

# Writing Processes with Word Processors

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## Abstract

In this study writing processes, performed using Word processing software, are portrayed and compared to theories dealing with pen-and-paper writing. The writing processes of 40 female university students were logged and recorded. Dividing the processes into writing phases and hierarchically clustering writing patterns we find that writing with Word processors involves processes which are both common to pen-and-paper writing and unique to the computerized environment. Word processed writing can still be characterized as a recursive activity in which planning is dominant in its initial stages and revision in its final stages, nevertheless, after an intensive early planning stage, it also involves simultaneous micro planning-translating-reviewing phases throughout the writing process. In addition, much of the revision performed is an editing of language errors immediately following the completion of words. Although such writing behavior is considered characteristic of novice writers, this was not apparent in the written products. Questions therefore arise regarding the compensative nature of the computerized writing tool.

**Keywords:** Cognition; Writing; Word processors.

## Introduction

In this study writing processes, performed using Word processing software, are portrayed. Although several models attempt to portray the cognitive activities involved in pen-and-paper writing (Bereiter & Scardamalia, 1987; Hayes, 1996; Hayes & Flower, 1980; Kellogg, 1996; Nold, 1981), few studies systematically deal with the analysis of full writing processes with computers. The various writing models differ in their explanations of the constraints and mental processes involved, yet they all describe writing as recursively engaging in three procedures, introduced by Hayes and Flower:

- a. Planning - a phase in which the content, the procedures and the design of the text are chosen and retrieved from memory.
- b. Translating - the transition from a mental plan of the text to a physical representation using written language.
- c. Reviewing – a rereading and rewriting phase, aimed to improve language, meaning and appropriateness of the text.

These stages are not linear, nevertheless, most of the planning is conducted prior to the translating and much of the reviewing is done after a substantial amount of writing (Flower & Hayes, 1980). In fact, writing in this order (i.e. planning first, reviewing last) is considered an important factor in "good" writing and distinguishes experts from novices (Bereiter & Scardamalia, 1987).

It is evident that writers engage in a different process when word processing. While planning is considered a crucial phase, Haas (1996) found that children writing with Word processors engaged in less planning and that it was more sequential and less conceptual. Similarly, drafts composed when Word processing were of less quality (Bernhardt, Edwards, & Wojahn, 1989). Nevertheless, this does not result in a decrease in the quality of products (Bangert-Drowns, 1993; Goldberg, Russell & Cook, 2003; Graham & Perin, 2007). While planning is limited, drafts are constantly reread (Haas, 1996) and the writing is inductive and performed systematically using bottom-up strategies (Bernhardt, Edwards, & Wojahn, 1989).

Revision behavior using a Word processor is also different than in pen-and paper writing. Since little initial planning is conducted and because of the easiness of editing, more revision is done and more drafts are written. In addition, revision in various levels (for example editing versus changes in meaning), is performed all through the writing process (Owston, Murphy, & Wideman, 1992). Nevertheless, there is disagreement among researchers regarding the type and quality of revision performed. Researchers have related the type and quality of revisions mainly to the writers' ability and habits, rather than to the writing environment (Hawisher, 1987; Hartley, 2007; Hartley, Howe & McKeachie, 2001; Hill, Wallace & Haas, 1991; Witte, 1987).

## **Method**

The following study is part of a larger scale research in which various forms of writing sessions on computers were monitored aimed to portray substantial computerized writing processes. In order to do so, recorded writing sessions on the computer were conducted.

## **Participants**

Participants are 40 university students studying in an introductory psychology course that volunteered and consented to participate in a writing study. All students were female, native speakers of Hebrew, and were skilled users of MS-Word 2003 software.

## **Procedure**

Students were asked to write either a persuasion or a pro-con essay on a given topic. Essays were required to be about a page long and students had papers for writing drafts, pencils and pens, texts dealing with the issues, the internet and a printer at their disposal. Writing sessions were recorded and were logged using the software Inputlog (Leijten & Van Waes, 2006). In all groups the researcher took notes of behaviors which are not monitored by the key-logger and recorder as which texts were read and other non-verbal behaviors. The writing session ended when the participant stated that she finished.

## **Analysis of protocols**

Words and other keys and mouse movements were analyzed according to the writing process components introduced by Hayes and Flower (e.g Hayes & Flower, 1980):

1. Planning – a pause of 1 second and above was classified as planning if text production had followed the pause. This time duration was chosen with reference to studies which found that pauses around this length of time and up, within the sentence boundary, indicate some form of disfluency in writing (e.g. Schilperoord, 1996).
2. Translating / formulating / text generation - any typing activity was classified as translating.
3. Reviewing / text interpreting – any activity conducted on text previously generated. Such activity includes reading of the texts (movement in the text), changes in the text, or formatting.

Reliability of the encoding process was examined using a repeated measure technique (analyzing protocols three times with a week interval) with few discrepancies found (0.45% in the coding of the three main processes). There are questions regarding the validity of this analysis, since such categorization involves inference and overgeneralization. Nevertheless, this categorization may offer a valuable picture regarding the nature of computerized writing activities including an accurate report of the writers' use of the Word processor.

### **Analysis of products**

Drafts were analyzed based on Cooper and Matsuhashi (1983), counting statements referring to the objectives of writing, to its structure and content. Essays were analyzed based on Nathan's (2004) grading elements which refers to the argumentative and rhetorical structure and language of the essays and to mechanical aspects. This was conducted by two referees, first separately and thereafter jointly reassessing texts in which discrepancies were found.

### **Statistical Analysis**

In order to examine writing patterns, the writing process (encoded into planning, translating and reviewing processes) was divided into writing phases and into writer patterns. To do so, time durations were transformed into proportions of time on each process, assuming that writers undergo similar stages in the writing although they may differ in their writing pace (Hayes & Flower, 1980). This was found true in this study when relating to the engagement patterns in the sub-processes and since no significant correlations were found between time on task and the quality of the essay or its length. Since different group sizes were anticipated, Ward's hierarchical cluster analysis with squared Euclidean distances was conducted (McQuitty, 1966) using PSAW version 17 software. Thereafter, a trial and error phase was conducted in which different time divisions and sub-grouping numbers were explored. Distinct clusters were found when dividing the writing process into 6 phases and forcing 3 to 6 cluster of cases. One-way analysis of variance (ANOVA) was used to determine whether the clusters were significantly different in quality measures.

### **Findings**

Although writers considerably differed from each other and engaged differently in the three writing activities throughout the process, several generalizations can be made: A prolonged planning stage was done at the beginning of the writing session. At that stage all writers read the resources offered on the topic and 9 searched the web for additional information. 23 writers wrote statements on paper (a draft) although mainly to off-load facts read in the texts and not to plan the essay's purpose, structure or content. Two wrote a comprehensive draft before starting writing. Following this stage, writers tended to simultaneously engage in planning, translating and reviewing processes, with less planning and more revision time throughout the process. The most common revision activities were the editing of micro-units as words and sentences (49% of activities). Towards the end of the process writers reviewed the text as a whole although continuing to make mainly micro-changes (mainly editing for language conventions). One student printed the text but did not follow this with a review of the printout.

Writing sessions ranged from 1089.6 to 5475.6 seconds ( $M=3134.07$ ,  $SD=1014.63$  – just over 52 minutes). For a division of the sub-process among the 6 phases of writing (each 522.35 seconds) see table 1.

**Table 1. Proportion of time spent on each process throughout the process (SD) n=40**

	Planning	Translating	Reviewing
Phase 1	0.85 (0.15)	0.09 (0.09)	0.07 (0.08)
Phase 2	0.58 (0.23)	0.23 (0.14)	0.19 (0.13)
Phase 3	0.51 (0.19)	0.26 (0.14)	0.23 (0.14)
Phase 4	0.42 (0.17)	0.30 (0.13)	0.28 (0.15)
Phase 5	0.38 (0.15)	0.29 (0.13)	0.33 (0.20)
Phase 6	0.22 (0.11)	0.25 (0.11)	0.53 (0.16)

Generally, writers engaged in planning activities during 49% (M=1537.15, SD=606.25 seconds), in translating (typing) 24% (M=708.63, SD=270.72 seconds) and in reviewing 27% (M=888.29, SD=487.53 seconds) of the process. Seeking writing patterns, four major clusters emerged (see table 2) describing different division among the sub-processes. No statistically significant differences were found between groups with relation to the quality of the essay (M=13.10, SD=2.99).

**Table 2. Proportion and mean time spent on each process and composition grade (SD)**

	Planning		Translating		Reviewing		Grade (NS)
	Pro.	seconds	Pro.	seconds	Pro.	seconds	
Group 1 (n=20)	0.56 (0.10)	1673.04 (706.18)	0.22 (0.06)	644.42 (226.33)	0.21 (0.06)	628.78 (238.81)	13.15 (3.01)
Group 2 (n=10)	0.47 (0.07)	1624.42 (378.94)	0.19 (0.06)	667.06 (188.76)	0.33 (0.03)	1143.04 (289.99)	13.5 (3.41)
Group 3 (n=4)	0.40 (0.05)	792.22 (306.01)	0.40 (0.05)	768.28 (188.76)	0.20 (0.08)	407.20 (238.26)	12.25 (2.63)
Group 4 (n=6)	0.41 (0.09)	1435.35 (606.25)	0.21 (0.07)	952.19 (393.30)	0.38 (0.08)	1649.46 (412.72)	12.83 (2.99)

The writers in group 1 (half of the sample) spent most of their time planning. Viewing the cases along the six phases we see that many of them engaged in planning throughout the process, with longer periods of planning at the beginning of session but also throughout the process. Writers in groups 2 and 4 reviewed about a third of their writing time, engaging in formatting and editing starting from early stages of the process (especially writers from group 4), and stopping to edit (mainly to correct language and style) while writing. After a planning period, writers from group 3 mainly engaged in translating tending to stop writing for reviewing and planning after meaningful boundaries as sentences and paragraphs. With the exception of one writer (from group 4), in all groups there was an extensive planning period at the beginning and thereafter simultaneous engagement in the three sub-processes.

## Discussion

Findings indicate that writing with Word processors involves processes which are both common to pen-and-paper writing and unique to the computerized environment. Word processed writing can still be characterized as a recursive activity in which planning is dominant in its initial stages and revision in its final stages (Hayes & Flower, 1980). Nevertheless, after an intensive

early planning stage, it also involves simultaneous planning-translating-reviewing phases throughout the writing process.

The need for continuous planning can be due to the fact that during initial stages, few writers prepared a global draft of their essay but rather most jotted down facts they wanted to use, and others started writing with no drafting altogether; behavior apparent in other studies (e.g. Bernhardt, Edwards, & Wojahn, 1989, Haas, 1996; Hartley, Howe & McKeachie, 2001). Thus, writing was conducted in an inductive manner - the writers producing chunks of text (as sentences and paragraphs), reading and reviewing them and planning a continuation. In addition, while many of the writers read throughout the text at the final stages of the process, most of the changes were editing actions within the sentence barrier. In parallel, many edited the text while it was produced, often after a word was flagged by the speller. This was seen in other studies in which half of spelling errors were corrected following writing the word (Rodriguez & Diaz, 2007). In summary, writers tended not to globally plan their text or make meaningful revisions but rather engage in micro-planning and micro-editing episodes. The recursive nature of writing is therefore evident when relating to the text as a whole but even more so in micro-units as paragraphs, sentences and even words.

While in pen-and-paper studies such behavior was characteristic of novice writers (Bereiter & Scardamalia, 1987) since attention to language and surface changes were found to inhibit higher order generating and organizing processes (Schoonen et al., 2003; Whalen & Me´nard, 1995), in this study, different writing activities were not connected to performance. This raises questions regarding a compensative nature of the tool which encourages continuous planning and revision resulting in a satisfactory product.

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