composing: Making plans and juggling constraints. In Lee W. Gregg & Erwin R. Steinberg (eds.) *Cognitive processes in writing*. Hillsdale, NJ: Erlbaum, 31-50.

Fox Tree, Jean E. & Herbert H. Clark. 1997. Pronouncing "the" as "thee" to signal problems in speaking. *Cognition* 62(2):151–167.

Gould, John D. 1980. Experiments on composing letters: Some facts, some myths, and some observations. In Lee W. Gregg & Erwin R. Steinberg (eds.) *Cognitive processes in writing*. Hillsdale, NJ: Erlbaum, 97-127.

Hall, Chris. 1990. Managing the complexity of revising across languages. *TESOL Quarterly* 24(1):43-60.

Hayes, John R. 1996. A new framework for understanding cognition and affect in writing. In C. Michael Levy & Sarah Ransdell (eds.) *The science of writing*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1-27.

Hell, Janet G. van., Ludo Verhoeven & Liesbeth M. van Beijsterveldt. 2008. Pause time patterns in writing narrative and expository texts by children and adults. *Discourse Processes* 45: 406-427.

Hull, Glynda A. & William L. Smith. 1983. Interrupting visual feedback in writing. *Perceptual and Motor Skills* 57:963–978.

Johansson, Victoria. 2009. *Developmental aspects of text production in writing and speech*. PhD thesis, Lund University.

Johansson, Roger., Victoria Johansson, Åsa Wengelin & Kenneth Holmqvist. 2008. Reading during writing. Dept. of Linguistics and Phonetics, Lund University. *Working Papers* 53: 43-59.

Jonassen, David H. & Hoan Y. Cho. 2011. Fostering argumentation while solving engineering ethics problems. *Journal of Engineering Education* 100(4):680–702.

Just, Adam M. & Patricia A. Carpenter. 1992. A capacity theory of comprehension: Individual differences in working memory. *Psychological Review* 99(1):122-149.

Kellogg, Ronald T. 2001. Competition for working memory among writing processes. *The American Journal of Psychology* 114(1):175-191.

Kellogg, Ronald T. 2008. Training writing skills: A cognitive developmental perspective. *Journal of Writing Research* 1(1):1-26.

Kellogg, Ronald T., Thierry Olive & Annie Piolat. 2007. Verbal, visual, and spatial working memory in written language production. *Acta Psychologica* 124:382-397.

Kircher, Tilo T., Michael J. Brammer, Willem Levelt, Mathias Bartels & Philip K. McGuire. 2004. Pausing for thought: Engagement of left temporal cortex during pauses in speech. *NeuroImage* 21(1):84–90.

Kolers, Paul A., Robert Duchinsky & Dennis C. Ferguson. 1981. Eye movement measurement of readability of CRT displays. *Hum. Factors* 23:517-527.

Kuhn, Diane. 1991. *The skills of argument*. New York: Cambridge University Press.

Kuhn, Diane. 2005. *Education for thinking*. Cambridge, MA: Harvard University Press.

Latif, Muhammad A. M. 2008. A state-of-the-art review of the real-time computer-aided study of the writing process. *International Journal of English Studies* 8(1):29-50.

Leki, Ilona., Alister Cumming & Tony Silva. 2008. *A synthesis of research on second language writing in English*. New York: Routledge.

Lifang, Zhai. 2008. Methods in the study of influencing factors on L2 writing performance. *Canadian Social Science Research* 4(6):66-74.

Lindgren, Eva & Kirk Sullivan. 2003. Stimulated recall as a trigger for increasing noticing and language awareness in the L2 writing classroom: A case study of two young female writers. *Language Awareness* 12:172-186.

Matsuhashi, Ann. 1981. Pausing and planning: The tempo of written discourse production. *Research in the Teaching of English* 15(2):113-134.

McCutchen, Deborah. 2011. From novice to expert: Implications of language skills and writing-relevant knowledge for memory in the development of writing skill. *Journal of Writing Research* 3(1):51-68.

Mills, Carol B. & Linda Weldon. 1987. Reading text from computer screens. *ACM Computing Surveys* 19(4):329-358.

New, Elizabeth. 1999. Computer-aided writing in French as a foreign language: A qualitative and quantitative look at the process of revision. *The Modern Language Journal* 83(1):81-97.

Newell, George E., Richard Beach, Jamie Smith, Jennifer van der Heide, Diane Kuhn & Jerry Andriessen. 2011. Teaching and learning argumentative reading and writing: A review of research. *Reading Research Quarterly* 46(3):273-304.

Nussbaum, Michael E. & Gregory Schraw. 2007. Promoting argument-counterargument integration in students' writing. *The Journal of Experimental Education* 76:59-92.

Oléron, Geneviève & Hubert Tardieu. 1978. Influence of scrolling up on the recall of texts. In Michael M. Gruneberg, Peter E. Morris & Robert N. Sykes (eds.) *Practical aspects of memory*. Orlando, Fla.: Academic Press, 137-144.

Olive, Thierry & Anne Piolat. 2002. Suppressing visual feedback in written composition: Effects on processing demands and coordination of the writing processes. *International Journal of Psychology* 37(4):209-218.

Olive, Thierry & Ronald T. Kellogg. 2002. Concurrent activation of high- and low-level production processes in written composition. *Memory & Cognition* 30:594-600.

Olive, Thierry., Ronald T. Kellogg & Annie Piolat. 2001. The triple task technique for studying the process of writing. In Thierry Olive & C. Michael Levy (eds.) *Contemporary tools and techniques for studying writing*. Dordrecht: Kluwer Academic Publishers, 31-61.

Perelman, Chaim & Lucie Olbrechts-Tyteca. 1969. *The new rhetoric: A treatise on argumentation*. Notre Dame: UND.

Phinney, Marianne & Sandra Khouri. 1993. Computers, revision and ESL writers: The role of experience. *Journal of Second Language Writing* 2:257-277.

Piolat, Annie., Jean Yves Roussey & Olivier Thunin. 1997. Effects of screen presentation on text reading and revising. *International Journal of Human-Computer Studies* 47:565–589.

Piolat, Annie., Jean Yves Roussey & Anne Gombert. 1999. The development of argumentative schema in writing. In Jerry Andriessen & Pierre Coirier (eds.) *Foundations of argumentative text processing*. Amsterdam: Amsterdam University Press, 117-137.

Raimes, Ann. 1987. Language proficiency, writing ability, and composing strategies: A study of ESL college student writers. *Language Learning* 37(3):439–468.

Ransdell, Sarah. 1995. Generating thinking-aloud protocols: Impact on the narrative writing of college students. *American Journal of Psychology* 108(1):89-98.

Ransdell, Sarah., C. Michael Levy & Ronald T. Kellogg. 2002. The structure of writing processes as revealed by secondary task demands. *Educational Studies in Language and Literature* 2:141-163.

Repovs, Grega & Alan Baddeley. 2006. The multi-component model of working memory: Explorations in experimental cognitive psychology. *Neuroscience* 139(1):5-21.

Sala, Joseph B., Pia Rama & Susan M. Courtney. 2003. Functional topography of a distributed neural system for spatial and nonspatial information maintenance in working memory. *Neuropsychologia* 41(3):341-356.

Santos, Selma L. 1993. *The construction of arguments: A comparison of the strategies employed in experimental and naturalistic settings*. PhD thesis, University of Cambridge.

Santos, Selma L. 1995. Argumentation in naturalistic setting. In Frans H. van Eemeren, Rob Grootendorst, J. Anthony Blair & Charles A. Willard (eds.) *Proceedings of the 3^{d} ISSA Conference on Argumentation. Vol.III Reconstruction and Application.* Amsterdam: Sic Sat, 31-41.

Santos, Clara M. 1996. *Good reasoning: To whom? When? How? An investigation of belief effects on syllogistic and argumentative reasoning*. PhD thesis, University of Sussex.

Santos, Clara M. & Selma L. Santos. 1999. Good argument, content and contextual dimensions. In Jerry Andriessen & Pierre Coirier (eds.) *Foundations of argumentative text processing*. Amsterdam: Amsterdam University Press, 75-97.

Sasaki, Miyuki. 2004. A multiple-data analysis of the 3.5-year development of EFL student writers. *Language Learners* 54(3):525-582.

Schilperoord, Joost. 1996. The distribution of pause time in written text production. In Gert Rijlaarsdam, Huub van den Bergh & Michel Couzijn (eds.) *Theories, models and methodology in writing research*. Amsterdam: Amsterdam University Press, 21-36.

Severinson, Kerstin E. & Py Kollberg. 1996. A computer tool and framework for analyzing on-line revisions. In C. Michael Levy & Sarah Ransdell (eds.) *The science of writing*. Mahwah, NJ: Erlbaum, 163-188.

Silva, Tony. 1993. Toward an understanding of the distinct nature of L2 writing. *TESOL Quarterly* 27(4):657-677.

Simon, Dan & Keith J. Holyoak. 2002. Structural dynamics of cognition: From consistency theories to constraint satisfaction. *Personality and Social Psychology* 6:283–294.

Spelman Miller, Kristyan. 2006. Pausing, productivity and the processing of topic in on-line writing. In Kirk Sullivan & Eva Lindgren (eds.) *Computer keystroke logging: Methods and applications*. Oxford: Elsevier, 131-155.

Spelman Miller, Kristyan., Eva Lindgren & Kirk Sullivan. 2008. The psycholinguistic dimension in second language writing: Opportunities for research and pedagogy. *TESOL Quarterly. Special Edition on Psycholinguistics and Second Language Learning* 42(3):433-454.

Stein, Nancy L. & Christopher A. Miller. 1993a. A theory of argumentative understanding: Relationships among position preference, judgments of goodness, memory, and reasoning. *Argumentation* 7:183-204.

Stevenson, Marie., Rob Schoonen & Kees de Glopper. 2006. Revising in two languages: A multidimensional comparison of online writing revisions in L1 and FL. *Journal of Second Language Writing* 15:201-223.

Teleman, Ulf. 1981. On visual feedback in writing. *Proceedings of the 6th International Congress of Applied Linguistics*. Lund, 424-425.

Voss, James F., Jennifer Wiley & Rebecca Sandak. 1999. Reasoning in the construction of argumentative texts. In Jerry Andriessen & Pierre Coirier (eds.) *Foundations of argumentative text processing*. Amsterdam: Amsterdam University Press, 29-43.

Weintraub, Naomi., Naomi G. Grill & Patricia L. T. Weiss. 2010. Relationship between handwriting and keyboarding performance among fast and slow adult keyboarders. *The American Journal of Occupational Therapy* 64:123-132.

Wen, Zhisheng. 2012. Working memory and second language learning. *International Journal of Applied Linguistics* 22(1):1-21.

Wengelin, Åsa. 2006. Examining pauses in writing: Theory, methods and empirical data. In Kirk Sullivan & Eva Lindgren (eds.) *Computer keystroke logging and writing: Methods and applications*. Oxford: Elsevier, 107-130.

Wästlund, Erik., Torsten Normander & Trevor Archer. 2008. The effect of age layout on mental workload: A dual task experiment. *Computers in Human Behavior* 24:1229-1245.

Appendix A Questionnaire form

Questionnaire

Please take a minute or two to fill out this questionnaire.
* Required

Name and surname *

Age *

Sex *

Nationality *

Native Language *

Education *

Total Years of Education in English *

Have you ever been explicitly taught how to write argumentative essays *

- Yes
- No

How often do you use the following abilities of English in your studies *

	Never	Rarely	Sometimes	Often	Very often
Writing					
Listening					
Reading					
Speaking					

How often do you have difficulty with the following: *

	Never	Rarely	Sometimes	Often	Very often
Writing					
Listening					
Reading					
Speaking					
Spelling					
Grammar					

During your BA studies how much did you write in: *

	Never	Rarely	Sometimes	Often	Very often
Writing in Native Language					
Writing in English					
Other					

Appendix B Questionnaire responses

(personal participant data is excluded)

Have you ever been explicitly taught how to write argumentative essays			
	Yes	**13**	93%
	No	**1**	7%
	People may select more than one checkbox, so percentages may add up to more than 100%.		
How often do you use the following abilities in English in your studies - Writing			
	Never	**0**	0%
	Rarely	**1**	6%
	Sometimes	**1**	6%
	Often	**7**	41%
	Very often	**5**	29%
How often do you use the following abilities in English in your studies - Listening			
	Never	**0**	0%
	Rarely	**0**	0%
	Sometimes	**2**	12%
	Often	**4**	24%
	Very often	**8**	47%
How often do you use the following abilities in English in your studies - Reading			
	Never	**0**	0%
	Rarely	**0**	0%
	Sometimes	**1**	6%
	Often	**2**	12%
	Very often	**11**	65%
How often do you use the following abilities in English in your studies - Speaking			
	Never	**0**	0%
	Rarely	**3**	18%

	Sometimes	**3**	18%
	Often	**4**	24%
	Very often	**4**	24%
How often do you have difficulty with each of these - Writing			
	Never	**3**	18%
	Rarely	**6**	35%
	Sometimes	**3**	18%
	Often	**2**	12%
	Very often	**0**	0%
n do you have difficulty with each of these - Listening			
	Never	**6**	35%
	Rarely	**6**	35%
	Sometimes	**2**	12%
	Often	**0**	0%
	Very often	**0**	0%
How often do you have difficulty with each of these - Reading			
	Never	**6**	35%
	Rarely	**4**	24%
	Sometimes	**4**	24%
	Often	**0**	0%
	Very often	**0**	0%
How often do you have difficulty with each of these - Speaking			
	Never	**3**	18%
	Rarely	**7**	41%
	Sometimes	**2**	12%
	Often	**2**	12%

	Very often	**0**	0%
How often do you have difficulty with each of these - Spelling			
	Never	**2**	12%
	Rarely	**6**	35%
	Sometimes	**4**	24%
	Often	**1**	6%
	Very often	**1**	6%
How often do you have difficulty with each of these - Grammar			
	Never	**2**	12%
	Rarely	**5**	29%
	Sometimes	**5**	29%
	Often	**1**	6%
	Very often	**1**	6%
During your BA studies how much did you write in: - Writing in Native Language			
	Never	**6**	35%
	Rarely	**2**	12%
	Sometimes	**3**	18%
	Often	**2**	12%
	Very often	**1**	6%
During your BA studies how much did you write in: - Writing in English			
	Never	**2**	12%
	Rarely	**1**	6%
	Sometimes	**2**	12%
	Often	**2**	12%
	Very often	**7**	41%

During your BA studies how much did you write in: - Other

Never	**6**	35%
Rarely	**4**	24%
Sometimes	**4**	24%
Often	**0**	0%
Very often	**0**	0%

Appendix C Customizing ScriptLog

The Appendix contains a step-by-step guide to the customization of ScriptLog for the purposes of the present study. In addition, the images show the functions in the current version of the software which is still under development.

I Customizing ScriptLog

Step 1. In the Experiment box define the name of the experimental condition and the participant ID. In the Text Window box set the width and height of the window (800x100 small window and 800x800 big window)

Figure 6

Step 2. Shows the small window we have obtained

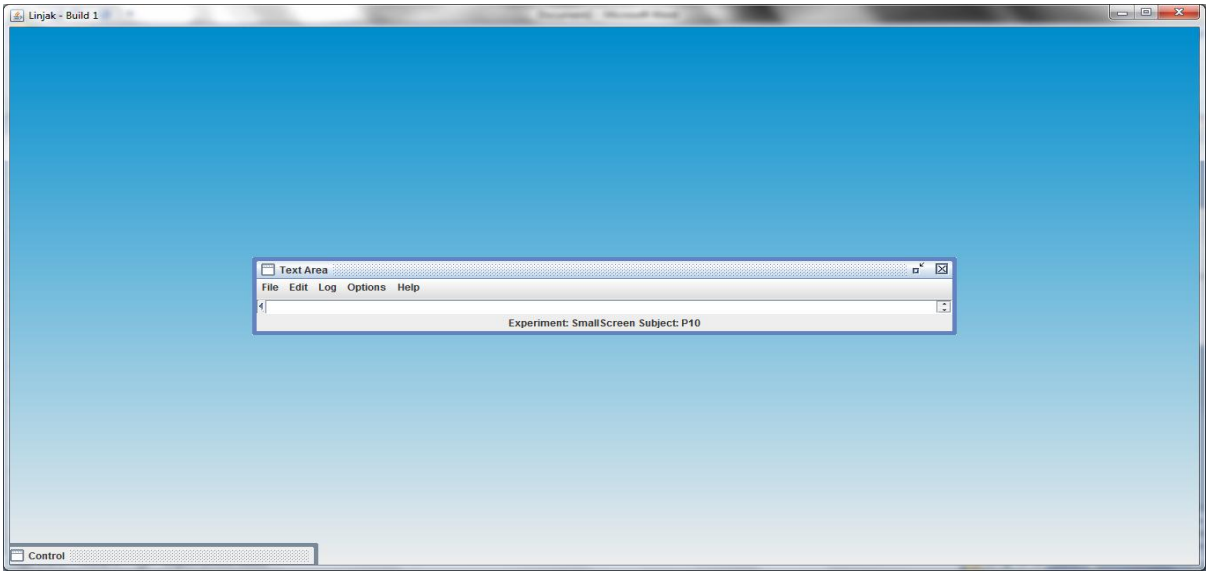

Figure 7

Step 2a. Big Window condition

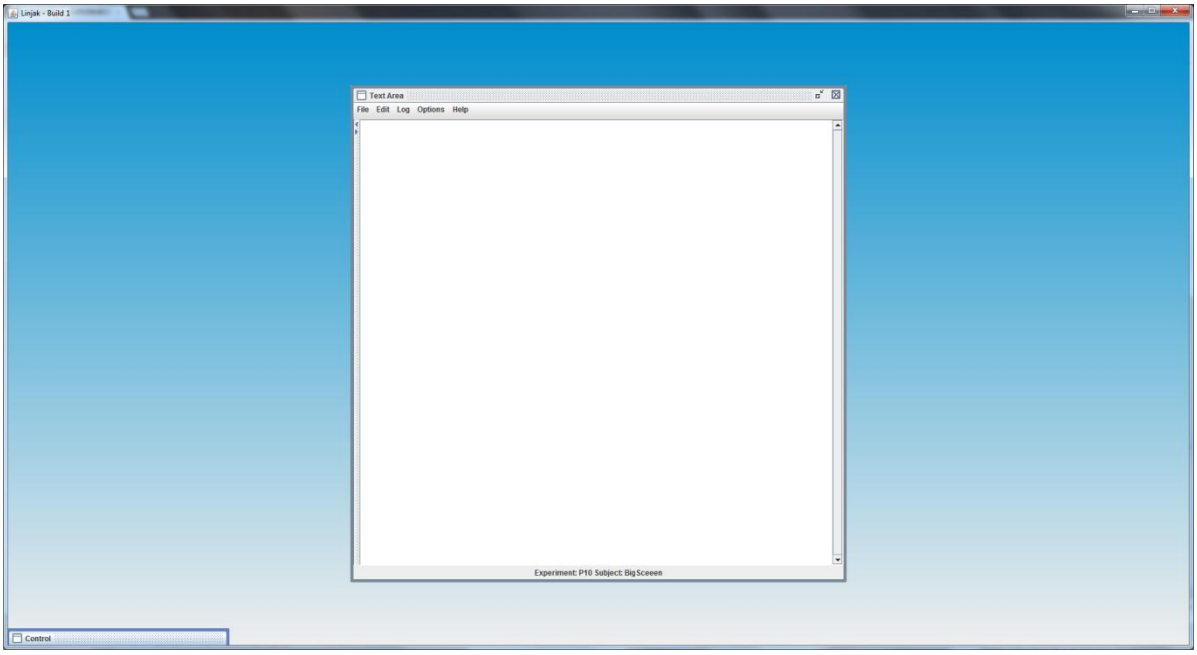

Figure 8

Step 3. In the Options functions define the Font size (in this case small size)

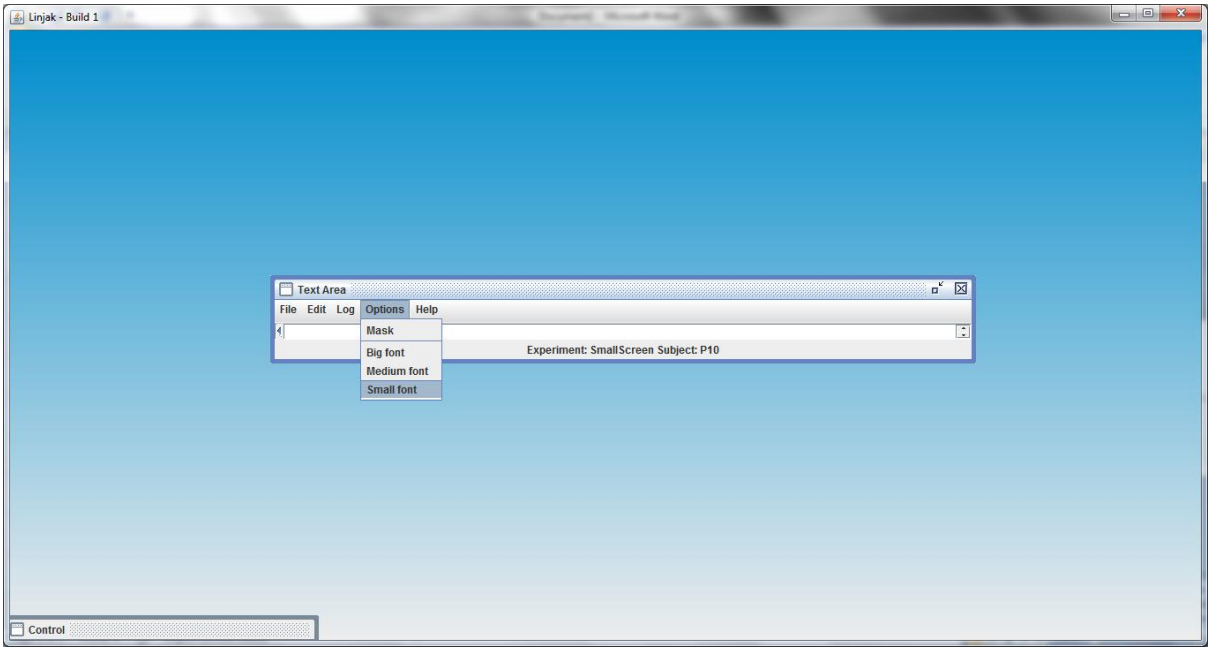

Figure 9

Step 4. Start the writing session by clicking on Start Log

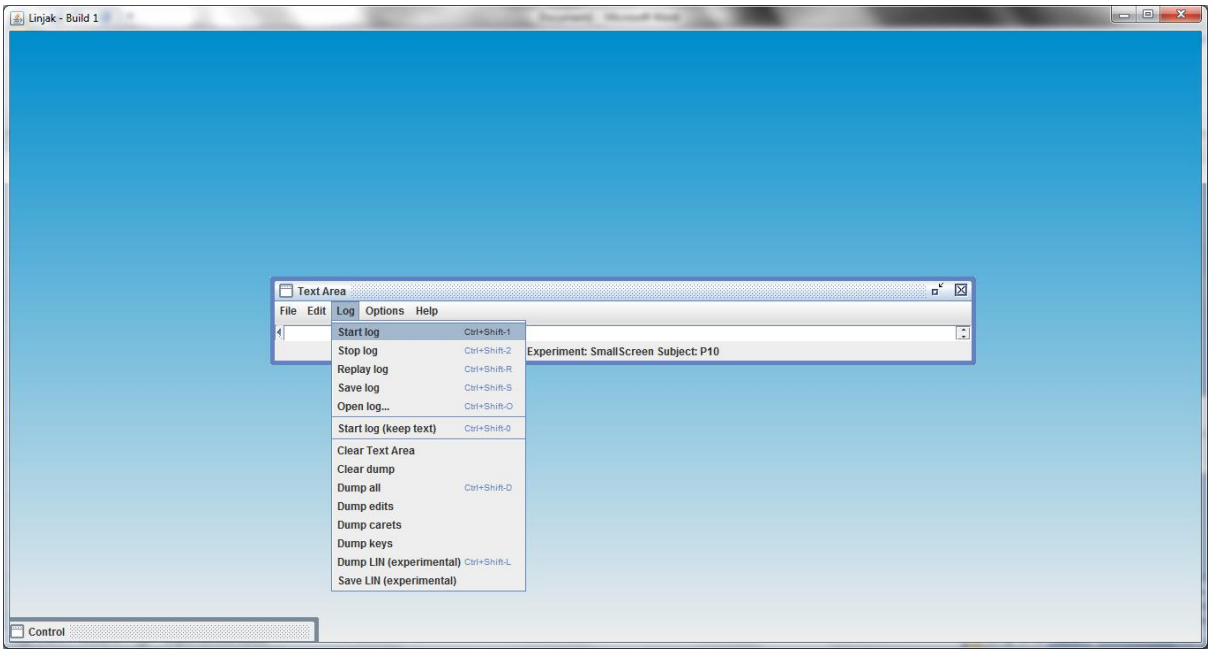

Figure 10

Step 5. Stop the writing session by clicking on Stop Log

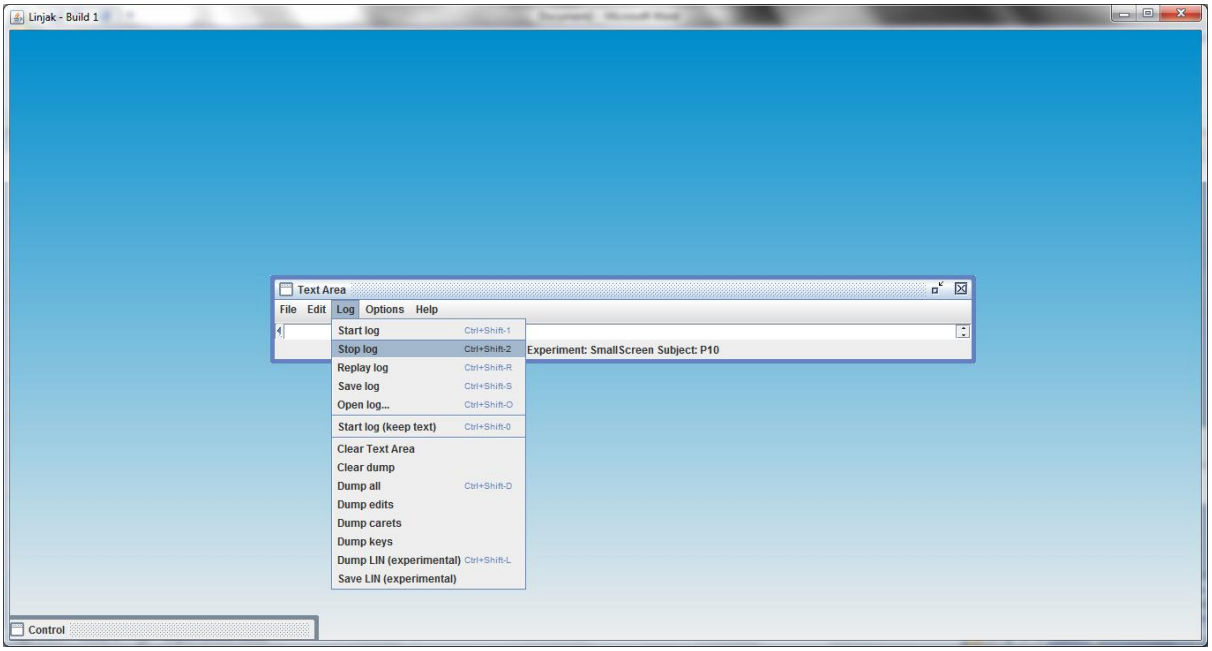

Figure 11

Step 6. Obtaining the linear file

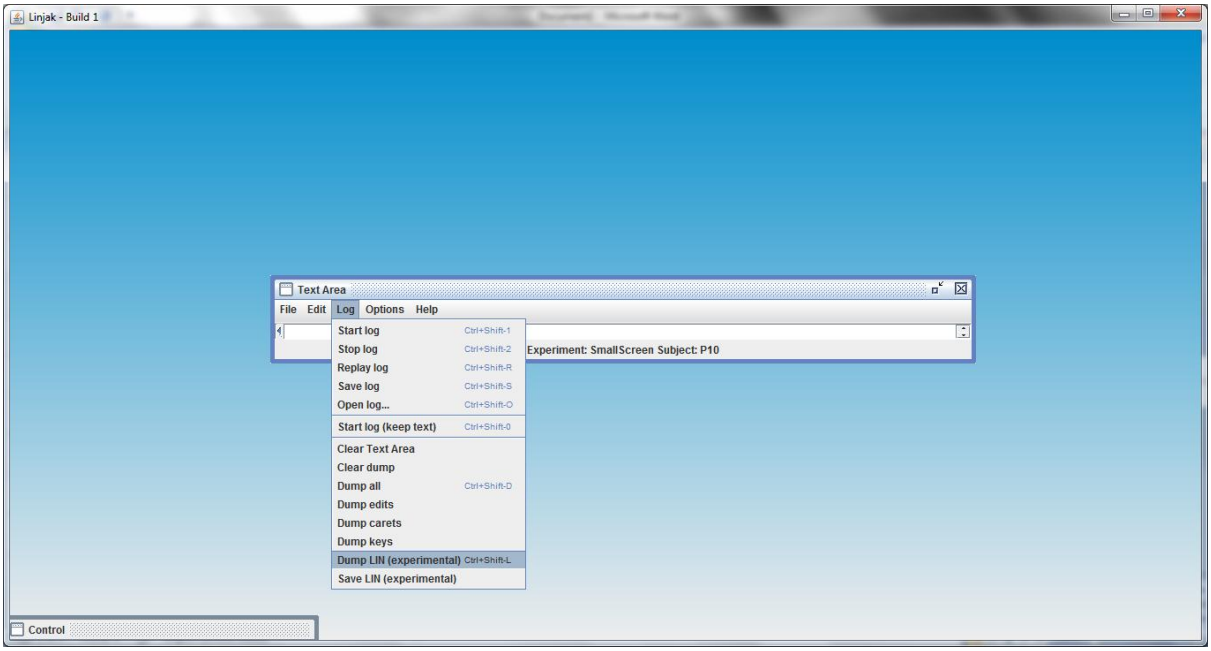

Figure 12

Step 7. Saving the linear file

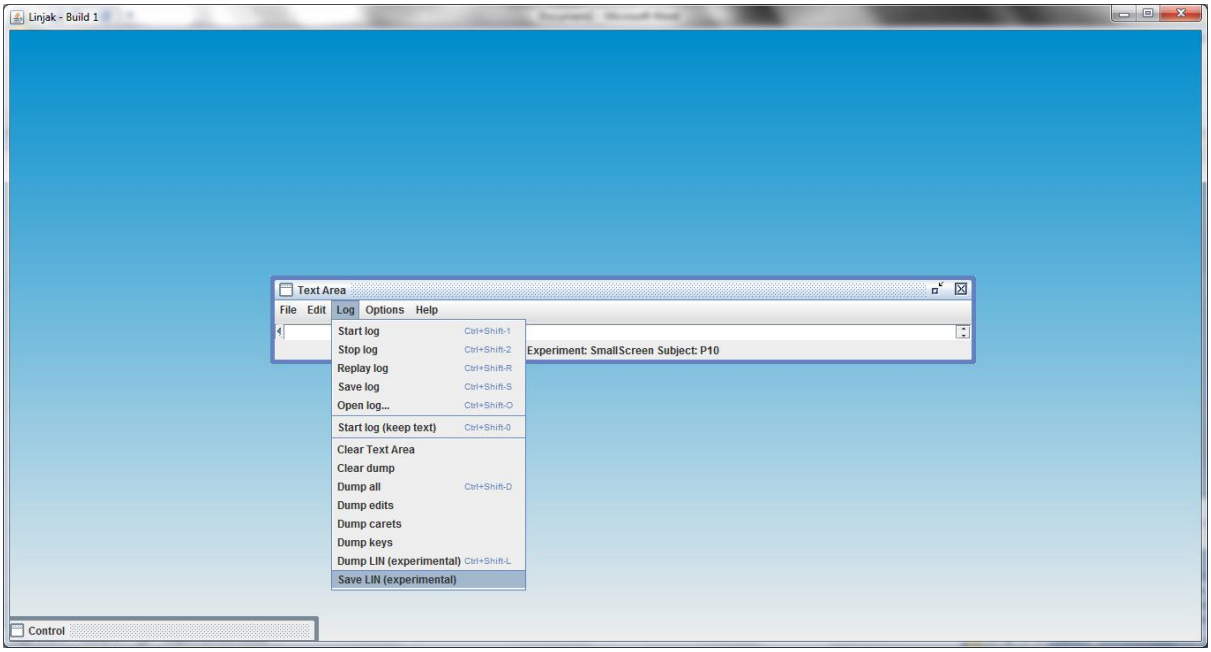

Figure 13

II An overview of functions in ScriptLog (under development)

File function

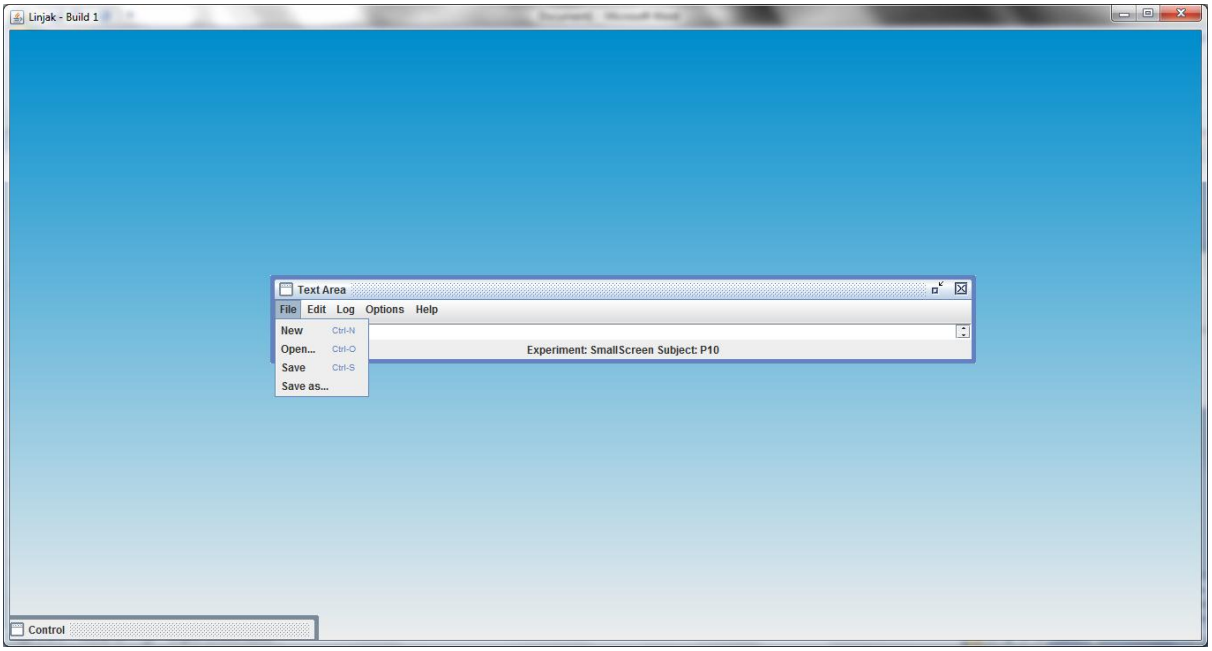

Figure 14

Edit function

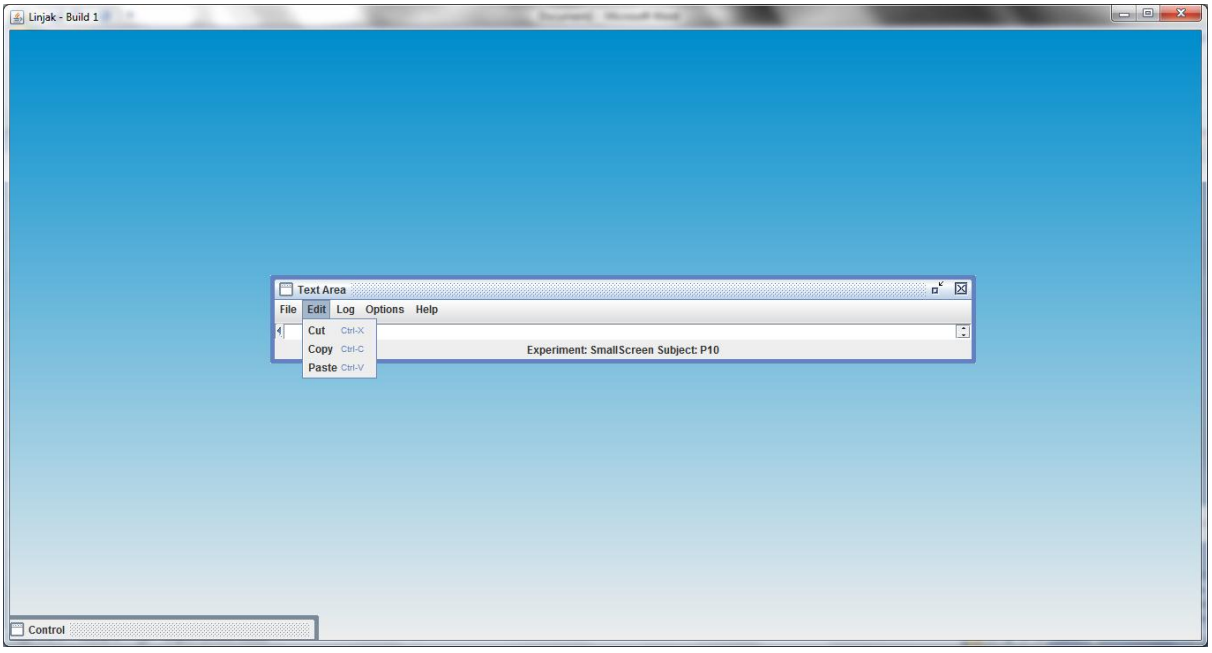

Figure 15

Log function

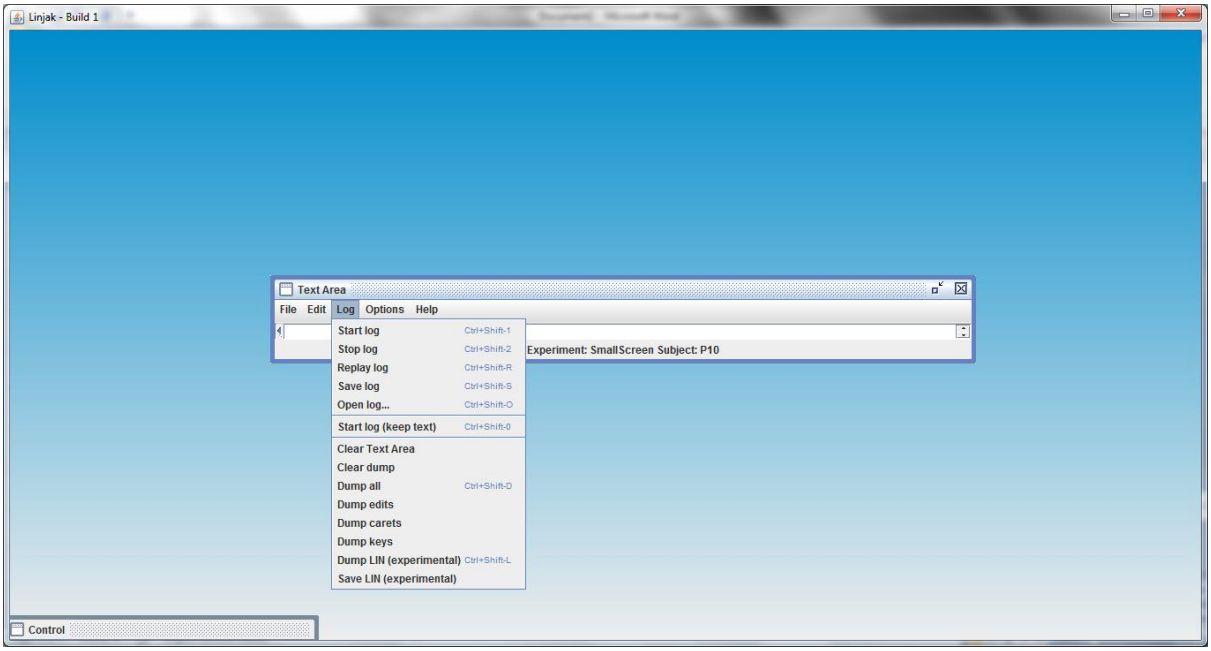

Figure 16

Options

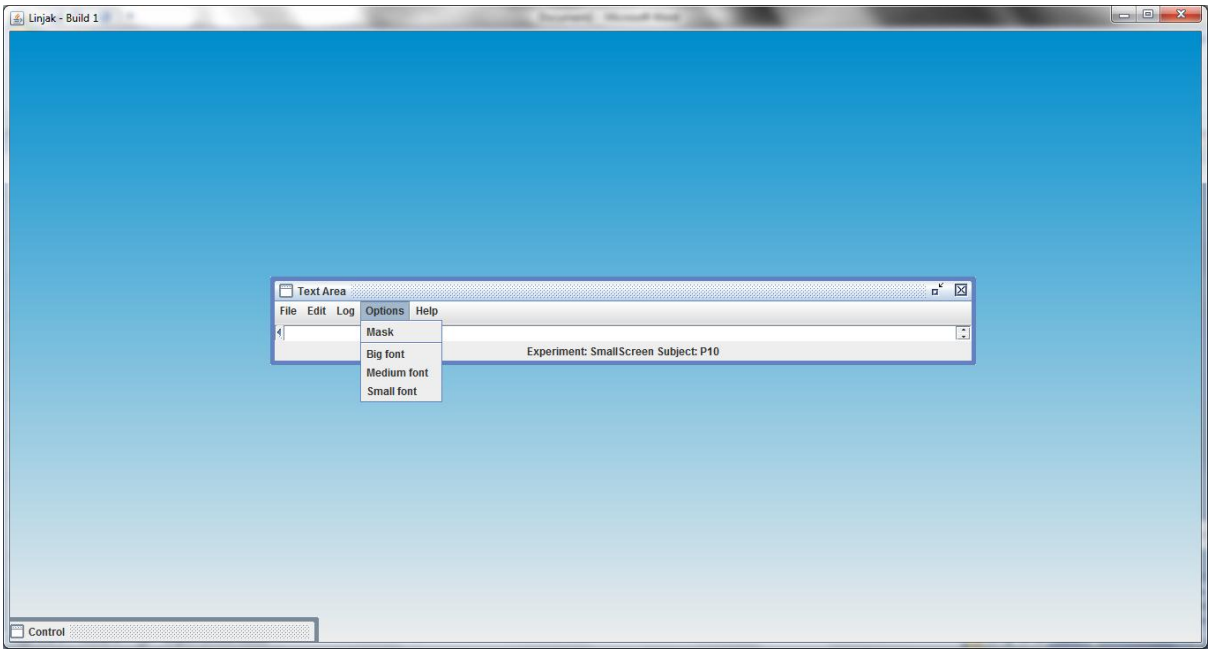

Figure 17

Help Function

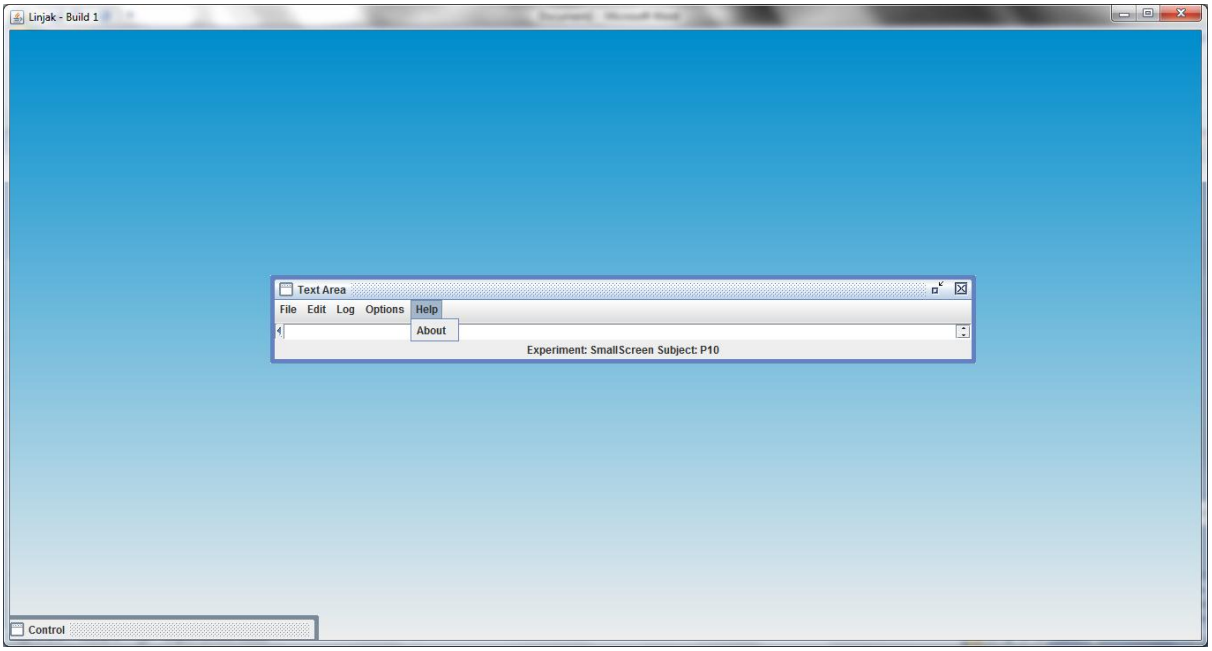

Figure 18

Appendix D Experimental protocol documentation

Vesna Mirkoska

vesnamirkoska@gmail.com

March 22, 2012

Attn:

Dr Paradis, Carita; Dr Johansson, Victoria
Centre for Languages and Literature
Lund University, Sweden

Subject: Documents for formal approval of experiment

In reference to the experiment for the purpose of the Master Thesis Project (30 ECTS): *Visual Feedback Effects on the Temporal Aspects of Argumentative Writing* to be conducted between March, 29 and April 25, 2012 in the premises of the Centre for Languages and Literature, Lund University, I hereby attach the accompanying documents for formal approval. The package contains the following attachments:

- Application for approval
- Project description
- Experimental protocol
- Written consent form

Please note that upon completion of the study, a Study closing form will be submitted.

Sincerely,

Vesna Mirkoska

Request for Approval of Human Subjects Research

INVESTIGATOR:

Vesna Mirkoska

TELEPHONE: /

STUDENT E-MAIL:
mas08vmi@student.lu.se

OTHER E-MAIL:
vesnamirkoska@gmail.com

Additional Contact Person: *(if any)*

Dr Carita Paradis
Professor
English Studies
Centre for Languages and Literature

E-mail
Carita.Paradis@englund.lu.se

Dr Victoria Johansson
Researcher, IT-pedagogue
Linguistics and Phonetics
Centre for Languages and Literature

E-mail
Victoria.Johansson@ling.lu.se

PRIMARY DEPARTMENT OR CONCENTRATION: Centre for Languages and Literature, Lund University

INVESTIGATOR STATUS (*Indicate one—Faculty, Graduate student, Post-doc, Undergraduate, Extension school student, Junior Fellow, Staff, Visiting Scholar, Other(specify))***:**

Master Student

PROJECT TITLE: *Effects of visual feedback on the temporal aspects of argumentative writing*

ANTICIPATED FUNDING SOURCE: *(add name of grant recipient for externally sponsored funding)***:**

Lund University internal funding: Department provided cinema tickets as compensation

External funding: n/a

FACULTY SPONSOR'S NAME AND EMAIL ADDRESS *(required for non-faculty applicants)*:

Supervising lecturer, instructor, or graduate student *(if applicable)*:

Dr Carita Paradis, Dr Victoria Johansson

DURATION OF ENTIRE PROJECT:

from January 2012 **to** May 2012**.**

APPROVAL REQUESTED FOR:

from March 29, 2012 **to** April 25, 2012**.**

1. Please give a brief summary of the purpose of the research in non-technical language. Be sure to include a statement of the research problem, its importance, and how your project will address it, i.e., briefly explain how your methodology will help to answer the research question(s). Cite two or three references directly relevant to the proposed inquiry.

Attached project description

2. Give details of procedures that relate to subjects' participation.

(a) <u>Subjects and Recruitment:</u>

(i) Salient characteristics of subjects--number who will participate, age range, sex, institutional affiliation, other special inclusion and exclusion criteria (*if children, prisoners or other vulnerable subjects are recruited, explain why their inclusion is necessary, append screening materials, if applicable*)**:**

14 English L2 students from the Centre of Language and Literature, Lund University will take part in the study.

(ii) How are subjects recruited? What inducement is offered? If participants are paid, what amount and when are they paid? Is there partial pay for partial completion? (*Append copy of letter, advertisement, poster, or recruitment text for online posting, if any*.**)**

Participants were addressed during regular class hours, after which a sheet was left for them to write down their e-mail addresses for further contact. Cinema tickets – equal to roughly 100 SEK were offered as inducement. Compensation with cinema tickets is more or less regular practice at the Centre for Languages in Lund University for comparatively longer and/or more demanding experiments.

(b) <u>Research Procedures:</u>

(i) What do subjects do, or what is done to them, or what information is gathered? Is there is an online component to your project, such as web-based surveys? (*Append copies of instructions, tests, questionnaires, or interview guides to be used. If applicable, include a link to the web-based survey.***)**

Attached: Consent form, Experimental Protocol

(ii) How many times will interviews, observations, tests, etc., be conducted? How long will their participation take? (*Describe in terms of what the subject will experience.***)**

Subjects will come 2 times in the lab. First they will watch a 10-minute clip and then they will write for 30 minutes. For more details please see the attached Experimental protocol.

(iii) Are subjects to be:

AUDIO recorded: ☐ tape ☐ digital

VIDEO recorded: ☐ tape ☐ digital

3. Describe how permission has been obtained from cooperating institution(s)--school, hospital, corporation, prison, or other relevant organisation. *(Append letters.)*

n/a

4. Describe your research experience and your research ethics training.

(a) Cite your experience with this kind of research and/or this population.

Executed two 2 separate linguistic experiments comprising 40 subjects in total. Experiments were conducted during 2011-2012

(b) Provide the names of everyone working with human subjects and/or their identifiable data and human subjects training.

Names of people working on this project	Role	Human Subjects Training
Investigator		
		Select
Others		
		Select

(c) Describe experience and role(s) of others:

n/a

5. How do you inform subjects about your research and then obtain their consent?

(a) Do subjects sign a written consent form and receive a copy for their records? If not, do they receive an information sheet that provides what they need to know before deciding to participate? (*In addition to answering parts a. – e., append a copy of consent form, information sheet, or script for oral explanation to subject.*)

Subjects sign the consent form and receive a copy

(b) Where (*In a lab? Online?***) , when (***immediately before participation, e.g.***), and by whom (anyone other than investigator?) is consent obtained?**

Immediately before the experimental session

(c) Are subjects children, mentally infirm, or otherwise not legally competent to consent? If so, how is their assent obtained, and who consents on their behalf?

n/a

(d) If subjects are vulnerable due, e.g., to legal status, economic status, illiteracy, or other circumstance, describe steps to minimize the risk of coercion or undue influence. Include in your answer how you ensure subjects understand that participation is voluntary.

n/a

(e) Is there any language barrier that could affect the consent process (*your explanation of the research and the subject's agreement to participate***)?**

n/a

6. Give details of possible risks of harm to participants.

(a) What are the possible risks—physical, psychological, legal, social?

There are no risks attached to the study

(b) If there are any risks, why are they necessary? Is there any other way to conduct the research that would reduce the risk to subjects, and, if so, why have you not chosen that alternative?

n/a

(c) What steps will be taken to minimize the risk? (*If the research may involve greater than minimal risk to participants, describe provisions for monitoring data to ensure participant safety.***)**

n/a

(d) Should a subject be injured or otherwise harmed, or experience significant distress, what are your plans for addressing the problem? *(e.g., emergency care training for lab staff if physical harm is a risk; referral for evaluation or treatment if there are significant psychological risks)*

n/a

If risks are anticipated to be no more than minimal, please state so here and in the consent form, if used.

There are no risks attached to the study

7. Are subjects deliberately deceived in any way? If so, what is the nature of the deception? Is it likely to be significant to subjects? Is there any other way to conduct the research that would not involve deception, and, if so, why have you not chosen that alternative? What explanation for the deception do you give to subjects following their participation?

n/a

8. How will participation in this research benefit subjects? If subjects will be debriefed or receive information about the research project following its conclusion, how do you ensure the educational value of the process? *(Append copies of any debriefing or educational materials.)*

To be supplied upon project completion

9. How are confidentiality and/or anonymity assured? For online studies, will IP addresses or other potentially identifying information be collected? What host site will be used *(i.e. SurveyMonkey, iCommons, etc.)***? Will identifiers be removed from the data? If so, at what point, and if not, please explain why identifiers must be retained.**

n/a

10. How is the privacy of subjects protected? (*e.g., are questions tailored to the research question so subjects are not asked to provide unnecessary information?*)

Texts will be coded and all names connected with the codes destroyed after data analysis

11. Will research data (*written or otherwise recorded*) **be destroyed at the end of the study? If not, where and in what format and for how long will they be stored? To what uses--research, demonstration, public performance, archiving--might they be put in future? How will subjects' permission for further use of their data be obtained? If there is a key code connecting subjects' data to their identity, when will the link be destroyed?** *(Include this information in the consent form, information sheet, or consent script.)*

Texts will be coded and all names connected with the codes destroyed after data analysis

12. Do you and/or any other investigators associated with the project described in this application have, or appear to have, any actual or potential conflict of interest with respect to this research?

☐ **Yes** ☒ **No**

By submitting this application, I certify that the study has been adequately designed to protect human subjects.

APPLICANT'S SIGNATURE: _____

DATE:

I have reviewed this completed application and I am satisfied with the adequacy of the proposed research design and the measures proposed for the protection of human subjects.

FACULTY SPONSOR'S SIGNATURE:

Dr Carita Paradis **Dr Victoria Johansson**

_____ **_____**

ATTACHMENTS:

☒ Project description

☒ Experimental protocol

☒ Written consent form

EFFECTS OF VISUAL FEEDBACK ON THE TEMPORAL ASPECTS OF ARGUMENTATIVE WRITING

Project Description

Vesna Mirkoska
March 10, 2012

Purpose:

This study explores the effect of visual feedback in the production of argumentative text in English L2 writers. The effect is measured through pause duration, pause frequency and pause distribution. Data are extracted online using ScriptLog, a keystroke logging programme.

Materials:

A 10-minute documentary will be shown per session (two different clips) after which a related writing task will take place. The task is to produce an argumentative text considering both arguments and counter-arguments.

Methods:

14 participants will be subjected to two conditions of the independent variable (visual feedback). The two sessions will be organized with the same protocol but under different condition of the independent variable (with and without visual feedback). In addition, participants will be completely counterbalanced to control for order. Subjects will first watch a short documentary for 10 minutes and write an argumentative text for 30 minutes. To measure the visual feedback effect, if any, pause duration, frequency and distribution, constituting the dependent variable will be recorded in ScriptLog for both conditions.

Data Interpretation:

Texts will be coded on a meta-textual, textual and syntactic level. The t Test for correlated samples will be performed. If the final product of both conditions differs in terms of pause duration, frequency and distribution, it may be concluded that visual feedback has an effect on writing.

References:

Nussbaum, Michael E. & Gregory Schraw. 2007. Promoting argument-counterargument integration in students' writing. *The Journal of Experimental Education* 76:59-92.

Olive, Thierry & Annie Piolat. 2002. Suppressing visual feedback in written composition: Effects on processing demands and coordination of the writing processes. *International Journal of Psychology* 37(4):209-218.

Experimental Protocol

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14
Session RESTRICTED	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Session NORMAL	x	x	x	x	x	x	x	x	x	x	x	x	x	x

□ Arrive 45 minutes before start of session

□ Switch on lights and computers

□ Switch master computer

□ Start ScriptLog on each PC (start-den här datorn-Gu-Human.lab-NyaScriptlog)

□ Set up window □□800-100 OR □□800-600 □□□□Font SMALL

□ Click on the arrows to the left to normalize window

□ Set up PARTICIPANT ID (Options-Set names-SmallWindow (BigWindow)-P1…

□ Put a piece of paper with participant name on it on the desk

□ Switch on projector (power)
□ Load and Check the documentary sound

□ Put blank screen

□ Take copies of Consent Forms and leave one on each desk

□ Wait for participants

□ Welcome them and hand out consent forms

□ Collect forms and thank students

□ Read the general instructions

1. Dear all, welcome and thank you for taking part in this experiment. For this experiment you will be granted a cinema ticket. I hope you already feel comfortable so I think we can start. The experiment has two parts. First we are going to watch a short documentary for 10 minutes and then we will write for 30 minutes. When we come to the writing part I will give you instructions.

□ Play the documentary (I SESSION START 1.00 min till 11.16-II SESSION START 00.till 11)

2. Before we start with the writing part, I have to tell you that the programme you are writing on looks differently than Word but has the same functions embedded, so you can use it as any other word doc. (The window you will see is very small) You can also use arrows to see what you have written also. I will start and stop the sessions for you.

3.Do you have any questions before we begin? If you don't we can start.

□ Show the prompt AND give specific instructions for the task

You have just watched a video that discusses the possibility of medicine extending our lives. You might have noticed that the arguments were mainly one sided. But for our task, I would like you to write a text on the following topic:

Write an essay discussing arguments for and against prolonging human life

II SESSION

□ Repeat general instructions with modifications below

You have just watched a video that discusses the consequences of having too many people on our planet. You might have noticed that the arguments were mainly one sided. But for our task, I would like you to write a text on the following topic:

Write an essay discussing arguments for and against controlling human population growth/birth rates

□ Ask if there are questions

□ Inform them that they may begin

□ Writing session 30 minutes

□ Send out demographic form

□ Keep time and notify subjects 5 minutes before end of session

□ Notify subjects that the session has finished

□ Remind them not to switch off anything

□ Stop the session for each participant

□ Debrief participants, thank participants and mention the procedure for next time

When you come again for the II session, we will follow the same procedure with one small difference that I will explain tomorrow.

□ Collect and save data from the files (data saved in My Documents-ScriptLogWD)

□ Switch off projector, computers, lights, check the room, lock and leave premises
□ Session completed

Thinking processes in writing
Vesna Mirkoska
Centre for Language and Literature
Thesis project (30 ECTS)
March 10, 2012

Please consider this information carefully before deciding whether or not to participate in this research.

Purpose of the research:

To examine thinking processes during writing.

What you will do in this research:

You will first watch a documentary for ~10 minutes. Then, you will be asked to write a text on a related topic.

Time required:

Please note that you will be required to write on 2 separate occasions. Participation will take approximately 45 minutes per session to complete. ~10 minutes will be allocated to the video clip and 30 minutes to the writing session.

Risks:

There are no risks associated with participating in this study.

Benefits:

At the end of the study, I will provide a thorough explanation of the study and of the hypotheses. I will describe the potential implications of the results both if the hypotheses are confirmed and if they are disconfirmed. In addition, you will have the opportunity to become familiar with reasoning skills required in academic environments. If you wish, you can send an email message to Vesna Mirkoska (vesnamirkoska@gmail.com) and I will send you a copy of any manuscripts based on the research (or summaries of the results).

Compensation:

You will receive a cinema ticket for participating in this study.

Confidentiality:

Your participation in this study will remain confidential, and your identity will not be stored with your data. Your responses will be assigned a code number, and the list connecting your name with this number will be stored safely and will be destroyed once all data have been collected and analysed.

Participation and withdrawal:

Your participation in this study is completely voluntary, and you may withdraw at any time.

Contact:

If you have questions about this research, please contact Vesna Mirkoska, (vesnamirkoska@gmail.com). You may also contact the faculty member supervising this work: Dr Carita Paradis, (Carita.Paradis@englund.lu.se) and Dr Victoria Johansson, (victoria.johansson@ling.lu.se).

Agreement:

I UNDERSTAND THE NATURE AND PURPOSE OF THIS RESEARCH AND I AGREE TO PARTICIPATE IN THIS STUDY. I UNDERSTAND THAT I AM FREE TO WITHDRAW AT ANY TIME.

Participant Signature: _____ Date: _____

Name (print): _____

Researcher's Signature: _____ Date: _____

Appendix E Study closing form

FROM: Vesna Mirkoska, Master student 120hp, English Linguistics, Lund University

TELEPHONE: /

EMAIL: vesnamirkoska@gmail.com

PROJECT TITLE: Effects of visual feedback on the temporal aspects of writing

---

1. How many subjects completed participation in the study? Fourteen (14) + (1 pilot study)

How many withdrew since the last report? None

Provide the reason(s) for withdrawal. n/a

2. Please provide a brief summary of the findings of your study.

Results of the paired t-test(s) show that when visual feedback is restricted frequency and duration scores for pauses at movement locations increase significantly. At editing locations, however, frequency and duration scores significantly decrease. Second, writers spend significantly less pause time in the introductory part but pause more while they produce arguments against. Third, results indicate that frequency scores are significantly higher at clause final and phrase internal locations when visual feedback is restricted. Finally, while fluency remains more or less constant between the two conditions, participants waste fewer characters in the restricted feedback condition. To conclude, manipulating visual feedback alters the temporal aspects of L2 writing.

3. Expenditures report

In total, 15 cinema tickets were used for the study. The pilot study participant received 1 ticket and the remaining 14 tickets were distributed to the participants in the experiment.