

# Read and think before you write: Prewriting time and level of print exposure as factors in writing and revision

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**Abstract:** This study investigated situational and writer characteristics that influence the revision process. Thirty-four students who scored high on print exposure and 32 students who scored low on print exposure had 10 or 70 seconds to think about each of 2 prompts before beginning to write (prewriting time) the essays on a computer. A keystroke-logging program captured writing and editing behavior, including pauses, edits (deletions, substitutions, insertions), and prompt reviews. Quality was measured using an 8-factor, 3-point analytic scoring rubric. Results indicated that high print exposure students wrote longer and higher quality essays than low print exposure students. In addition, the short prewriting time increased prompt reviewing and average pause lengths. High and low print exposure writers showed differential responses to the prewriting time manipulation in terms of total pause-associated edits during writing. The complexity of the revision process and the importance of understanding multiple immediate variables in the writing situation are discussed.

**Keywords:** prewriting, revision, print exposure, planning time, self-editing



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Research on the writing and revision process suggests that writing is dynamic, exceptionally recursive, and highly individual (Hayes, 2004; Hayes & Flower, 1986; Kowal & O'Connell, 1987), making it difficult to adequately characterize a singular writing profile. Some researchers have attempted to describe profiles of writers based on patterns seen in writing and revising processes (e.g., Severinson Eklundh, 1994; Van Waes & Schellens, 2003), but these processes can be affected by a number of variables. For example, computer-based composition may produce more revision than pen-and-paper composition (Daiute, 1984; Rau & Sebrechts, 1996) or at least different types or distribution of revision (Daiute, 1986; Van Waes & Schellens, 2003). And persuasive or argumentative writing, versus reporting or narrative, is associated with more revisions and pauses or more diversity in their length and distribution (Glynn, Britton, Muth, & Dogan, 1982; Matsuhashi, 1987; Severinson Eklundh, 1994). Simply providing instructions to revise can alter the amount and types of revision (Wallace & Hayes, 1991; Wallace, et al., 1996), and providing opportunities for planning or outlining may change revision as well (Rau & Sebrechts, 1996). Indeed, myriad factors may impact the writing and revision process, including related tasks.

Reading and writing are inextricably linked (Galda, 1984; Nystrand, 1982; Ransdell & Levy, 1996; Snow, Burns, & Griffin, 1998; Thompson, 1998), which is clearly illustrated in the concept of literacy. At the colloquial level, literacy often is defined simply as the ability both to read and to write, yet technically, the concept implies a much broader class of abilities (Gottfredson, 1997; Snow et al., 1998). Self-editing processes are included explicitly among skills of literacy development. For example, the National Research Council advises that children should start exhibiting, and parents and teachers should start encouraging, rudimentary revising of their own work as early as first or second grade (Snow et al., 1998). Moreover, it is often assumed that fluency in one area of language (e.g., reading) is met by fluency in other areas of language (e.g., writing; Galda, 1984; Thompson, 1998).

Research confirms that reading and writing (and speaking) are strongly connected and share some overlapping skills, abilities, and knowledge bases (see Fitzgerald & Shanahan, 2000). Yet skills in one area do not fully account for the other; thus, they are recognized as separate but interacting processes (Fitzgerald & Shanahan, 2000; Shanahan, 1984). It is proposed, however, that reading and writing can and do affect each other. For example, Shanahan and Lomax (1986) advocate the interactive model of the reading-writing relationship, wherein at the most general level, learning skills in one mode can facilitate learning similar or related skills in the other mode. Although research on the relationship between reading and writing has gained traction in recent years, consideration of general reading experience as a factor in studies of writing and revision has not been a research focus.

An individual's history of reading experience is often referred to simply as print exposure, and amounts of print exposure vary tremendously across a population, even within a generally literate culture (Anderson, Wilson, & Fielding, 1988; Snow et al., 1998). Validly and reliably measuring an individual's exposure to print has not been an

easy task. Stanovich and his colleagues devised a measure of print exposure that has proven more reliable and valid than traditional print exposure measures (see Stanovich, 2000). Their assessment of print exposure consists of deceptively simple checklists, for example, of authors' names (Author Recognition Test) and magazine titles (Magazine Recognition Test). In brief, the checklists include real authors or titles intermixed with a number of foils, allowing a correction for guessing. As an experience-based measure, print exposure has been found to be related to several reading and writing relevant behaviors, such as reading comprehension (Cipielewski & Stanovich, 1992; Landi, 2010; McBride-Chang, Manis, Seidenberg, Custodio, & Doi, 1993; Spear-Swerling, Brucker, & Alfano, 2010), word recognition (Chateau & Jared, 2000; Cunningham & Stanovich, 1998), orthographic processing (Cunningham, Perry, & Stanovich, 2001; Sears, Siakaluk, Chow, & Buchanan, 2008), and sentence processing (Acheson, Wells, & MacDonald, 2008).

The consensus view is that more reading should lead to better writing, as Galda's words nicely illustrate: "But writing doesn't simply spring, fully formed, on to paper. It is partially the result of prior experiences with print" (1984, p. 201). This view directly implies that those with richer reading histories—that is, greater exposure to printed material—should produce better quality writing and possibly exhibit different writing profiles than those with comparatively lean reading histories or exposure to print. Certainly reading more is likely to help build vocabulary and orthographic processing skills, but it stands to reason that experience reading various texts also helps build knowledge of sentence structures, phrase manipulations, and the like (Fitzgerald & Shanahan, 2000; Hood, Conlon, & Andrews, 2008); after all, rarely is our exposure to print in the form of isolated words. Consequently, one might expect writers with higher levels of print exposure to have a broader writing repertoire. Those with higher print exposure, having had more experience with varying writing quality, should then be more likely to be able to produce writing of better quality, using those resources gained by exposure to better writing through reading. This has implications for revision itself, but few studies of the reading-writing relationship have explicitly considered revision. Furthermore, although research has illustrated the utility of print exposure checklists as a reliable and valid measure of exposure to print and has shown that print exposure correlates with a variety of literacy behaviors (see Stanovich, 2000), there have been no investigations of print exposure with respect to the writing process or revision in particular.

One feature of writing, as with speech, is that it is full of pauses. Some research suggests as much as 50% of writing time consists of pausing (e.g., Alamargot, Dansac, Chesnet, & Fayol, 2007). Research on self-editing in the context of speech long has made use of recording, describing, and analyzing pauses during speech (e.g., Epting & Critchfield, 2006; Fromkin, 1980; Postma, 2000). Consistent with the speech research literature, the writing literature espouses the assumption that pauses during writing reflect some type of cognitive activity (Gould, 1980; Hieke, Kowal, & O'Connell, 1983; Hyten & Chase, 1991; Matsushashi, 1982). Specifically, it is typically assumed, and

some data support, that pauses involve conceptual planning or covert editing and reviewing of existing or planned text (Flower & Hayes, 1981; Matsuhashi, 1987; Schilperoord, 1996), but the exact distribution, structure, and function of pauses, and the variables that affect those characteristics, are not completely understood (see Alamargot et al., 2007; Alves, Castro, & Olive, 2008).

Defining and measuring pauses is methodologically important yet difficult, as it is not immediately evident what length of pause is psychologically-relevant. Some earlier work in the area counted only times between words that exceeded 1 second as a pause (Matsuhashi, 1981). Others have included every inter-keystroke-interval, regardless of boundaries or length (Hyten & Chase, 1991). Many have not restricted pausing to between words but necessarily set other uniform criteria, independent of individual differences. Some have followed Matsuhashi's lead and set pauses at 1 second or greater (e.g., Alves, et al., 2008), while others have considered only those intervals meeting a threshold of 2 seconds (e.g., Chenoweth & Hayes, 2001) or 3 seconds (Van Waes & Schellens, 2003) as pauses for analysis. Flower and Hayes (1981) advocated a focus on so-called "pregnant pauses"—longer exaggerated pauses. Although valid and important, there is no obvious reason to presume that only longer pauses are meaningful. Van Waes and Schellens (2003), for example, noted that computer writers tended to alternate between planning, translating, and revising tasks, resulting in more, but shorter pauses, within sentences during the composing process (cf. Hayes, 2004). Particularly with computer composition, then, it is possible that smaller, local, revision-related pausing may be occurring in response to various situational or individual factors. Given the highly individualized nature of the writing process (Hayes & Flower, 1986), establishing individualized pause criteria based on some measure of individual typing speed may be useful. Alves, et al. (2008) divided participants into fast typists and slow typists, based on self-reports of frequency of typing, and reasoned that better typing skill should reduce some of the demands of translation. More direct measures may be available, too. For example, during simple transcription virtually no conceptual translating, planning, or revising is necessary, such that an individual's pause lengths therein would reflect his or her typical range of non-cognitively loaded pausing during typing (cf. Alves, et al., 2008; Glynn, et al. 1982). Using some measure of inter-keystroke-intervals (IKI) from a transcription task (e.g., 50th percentile, or more conservatively, even the 99th percentile) would allow for smaller but important pauses, yet take into account typing speed so that analyses still capture primarily pauses beyond those needed for translation.

To the extent that pausing during writing does involve psychologically relevant activities like covert planning and editing (cf. Schilperoord, 1996), it stands to reason that experimental manipulations of programmed time before composition would influence aspects of pausing and editing during composition. Most studies have intentionally avoided placing time constraints on the writing situations, as primary efforts have been on understanding the normal composing process without constraint (cf. Hayes & Nash, 1996). Investigators generally have arranged for generous planning

or prewriting times, but the specific amount of time has varied widely across studies. In some studies, experimenters explicitly encouraged prewriting, even pre-session, planning (e.g., Bridwell-Bowles, Johnson, & Brehe, 1987; Caccamise, 1987; Matsuhashi, 1981; Severinson Eklundh, 1994); some allowed writers to bring or have written notes or outlines (e.g., Bridwell-Bowles et al., 1987), but others prohibited written (but not mental) planning or pre-response material (e.g., Matsuhashi, 1981; Severinson Eklundh, 1994). Some researchers provided the topic or instructions to participants one or more days in advance of a (usually) multi-hour writing session (e.g., Bridwell-Bowles et al., 1987; Matsuhashi, 1981; Van Waes & Schellens, 2003) whereas others provided the relevant information to participants at the beginning of the writing session (e.g., Caccamise, 1987; Hyten & Chase, 1991; Jones & Tetroe, 1987; Kaufer, Hayes, & Flower, 1986; Scardamalia, Bereiter, & Goelman, 1982). Prewriting time was not a primary variable of interest in these studies, but the wide variation therein and the fact that writing situations in everyday life often do involve time constraints of various kinds raise questions regarding its influence.

Burtis, Bereiter, Scardamalia, and Tetroe (1983) have argued that planning is more important in writing than in speaking because a writer cannot rely on subsequent and ongoing interaction with the reader to clarify and edit his or her message as speakers can do given the interplay with their listeners. The relationship between planning, or editing activities generally, and pausing is difficult to isolate and confirm, but some research has provided support for the link. For example, Kellogg (1988, 1994) found that, compared to writers who engaged in no initial prewriting (i.e., formal outlining), writers required to outline wrote more fluently, spent less time pausing during writing, and spent less time reviewing or revising. Van Waes and Schellens (2003) reported that computer writers took less in-session prewriting time compared to pen-and-paper writers, and relatedly, composed in more fragmented, recursive processes, with longer pauses distributed across the entire composing session more equally, compared to a concentration of longer pauses at the beginning of a pen-and-paper writing session. Such findings have been interpreted as indicating writers strategically extend what would otherwise be initial planning throughout the writing process—via pauses and edits—when composing on computers. In a between-subjects design, Rau and Sebrechts (1996) found that a 5-minute prewriting phase was associated with more revisions and longer pausing during composition compared to no prewriting time. Making written plans (i.e., outlines) during the 5-minutes attenuated that effect. They also found those longer pauses were most often associated with subsequent content changes. Taking their findings as a whole, Rau and Sebrechts suggested that prewriting time provides an opportunity for “option expansion,” wherein the writer generates multiple possibilities for the content and structure of their impending composition, but that those options must then be “resolved” during composition, including through pausing and editing. Relatedly, Alves, et al. (2008) found writers reported translating during typing episodes and pausing episodes, but reported revising and planning mostly, though not exclusively, during pausing. If planning and revising are more

integrated in computer composition than pen-and-paper then manipulations in prewriting time may have numerous effects on pausing as well as other aspects of editing.

The present study sought to answer two questions regarding the possible interplay of the factors discussed above. (1) How do writing and editing behaviors differ between participants low in print exposure and participants high in print exposure? If the common assumptions that reading experience is associated with writing ability and better writers judiciously engage in more revision are true, then print exposure, as a measure of reading experience, should show a relationship with at least some editing measures. The writing of students who scored in the upper or lower third on a combined measure of print exposure was compared in this study. (2) How is writing and revising affected by the amount of time a participant is allowed to think about his or her response before beginning composition? Participants were exposed to two conditions that differed in terms of the available prewriting time (PWT). Thus, this experiment sought to discover how print exposure might account for aspects of the writing and revision processes, as well as whether writing profiles of the individuals or their relationship with print exposure differed as a function of short-term prewriting time.

## **1. Method**

### **1.1 Participants**

Sixty-six undergraduate students enrolled in psychology courses at two universities volunteered as participants. Participants were offered research participation credit or extra credit for their participation. The Institutional Review Boards approved all methods, and all participants gave informed consent. No participants reported any reading disabilities or writing disorders. The participants were selected from a larger group of students who completed the Author Recognition Test (ART) and Magazine Recognition Test (MRT) print exposure (PE) checklists (Stanovich & West, 2000; see description in Materials). Those who had a combined score lower than .500 and those with a combined score higher than .700, representing the lower and upper thirds of the screened sample, were invited to participate in the study. Thirty-two low PE students and 34 high PE students volunteered to participate.

### **1.2 Materials**

*Analytic Scoring Guide for Writing Samples.* Essay quality was assessed using Prater's (1984) Analytic Scoring Guide for Writing Samples. Prater's Guide rates each of five factors – mechanics, usage, syntax, paragraph organization, spelling – on a three-point scale (0 = not proficient, 1 = borderline, 2 = proficient, with verbal descriptions for the ratings). Three factors – addresses question posed, overall construction, and developed

argument – were added to tailor the scoring more toward the writing task in the present experiment. Thus, eight factors were assessed for 16 total possible points. Two trained raters scored each essay. Raters scored the essays blind with respect to which print exposure group writers belonged (inter-rater agreement = 92.5%). Any essays on which the raters' scores differed by more than one point were reevaluated by both raters until their respective scores were within one point. The average of the raters' scores provided the final quality score for each essay<sup>1</sup>.

*Print Exposure Task.* The Print Exposure Task consisted of the Author Recognition Test (ART) and the Magazine Recognition Test (MRT) (see Stanovich, 2000). The most up-to-date versions of the checklists were obtained (Stanovich & West, 2000) and then updated as outlined by Acheson, et al. (2008). The ART contained a list of 80 names, of which 40 were widely read authors (based on circulation records) across a wide range of genres and 40 were foils. The participant simply placed a check next to all the names with which she or he was familiar as bona-fide authors. The foils are included to discourage participants from endorsing all of the names or guessing. Foils were intermixed alphabetically with the targets. Each checklist was scored separately by subtracting the proportion of endorsed foils from the proportion of correctly checked items. The MRT was identical to the ART in form, procedure, and scoring. However, instead of author names the MRT listed titles of widely circulated magazines. A composite print exposure score was calculated by simply summing the ART and MRT scores.

*Transcription Task.* The transcription and writing tasks were Visual Basic programs run on a PC operating under the Windows operating system. The transcription task consisted of six sentence selections presented one at a time to the participant. The selections were drawn from the first opening sentence or two from 6 chapters chosen randomly from an introductory psychology textbook (Barker, 2002). The selections averaged 25.5 words, Flesch Reading Ease score 46.65, and Flesch-Kincaid Grade Level 10.42. Three of the selections contained one sentence and three selections contained two sentences; a variety of punctuation, capitalization, and structures existed across the passages. For each trial, the entire passage appeared on the screen. Participants read the sentence(s) and then clicked on a box labeled "End Read." A blank box then opened below the sentence(s), in which participants reproduced the sentence(s). Participants could edit their work as needed so that their sentences exactly matched the presented sentences. The font size and margins were preset to match the verbal stimuli, making visual inspection easier. Participants submitted each sentence by clicking on a box labeled "Submit," which produced a screen allowing them to initiate the next trial by clicking on "Next." The sentence selections were presented in random order across participants.

As a participant typed, the program recorded every inter-keystroke-interval (IKI; e.g., character-to-character, punctuation-to-space, space-to-character), including any typographical error corrections. Because the participants merely copied sentences in this task, IKIs should reflect natural typing speed without interference from additional

thought processes. The 99th percentile IKI was recorded as a conservative index of the longest normal pauses relatively free of any cognitively-loaded composing or revising activity. Each participant's 99th percentile IKI across the last five trials (the first trial was discarded as a practice trial) determined the criterion length for a pause in the writing task. Thus, any IKIs that exceeded those during basic transcription were considered relevant pauses for analysis in the writing task.

*Writing Task.* The writing task was designed to provide an opportunity to capture writing and revision behavior in action. Participants composed short essay answers to two prompts, presented separately in randomized order across participants. The prompts averaged 18.5 words, Flesch Reading Ease score 46.25, and Flesch-Kincaid Grade Level 9.05. Pilot data from different student writers revealed no significant differences in total production or editing measures on the two prompts. The two prompts were:

- "Discuss the higher education system and its function in our society. Include both strengths and weaknesses and defend your arguments." and,
- "Discuss the importance of energy and water conservation. Consider both pros and cons and defend your arguments."

The particular discussion prompts were chosen for several reasons. They represented generalizing or knowledge-transforming questions, which have been associated with more time and editing than knowledge-telling or reporting prompts (see Bereiter & Scardamalia, 1987; Janssen, van Waes, & van den Bergh, 1996; Matsuhashi, 1981, 1987), and they were similar to prompts used in other studies of writing (e.g., Caccamise, 1987; Kaufer, et al., 1986). Also, the prompts were on topics about which typical college students should have at least some knowledge and be able to write two or more substantial paragraphs.

Each prompt was presented on the screen for the participant to read under one of two prewriting time (PWT) conditions: 10-second PWT or 70-second PWT. The PWT began as soon as the prompt was displayed for the participant. At the end of the PWT the prompt disappeared and the participant had to begin composing his or her essay response. A tone sounded when the PWT had elapsed and participants were to begin typing. A blank text editor box appeared at the end of the PWT and the participant began typing his or her answer. Once participants had begun composing their answers, they could review the prompt as desired by clicking and holding a "Show Prompt" button above the text box. Releasing the key caused the prompt to disappear again. There were no additional time constraints on this task, and participants were allowed to edit their work as needed until they were satisfied with their essay. The participant ended the writing trial by clicking "Submit" when he or she was finished composing his or her essay. When an essay had been submitted, the participant clicked on "Next" to start the next prompt.

Numerous dependent measures were derived from the writing task. The program recorded every keystroke and its timestamp; however, only those pauses that exceeded

the criterion set for each participant counted as pauses in the output file. There were 17 specific dependent measures for the writing task, grouped into six categories: Quality/production, Reviews, Pauses, Pause-Associated Edits (PAE), Non-Pause Edits (NPE), and Total Edits Indices. Two measures comprised the Quality/production category: (a) subjective quality score (Prater Analytic Scoring Guide), and (b) total number of words of the completed essay. The Reviews category included two variables: (a) the number of times the participant reviewed the prompt, and (b) the total amount of time (in seconds) spent reviewing the prompt. Pauses included three specific measures: (a) average pause length, (b) total number of pauses, and (c) post-response time (time between last keystroke and clicking "submit"). Pause-Associated Edits involved changes to the text that were immediately preceded by a pause. There were four specific PAE measures, all recorded in terms of number of characters and then converted to proportion of total characters in the essay, to account for different length essays: (a) pause-associated deletions (text was deleted via the delete or backspace key, but not immediately replaced), (b) PAE substitutions (text was selected and overwritten), (c) PAE insertions (text was added to existing text, not associated with any deletion), and (d) total PAEs (sum of a-c). Non-Pause Edits were changes in the text that occurred not preceded by a pause. NPEs included four measures, all recorded as number of characters and then converted to proportion of total essay characters: (a) NPE deletions, (b) NPE substitutions, (c) NPE insertions, and (d) total NPEs. The Total Edit Indices included two combinatorial measures: (a) the summed proportions of total PAEs and NPEs (Total Edits), and (b) the proportion of total keystrokes to number of released characters (K/R ratio). All dependent measures were recorded for each of the two discussion prompts.

### 1.3 Procedure

The study was a 2 x 2 mixed factors quasi-experimental design, with prewriting time (10 s PWT vs. 70 s PWT) as a within-subjects factor and print exposure (high vs. low PE) as a between-subjects factor. Participants were tested individually and completed the transcription task followed by the writing task.

Participants completed the 6-trial transcription task alone. The computer program determined the 99th percentile IKI, which was set as the pause-length criterion for that participant in the writing task (see explanation in Materials). When the participant completed the transcription task, the experimenter returned to provide instructions for the writing task. Participants were informed that the time they had between reading each prompt and beginning composition of their answers on the writing task could vary for each prompt, but they were not told which condition they would encounter first. The starting PWT condition was randomized across participants and each participant was exposed once to each condition. Participants completed the writing task alone and were allowed to leave when they had finished composing responses to both prompts

(following debriefing). The writing task was not time-limited overall; all participants completed the study within one and a half hours.

## 2. Results

Means and standard deviations for each of the dependent measures for each condition are provided in Table 1.

Table 1. Low Print Exposure and High Print Exposure Means and Standard Deviations for All Dependent Measures in the 10-sec and 70-sec Prewriting Time (PWT) Separately

Measure	Low Print Exposure				High Print Exposure			
	10 sec PWT		70 sec PWT		10 sec PWT		70 sec PWT	
	M	SD	M	SD	M	SD	M	SD
Quality/Production								
Quality Score	11.27	2.93	11.14	2.85	13.56	1.96	13.72	1.86
Word count	187.97	98.18	179.38	86.37	256.56	131.54	270.79	117.62
Question Reviews								
Number of reviews	2.72	2.54	1.44	2.41	2.47	3.44	1.26	1.73
Total review time (s)	14.46	16.67	4.18	5.95	9.85	14.44	4.60	8.39
Pause Measures								
Post-response time (s)	12.98	28.53	9.01	9.90	8.82	15.01	14.63	26.59
Ave pause length (s)	3.39	2.33	3.13	2.06	2.94	1.61	2.65	1.32
Total # pauses	229.00	319.43	196.41	218.18	254.24	287.16	261.79	295.00
Pause Associated Edits (proportion of total essay characters)								
Deletions	0.0435	0.0450	0.0402	0.0352	0.0325	0.0294	0.0297	0.0313
Substitutions	0.0497	0.1012	0.0359	0.0503	0.0131	0.0333	0.0290	0.0436
Insertions	0.0102	0.0131	0.0118	0.0200	0.0066	0.0108	0.0118	0.0202
Total PAEs	0.1034	0.1338	0.0803	0.0698	0.0523	0.0514	0.0741	0.0803
Non-Pause Edits (proportion of total essay characters)								
Deletions	0.1469	0.0944	0.1546	0.0876	0.1591	0.0921	0.1632	0.1123
Substitutions	0.0725	0.1954	0.0485	0.1164	0.0221	0.0815	0.0759	0.1326
Insertions	0.1083	0.1865	0.1347	0.2199	0.0754	0.1305	0.1413	0.2705
Total NPEs	0.3277	0.2884	0.3293	0.2520	0.2566	0.1993	0.3804	0.3366
Total Edit Indices								
Total edits ( <i>proportion</i> )	0.4311	0.3948	0.4181	0.2697	0.3089	0.2251	0.4545	0.3744
K/R ratio	1.4710	0.2800	1.4492	0.2264	1.4614	0.2580	1.4391	0.2981

**Note 1:** Descriptive data reflect raw data, not the log-transformed data used for multivariate analyses.

**Note 2:** Quality scores could range from 0-16. Time measures are reported in seconds. Edits are proportion of total essay characters.

Initial evaluation indicated substantially positively skewed distributions of all variables except quality score and average pause length; consequently, data transformations were performed on those 15 variables with skewed distributions. Specifically, log (base-10) transformations of  $X+1$  were performed, an acceptable and recommended transformation given positively skewed distributions with zero values (Howell, 2007; Tabachnick & Fidell, 2007). The means and standard deviations reported in Table 1 represent the untransformed data to facilitate more direct interpretation of the variables (recall, as well, edits are reported as proportions of the total essay characters).

A mixed factors MANOVA was conducted with print exposure (high vs. low PE) as the between-subjects factor, prewriting time condition (10 s vs. 70 s PWT) as the within-subjects factor, and the 17 writing task measures as dependent variables (transformed data, save quality score and average pause length). The multivariate test indicated a marginally significant omnibus effect of print exposure [ $F(17, 48) = 1.80, p = .056, \eta_p^2 = .39$ ] and a significant omnibus effect of prewriting time condition [ $F(17, 48) = 3.90, p < .001, \eta_p^2 = .58$ ]. There was no significant omnibus interaction between PE and PWT,  $F(17, 48) = 0.89, p = .592$ .

Univariate analyses for each of the 17 dependent measures further examined the overall marginal main effect of print exposure and the overall main effect of prewriting time. Only those tests that indicated significant effects are discussed here.

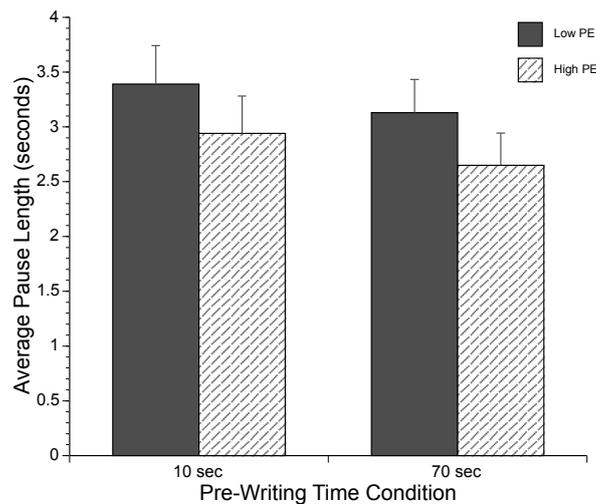
## 2.1 Effects of Print Exposure

Two variables revealed significant differences between print exposure groups. First, the PE groups differed significantly on quality scores of their essays [ $F(1, 64) = 18.93, p < .001, \eta_p^2 = .23$ ], such that on average, high PE participants ( $M = 13.64, SD = 1.91$ ) wrote higher quality essays than low PE participants ( $M = 11.20, SD = 2.89$ ). Secondly, the PE groups differed on the total number of words written,  $F(1, 64) = 10.23, p = .002, \eta_p^2 = .14$ . Specifically, high PE participants wrote significantly more across both PWT conditions ( $M = 263.68$  words,  $SD = 124.58$ ) compared to low PE participants ( $M = 183.68$  words,  $SD = 92.27$ ).

## 2.2 Effects of Prewriting Time Condition

Univariate tests indicated that prewriting time condition had a significant effect on three of the dependent measures. There was a significant effect of PWT condition on the number of prompt reviews writers used,  $F(1, 64) = 23.94, p < .001, \eta_p^2 = .27$ . Both low PE and high PE writers reviewed the prompt more times ( $M = 2.59, SD = 3.02$ ) in the PWT 10s condition than they did in the PWT 70s condition ( $M = 1.35, SD = 2.07$ ). Similarly, there was a significant effect of PWT condition on the amount of time spent reviewing the prompt,  $F(1, 64) = 14.06, p < .001, \eta_p^2 = .18$ . Writers spent more time, on average, reviewing the prompt in the PWT 10s condition ( $M = 12.08$  s,  $SD = 15.61$ ) than they did in the PWT 70s condition ( $M = 4.40$  s,  $SD = 7.26$ ). In addition, there was

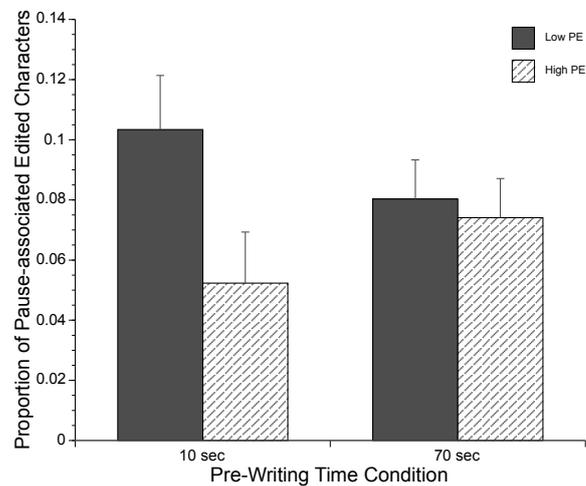
a significant effect of PWT condition on average pause length,  $F(1, 64) = 6.69$ ,  $p = .012$ ,  $\eta_p^2 = .10$ . Overall, the average length of pauses was longer while writing an essay after the short PWT condition ( $M = 3.16$  s,  $SD = 1.99$ ) compared to the long PWT condition ( $M = 2.88$  s,  $SD = 1.72$ ). Figure 1 shows the average pause lengths ( $\pm 1$  SE) for high and low PE writers in the two PWT conditions.



**Figure 1:** Average pause lengths ( $\pm 1$  SE) during composition of essays given a 10s and 70s prewriting time, for low (dark gray bars) and high (striped bars) print exposure writers.

### 2.3 Planned Interaction Analyses

Previous exploratory data from our lab suggested small interactions between PE and PWT for pause-associated edits in general, and for the substitution subtype in particular. Thus,  $2 \times 2$  ANOVAs were conducted for those two dependent measures. There was no significant interaction between PE and PWT condition for PAE substitutions,  $F(1, 64) = 2.75$ ,  $p = .10$ . However, there was a small, statistically significant interaction between PE and PWT condition for total PAEs,  $F(1, 64) = 4.44$ ,  $p = .039$ ,  $\eta_p^2 = .07$ . Figure 2 shows the average ( $\pm 1$  SE) total proportions of PAEs for high and low PE writers in the two PWT conditions. Essentially, low PE writers and high PE writers showed reverse patterns across PWT conditions. Whereas high PE writers made a greater proportion of pause-associated edits in the PWT 70s condition than they did in the PWT 10s condition, low PE writers had a greater proportion of pause-associated edited characters following pauses in the PWT 10s condition than they did in the PWT 70s condition.



*Figure 2:* Average proportion of total pause-associated characters (+1 SE) during composition of essays given a 10s and 70s prewriting time, for low (dark gray bars) and high (striped bars) print exposure writers.

### 3. Discussion

The present study had two primary objectives: (a) investigate possible links between print exposure and aspects of writing, and (b) determine how the immediate amount of time writers had to think about or mentally plan their written essays influenced the writing or editing process.

Print exposure was related to quality and amount of writing in that writers who measured higher in print exposure wrote longer and better quality essays than their lower print exposure counterparts. Shorter prewriting time (10s PWT), compared to longer prewriting time (70s PWT), resulted in more and longer prompt reviewing and also occasioned an increase in average pause length during the writing session. Finally, the manipulation of short-term prewriting time affected the proportion of pause-associated edits of high and low print exposure writers differently; high PE writers increased their PAEs given greater planning time, whereas low PE writers had more PAEs under the shorter prewriting time condition.

The present results add to the relationships found between print exposure and numerous literacy-related abilities and behaviors (e.g., Cunningham & Stanovich, 1997; Stanovich & Cunningham, 1993; also see Stanovich, 2000), and directly support the well-embedded assumption that reading experience relates to and may influence writing ability (e.g., Cox, Shanahan, & Sulzby, 1990; Fitzgerald & Shanahan, 2000; Galda, 1984). There was a clear and significant difference between high and low print exposure writers in blindly rated essay quality. It is notable that high PE writers' higher

quality essays were produced in roughly the same amount of time as the low PE writers' lower quality essays, indicating that better quality did not come simply from spending more time on the writing. Similarly, high PE writers did not, on average, revise more or pause differently than low PE writers<sup>2</sup>. Thus, the differences in quality are likely the result of having a richer writing repertoire and enhanced writing-related skills at the outset. For example, better sentence processing is associated with higher print exposure (Acheson, et al., 2008). This may relate to high PE writers' ability to create higher quality essays within roughly the same amount of writing time as low PE writers. It also may relate to how they used editing opportunities under the PWT manipulation; given more planning time, high PE writers had more pause-associated edits whereas low PE writers had fewer. Given more planning time and better sentence processing skills, among other skills, perhaps high PE writers can generate and process more options (cf. Rau & Sebrechts, 1996).

Indeed, the interaction between PE and prewriting time on proportions of pause-associated edits suggests that print exposure provides writers with information that leads to differential reactions to changes in the writing situation. That it was exclusively the pause-associated edits that differed in the interaction is congruent with the notion that pauses are related to—indeed, part of—the revising process (cf. Alves, et al., 2008; Schilperoord, 1996; Van Waes & Schellens, 2003). But the differential effect of PWT on pause-associated edits for high and low PE writers reveals complexity in the relationship between prewriting time and revision. On one hand, the increased editing in the PWT 70s condition among the high PE writers seems to contradict previous findings of greater planning time resulting in less editing (e.g., Kellogg, 1988, 1994). On the other hand, the same finding provides indirect support for the notion that good writers have greater knowledge of alternatives and time to organize and choose from those choices increases their opportunities to test alternatives (cf. Bartlett, 1982; Rau & Sebrechts, 1996; Scardamalia et al., 1982; Thompson, 1998). One interpretation is that high PE writers simply are more “stable”—their process and patterns less able to be disrupted. Perhaps a primary contribution of print exposure to writing is defending the integrity of a given individual's writing process, allowing the writer to move through different writing situations rather seamlessly (cf. Rijlaarsdam & van den Bergh, 1996).

The conceptual basis for manipulating prewriting time in the present study was that if the time before putting the first words on the page (or screen) is part of the larger revision conglomerate then placing constraints on it should affect other aspects of the conglomerate (e.g., reviewing the question, total edits, pausing). Previous studies have not systematically studied prewriting time, choosing instead to protect against distortion of an otherwise natural or normal writing process (e.g., see Hayes & Nash, 1996). Yet, natural situations often do involve some (situational) time constraints, sometimes including prewriting time. In the present case, prewriting time proved to be an influential variable over a number of writing aspects. As discussed above, total pause-associated edits differed in the two PWT conditions, but the difference depended on whether the writers were low print exposure or high print exposure. But PWT also had

an impact when considered alone. Specifically, constraining the PWT to 10 s produced an increase in the number of times writers, both high and low PE, reviewed the question, as well as an increase in the total amount of time spent reviewing the question during composition. The short PWT condition also led to an increase in the average pause length during composition. At first glance, it may seem an obvious finding that review time increased under the short PWT condition given the significant increase in the number of reviews made under that condition, but there is no reason that more reviews necessarily requires more time. Although this was true for the majority of writers (75%, excluding the 10 participants who did not review the question at all), it was not true for all writers. Together, these two findings imply that reading or viewing the writing stimulus is an important part of the writing and revision process, perhaps as a means of keeping their “communicative intent” in focus (cf. Bartlett, 1982; Matsuhashi, 1987; also see Steinmann, 1982).

Manipulation of immediate prewriting time (PWT) also influenced the average pause length during composition. Writers increased not the number of pauses they made, but rather the average length of their pauses when they were given only 10 seconds prewriting time. This is a particularly interesting finding for a number of reasons. First, these data indicate that frequency of pausing and the length of pauses can be affected independently. Specification of variables that affect one or both is a matter for continued research. It also provides the most direct confirmation that pauses during composition are part of the planning or revising process and is consistent with previous research (e.g., Kellogg, 1988, 1994; Van Waes & Schellens, 2003). If pause length itself is one measure of conceptual planning (Matsuhashi, 1987; Van Waes & Schellens, 2003), then the present data suggest that with less planning time before composition (10s PWT), writers were forced to do more conceptual planning during composition, evidenced by longer average pause lengths compared to the longer prewriting condition (70s PWT).

Apparent inconsistencies with the present data and other research also point to the need for more systematic investigations of prewriting time. For example, unlike Rau and Sebrechts (1996), the present study did not reveal more edits given longer planning time overall. However, that pattern was found for the high PE writers alone. It may be that the relationship between PWT and pause length is complicated, and print exposure is one variable that can mediate that complicated relationship. Rau and Sebrechts told their control group to “immediately” start writing, but their participants still waited an average of 40 seconds before beginning to type. In the present study, all of the participants began typing within 1.5 seconds of the 10s prompt exposure. Notably, the 40s participants waited in Rau and Sebrechts resides nearly at the midpoint between the PWTs manipulated in the present study. Forty seconds may well have provided the low PE writers in the present study enough time to eliminate the PE and PWT interaction on pause-associated edits. In other words, it may be that PE exerts its influence only with particular time parameters. These parameters deserve further investigation.

It is somewhat disappointing that specific types of edits (substitutions, deletions, insertions) were not influenced by the PWT manipulation or sensitive to PE level. However, like in some other studies (e.g., Rau & Sebrechts, 1996), participants in the present study wrote for relatively short amounts of time overall, and revisions were not extensive (see proportions in Table 1). This could be an artifact of using students and short-term, experiment-specific essays. But it may also point to the fact that typical college students (compared to graduate students, faculty, or professional writers) simply do not engage in much revision.

Nevertheless, this relatively simple study with college students did reveal some interesting findings. One of the unique aspects of the present study was that pauses in writing were defined based on individual transcription behavior. This, in conjunction with a within-subject manipulation of PWT, should have increased sensitivity to changes in an individual's writing or editing process. Alves et al. (2008) found that "slow typists" wrote less and poorer quality than "fast typists," but typing speed was determined by self-report of frequency of typing, which does not necessarily correspond to being slower/faster at the task (though one assumes practice should increase speed to some degree). Given the differences in quality in their study, it would be interesting to see if those who self-report not to type very often ("slow typists" in Alves et al. study) also score lower on print exposure. It is also noteworthy that the significant change in average pause lengths as a result of the PWT manipulation was from roughly average pauses of 2 to 3 seconds. Note that this effect would have been missed if the pause criterion had been uniformly set to capture only those greater than 3 seconds or other exaggerated pauses, as has been the case in other studies (e.g., Van Waes & Schellens, 2003). If researchers are interested in any changes in timing variables of the writing and revision process—versus only relatively long pauses—it may make sense, given such great individual variation, to use individually established pause criteria; the present study offers just one way of accomplishing that task.

In conclusion, this study contributes to the growing understanding of the many controlling variables in the complicated process of revision. Results reported here clearly show that the situational variable of prewriting time can influence various aspects of the writing process. Moreover, a writer characteristic linked to reading history (i.e., print exposure) may moderate some of those effects. The fact that print exposure was found to interact with prewriting time (for pause-associated edits) strengthens the possibility that print exposure may indeed provide a basis by which to distinguish writers, inasmuch as writers of different print exposure levels react differently to various manipulations of the writing situation. The print exposure findings also provide supporting evidence for the assertion that more experienced readers make better writers. Finally, as a whole, the study points to the importance of considering both historical and immediate environmental variables as contributors to writing and revision processes, as well as considering different elements of those processes individually.

## Notes

1. A 3-point rating scale may artificially increase agreement among raters, but ratings across the eight factors and across the 132 essays (2 per participant) varied considerably using Prater's (1984) established scale. Future researchers may wish to compare small-range and large-range scales if quality assessment is their primary variable.
2. The absence of a difference in average pause length between high and low PE writers could be due to the method of establishing pause criteria if low PE writers were, on average, slower transcribers, such that more of their shorter transcription pauses were captured in the analyses. In that case, the average pause criterion for the low PE writers should be greater (indicating slower) than for the high PE writers. This was not the case. We evaluated the pause criteria for 17 low and 19 high PE writers (due to a change in the way the output file reported data, we only had access to the actual pause criterion for these 36 participants). The distributions did not violate the test for equal variances ( $p = .856$ ), and the average pause criterion for low PE writers ( $M = 1.37$  s;  $SD = .53$ ) did not differ significantly from the average pause criterion for high PE writers ( $M = 1.33$  s;  $SD = .53$ ),  $t(34) = .266$ ,  $p = .793$ . The method may still be allowing many transcription pauses to be captured in the writing task, but it is likely doing so equally for low and high PE writers.

## Author Notes

1. Evan Gallena is now a graduate student at The College of William & Mary; Stephanie Hicks is now a graduate student at UNC-Wilmington; Elizabeth Palmer is now a graduate student at Thomas Jefferson University.
2. Portions of these data were collected as part of the first author's dissertation at Auburn University. The first author thanks Dr. Lewis M. Barker for his support and involvement during that portion of the study.
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