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An examination of how a cross-section of academics use computer technology when writing academic papers

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Abstract

A cross-section of 361 faculty, graduate and undergraduate students completed a survey that assessed computer availability, experience, attitudes toward computers, and use of computers while engaged in academic writing. Overall, computers served as a tool for all participants, however, undergraduates in the math and computer science areas were more comfortable with computers than others. Experience with computers increased with academic level, suggesting that academics currently use, and have been using, computers throughout their careers. Generally, there were few differences as a function of discipline or gender. Participants indicated different reasons for using computers during the process of writing academic papers relative to written/hard copies. Their responses indicate that these two formats may facilitate the writing process in unique ways. Rather than viewing continued use of hard copy as a transitional period to more extensive computer use, it may be that hard copy offers cognitive supports that may not be available in computer writing software.

Keywords: Post-secondary education; Adult learning; Teaching/learning strategies; Media in education

A critical component of every academic's career is the ability to disseminate his/her work through academic writing. Whether the written product is a final course paper for undergraduates or a manuscript submission by faculty, at all levels of academic training, writing papers is an essential component of the academic process. Although writing is critical to the academic environment,

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relatively little research examines variables that affect the process or products of academic papers. Levy (1995) argued that, compared with other academic skills such as reading or mathematics, writing is severely under-represented in the literature. Recently, significant headway has been made toward developing theories that explain the process of writing (Flower, 1989; Hayes & Flower, 1980, 1986). Our understanding of external variables that impact on the writing process, however, remains under-explored. For example, research is limited on how tools, specifically, computer-based technology, support or hinder academic writing (Bangert-Drowns, 1993). The present study examines the use of computer technology as a tool in the writing process.

The prevalence and usage of computers on every campus makes it clear that computers are important for academics and academic tasks. The issue, then, is not whether computer technology is valuable, but more importantly, how the technology is used. There is some concern that academics may not use computers to the extent that they could (Selber, Johnson-Eilola, & Selfe, 1995). For example, there is an array of computer software that can facilitate writing, including spelling and grammar programs as well as software that supports the writing process by training writing skills (Hartley, 1993; Pennington, 1996), yet research among undergraduates suggests that they restrict their use of computers to making text-based revisions (Ransdell & Levy, 1994). In other words, students change the physical presentation by using programs such as a spelling check, but this does not lead to a change in the quality of writing. These non-meaningful revisions often result in a physically attractive revision, but when compared to revisions that students make to hard copy (or by hand), they are often judged to be of a lesser quality (Collier, 1983; Lutz, 1987; Ransdell & Levy, 1994) or, at best, equivalent to hand written work (Hartley, 1993; Hill, 1991). These findings contradict Bangert-Drowns' (1993) argument that word processing programs should facilitate the quality of writing by freeing the writer from low-level cognitive demands (e.g. spelling) and allowing them to focus on the higher level tasks such as revision and organization.

Given the potential of computers for facilitating written performance, then it is surprising that little or no substantive gains accompany their use. One explanation for these findings is that undergraduates lack the familiarity with computers and relevant software to use the computer to its full potential (Pennington, 1996). Thus, students are in a transitional phase with respect to how well they could potentially use computers during the writing process. This also may or may not be true of more senior academics (such as faculty). Alternatively, it is possible that factors other than simple experience with computers accounts for undergraduates' limited use of computers. For example, hard copy/written drafts may support some cognitive writing processes more easily than using computers permits. Specifically, many components of the writing process require considerable evaluation of previous material. For example, review and revision of planning material, organization and re-organization of written material, editing, and comparison of new content ideas with stated ones (Hayes & Flower, 1980, 1986) have fairly extensive memory requirements especially if past changes cannot be viewed readily. Having previous revisions available simultaneously reduces the cognitive load. At present, this opportunity is not readily available with the computer software used by most academics—once changes are made and saved, they cannot be retrieved nor can many pages be produced on one screen to allow easy comparison of previous and present work. The present study investigates academics' use of computers and hard/written copies to determine whether these two mediums are used for different purposes. The study also considers academics at different levels of their career to determine whether varying levels of writing or computer experience impacts on how computers are used.

Experience with computer technology itself may have a considerable impact on how well and for what tasks individuals use computers. For example, Scott and Rockwell (1997) demonstrated that greater experience with computers led to less anxiety, more use of computers, and a more positive attitude towards computers. There also seems to be a relation between gender and computer use, with females having less experience (e.g. Loyd, Loyd, & Gressard, 1987), more anxiety (e.g. Farina, Arce, Sobral, & Carames, 1991) and hence less willingness to use computers (Farina et al., 1991; Loyd et al., 1987). Given that there are relatively no gender differences when computers are used at early ages (Beer, 1994), and that there is some research suggesting no gender differences later on (e.g. Czaja & Shant, 1998; Jones & Wall, 1989), it seems likely that females who are regularly exposed to computers in a way that impacts positively in their development, will use them more frequently and with greater confidence. In the university environment, the use of computers for word processing is so fundamental that gender differences should not be expected for tasks such as writing. The present paper examines the impact of gender, attitudes, and experience on computer use among academics at different levels of their academic careers.

Apart from experience we also know that specific features of computers can make them more difficult or easier to use when writing. For example, individuals tend to read computer-displayed text more slowly than printed text (Belmore, 1985; Gould, Alfaro, Barnes, Finn, Grischkowsky, & Minuto, 1987). Some researchers suggest that reading from terminals results in more eye strain than reading from paper even when the contrast is the same (dark letters on a light surface; e.g. Cushman, 1986). However, these findings must be considered in light of the available technology. Early studies were limited by the size of monitor but today larger monitor displays are available. Similarly, early monitors often were reported to "flicker" (Cushman, 1986) when black on white contrasts were used—a technological limitation which has been upgraded. Still, these early studies suggest that it is important to consider the type of equipment that is available in order to understand why and when computers may be perceived as more or less useful. The present paper, therefore, examines the type of equipment that is available to academics as well as how they use that equipment when writing.

To summarize, our survey investigates two issues regarding computer use among academics. First, we examine the kind of computers, monitors and computers that are available to students and faculty because these factors most probably constrain or facilitate computer use. Second, we examine the nature of computer use for the task of writing academic papers. In both cases we consider academic experience by including undergraduates, graduate students, and faculty (at all ranks) and discipline areas because these specific learner characteristics may also influence how and for whom computers play a role in the academic environment.

1. Method

1.1. Participants and design

A total of 361 individuals participated in this study. There were 142 faculty and graduate students (57 females, 84 males) and 219 undergraduates (85 males and 134 females). All participants attended, or worked at, one of two universities located in the same mid-sized Canadian city. The faculty and graduate students were drawn from 17 different departments in the two universities

(86 and 56 participants from the larger and smaller universities, respectively). Ages ranged from 23 to 72 years, with a mean of 41 years and 3 months ($M = 37$ years for females and $M = 45$ years for males). All 219 undergraduate students volunteered to participate for course credit.

1.2. Materials and procedure

One survey was administered to each participant. The survey was comprised of 25 questions; 19 in section one and six in section two. The first section assessed demographic information (age, faculty, academic level), access to computers (at home and work), computer experience, and attitudes toward computers. Attitudes were assessed through an 11-item scale (Wood, Willoughby, & Specht, 1997), each of which used a five-point Likert-type scale with 1 representing a stem that was not typical of the participant and 5 representing a stem that was very typical (see Appendix). Six of the items were reversed to minimize response bias.

The second section assessed participants' use of computers when writing academic papers. Participants identified the number of years they have used computers for writing papers and their preference for working from a "hard copy", on-screen computer, or a combination of the two formats. Using a four-point scale (always, often, sometimes or never), participants also identified the frequency of each source for specific components of the writing task (planning, rough drafts, editing, etc.). Through three open-ended questions, participants described the advantages/disadvantages for using hard copy/computers.

Participants were also provided with an opportunity to qualify any of their previous responses, or add additional information through one open-ended question at the end of the survey.

Surveys were mailed to each potential faculty and graduate student. Envelopes contained an information letter, one survey and a stamped, addressed return envelope. The undergraduates volunteered, through a participant pool, to complete the survey and received course credit. All participants were informed that the purpose of the study was to assess computer use and that all information was anonymous.

2. Results

The results represent the two sections of the survey. In the first section analyses regarding the use of computers in general are presented. This section contains three sets of analyses. The first set provides descriptive information regarding accessibility and general use of computers. The second set contrasts computer attitudes as a function of gender, department and academic level. The third set contrasts computer use as a function of gender, department and academic level. The second section presents analyses related specifically to computer use for academic writing. There are two subsections, a quantitative assessment of the frequency and preference for using computers while writing academic papers and a qualitative assessment of using computers to write.

2.1. Descriptive information about computer use

All but one individual at each academic rank (full professor, associate professor, assistant professor and graduate student) indicated that they had access to a computer at work. The four

individuals who did not have access at work did have access at home. Among the undergraduates, 94.5% had access to computers at school and 11 of the 12 who did not have access had a computer at home. For the entire sample then, only one individual did not have access to a computer at school or at home.

The predominant type of computer used by participants at all levels was an IBM-compatible computer (ranging from 65.8 to 84.4% of the machines used at school and from 67.4 to 94.6% of the machines used at home). There were no clear alternative computer types to the IBM-compatible within the school environment but almost a quarter of associate professors (23.9%) and 15.6% of assistant professors indicated use of Macintosh computers at home. Preference for computer type matched the predominance in use. A higher percentage of participants, at all academic levels, indicated their preference for IBM-compatible machines (69.6–85.4%) with the next largest proportion preferring Macintosh machines (4.6–23.9%).

As expected, the mean number of years of experience with computers was greater for full and associate professors ($M = 17.2$ years and $M = 18.5$ years, respectively) than for assistant professors ($M = 13.4$ years), graduate students ($M = 10.7$ years) or undergraduates ($M = 8.5$ years). This indicates that faculty currently are using computers and have been using computers throughout most of their careers.

Participants were asked to indicate whether or not they used their computer to compose academic papers. Given the possibility of differences in computer use as a function of gender, academic level or department, we looked at all three variables. Among the faculty and graduate students, departmental membership was combined to yield six sub-areas. These included psychology, business, biological sciences, humanities, math and computing, and sociology/anthropology. A total of 12 individuals (four females, eight males) indicated that they did not use computers and 344 indicated that they did use computers (187 females, 157 males) for writing academic papers. Five individuals in the math and computing department (two females and three males) did not use computers to write. All were junior academics (assistant professors, graduate and undergraduate students). The remaining females who did not use computers included one associate professor in sociology/anthropology and one undergraduate who did not indicate department. Among the males who did not use computers, there was one full professor in the biological sciences and one undergraduate in the humanities. Overall, the vast majority of participants used computers to compose academic papers.

In terms of the features of computer equipment available, there was a significant difference between departments in the size of monitors, $F(5,147) = 4.45$, $P < 0.05$, with math and computing departments having access to much larger monitors than all of the other departments except psychology. Psychology, however, did not differ significantly from other departments. It is important to note, however, that 21% of faculty and graduate students and 60% of undergraduates were not aware of the size of their computer monitor.

2.2. Comparing computer attitudes across department, gender, and academic experience

A 2 (gender)×5 (academic levels)×6 (departments) ANOVA was conducted to assess general attitudes toward computers on the 11-item attitude scale. The main effect for academic level was not significant ($F(4,273) = .67$, $P > 0.05$), but there were significant main effects for gender ($F(1,273) = 6.70$, $P < 0.05$) and department ($F(5, 273) = 3.41$, $P < 0.05$). Males ($M = 41.17$, SD = 8.52) reported a higher level of comfort with computers than females ($M = 33.48$, SD = 8.31) and those in

Table 1
Mean attitudes toward computers as a function of academic level and department

Department	Full professor	Associate professor	Assistant professor	Graduate student	Undergraduate student
Psychology	38.25 (5.38)	42.60 (9.56)	36.40 (5.81)	37.56 (8.46)	30.02 (8.12)
Business	39.50 (7.97)	37.58 (4.89)	39.43 (9.69)	45.33 (6.66)	35.46 (8.26)
Biological Sciences	N/A[a]	40.60 (6.91)	30.33 (13.05)	N/A	37.83 (8.81)
Humanities	30.60 (9.18)	35.27 (5.87)	39.00 (7.94)	31.71 (7.13)	35.71 (10.06)
Math and Computing	39.20 (7.12)	38.40 (4.72)	39.00 (10.79)	43.75 (9.67)	48.43 (4.78)
Sociology/Anthropology	N/A	29.17 (8.38)	N/A	37.80 (8.46)	30.20 (8.19)

[a] N/A = responses not included because of low sample size.

math and computing were more comfortable than academics in other departments. In addition, the main effect for department was qualified by a significant two-way interaction between academic level and department ($F(16, 273) = 2.03$, $P < 0.05$). See Table 1 for a summary of means.

For full professors, assistant professors and graduate students, there were no differences in computer attitudes across departments. For associate professors, faculty in the biological sciences and psychology were more comfortable with computers than faculty in sociology/anthropology. There were no other significant differences for the associate professors. Among undergraduate students, those in the math and computing department were more comfortable with computers than all other students. In addition, undergraduate students in the biological sciences were more comfortable than students in sociology/anthropology or psychology.

A second, less direct, assessment of attitudes toward computers was examined through participants' responses to questions about their personal use of computers (e.g. as interesting in their own right versus merely tools, and the activities for which computers are used). Three chi-square analyses were conducted on the responses given to the questions on personal use of computers, one each for gender, department, and academic level. With respect to gender, females were much more likely than males to perceive computers mainly just as tools rather than interesting in their own right, $\chi^2 = 7.64$, $P < 0.05$.

Among departments, both humanities and sociology/anthropology were more likely to perceive computers mainly just as tools rather than interesting in their right, $\chi^2 = 18.0$, $P = 0.001$, $\chi^2 = 8.33$, $P < 0.004$, respectively. Math and computing, however, was much more likely to find computers interesting in their own right rather than mainly just as tools, $\chi^2 = 12.36$, $P < 0.001$. Differences in the two categories in psychology, biological sciences, business were not significant, largest $\chi^2 = 3.60$, $P > 0.05$ for biological sciences.

Among all levels of faculty and graduate students, respondents perceived computers mainly as tools rather than interesting in their rights, smallest $\chi^2 = 5.45$, $P = 0.02$ for the assistant professors. Undergraduates, on the other hand, had equal numbers of students indicating that computers were tools and computers were interesting in their own right, $\chi^2 = 1.84$, $P = 0.18$.

2.3. Comparing computer use across departments, gender, and academic level

A 2 (gender)×5 (academic levels)×6 (departments) ANOVA was conducted to assess activities on the computer. The main effect for gender was not significant for any activity, largest $F(1,320) = 1.45$, $P > 0.05$, but there was a significant main effect for academic level for games,

statistics, spreadsheets, publishing and presentations, smallest $F(4,320) = 2.73$, $P < 0.03$ for publishing, and Department for programming, statistics, spreadsheets, and presentations, smallest $F(5, 320) = 3.77$, $P < 0.003$). See Tables 2 and 3 for means and a summary of the significant post-hoc differences.

These main effects were qualified by two significant two-way interactions, department by academic level for programming, statistics, spreadsheets, email, and presentations, smallest $F(19, 320) = 1.71$, $P < 0.03$, for e-mail, and department by gender only for presentations, $F(5, 320) = 3.34$, $P < 0.006$). Among females, there were no differences as a function of department for all presentations. Males in psychology, however, used computers for presentations significantly more than males in the humanities. There were no other significant differences.

Post-hoc analyses were conducted to examine the two-way interaction between department and academic level for programming, statistics, spreadsheets, email, and presentations. See Table 4 for a summary of the significant findings. For the most part, among the senior academics, psychology professors were the most likely to use the computer for programming, presentations and statistics. Graduate business students were the most likely to use the computer for programming, statistics, spreadsheets and e-mail. Undergraduates in the sciences, on the other hand, were the most likely to use the computer for programming, spreadsheets and e-mail.

2.4. Using the computer to write academic papers

To determine the extent of use of computers for writing academic papers, participants were asked to identify how long they had used computers for writing and which aspects of the writing

Table 2
Mean computer use at home and work as a function of academic level[a]

Academic Level	Statistics	Spreadsheets	Presentations	Publications	Games
Full Professor	0.83 (0.94)a	0.96 (0.93)a,b	0.96 (0.88)a	0.30 (0.70)a	0.30 (0.64)a
Associate Professor	0.61 (0.87)a,b	0.71 (0.92)a,b	0.44 (0.72)b,c	0.31 (0.60)a	0.40 (0.54)a,b
Assistant Professor	0.41 (0.73)b,c	0.59 (0.82)a,b	0.52 (0.74)b,c	0.24 (0.51)a	0.28 (0.45)b
Graduate Student	0.85 (0.74)a	0.97 (0.87)a	0.85 (0.89)a,b	0.15 (0.44)a	0.68 (0.73)a,b
Undergraduates	0.10 (0.37)c	0.38 (0.67)b	0.27 (0.58)c	0.11 (0.37)a	0.76 (0.67)a

[a] Range = 0–2. Means within columns that share letters do not differ significantly.

Table 3
Mean computer use as a function of department[a]

Department	Statistics	Spreadsheets	Presentations	Programming
Psychology	0.63 (0.80)a	0.51 (0.78)a,b	0.58 (0.79)a	0.18 (0.50)b
Business	0.40 (0.73)a,b	0.60 (0.85)a,b	0.60 (0.79)a	0.24 (0.57)b
Biological Sciences	0.26 (0.57)b	0.85 (0.82)a	0.35 (0.64)a	0.39 (0.65)b
Humanities	0.04 (0.29)b	0.35 (0.71)b	0.22 (0.51)a	0.09 (0.35)b
Math and Computing	0.17 (0.50)b	0.67 (0.85)a,b	0.43 (0.73)a	10.36 (0.77)a
Sociology/Anthropology	0.23 (0.51)b	0.27 (0.53)b	19 (0.49)a	0.15 (0.46)b

[a] Range = 0–2. Means within columns that share letters do not differ significantly.

process that the computer was used. A 2 (gender)×5 (academic levels)×6 (departments) ANOVA was conducted to determine possible differences in the number of years that computers had been used for writing. The main effects for academic level and departments both were significant, $F(4,277) = 41.66$, $P < 0.05$ and $F(5,277) = 3.40$, $P < 0.05$, respectively. There were no other significant main effects or interactions.

For academic level, as expected, undergraduates and graduate students had less years of computer writing experience than assistant professors who in turn had less experience than full or associate professors (Table 5). Among departments, academics in the humanities had more years of computer writing experience than business, sociology/anthropology, and psychology. However, math and computing, and the biological sciences did not differ from humanities or other disciplines (Table 6).

Table 4
Results of interaction between department and academic level for computer use

Academic level	Activity	Significant differences (i.e. $P < 0.05$)[a]
Full professor[b]	Statistics	Psych > Math & Comp, Humanities, Business > Humanities
	Presentations	Psych > Humanities
Associate professor	Programming	Psych, Math & Comp > Soc/Anthro
	Statistics	Psych, Biol Science > Humanities
	E-Mail	Psych, Humanities > Soc/Anthro
Assistant professor	Statistics	Psych > Biol Sciences, Humanities, Math & Comp
Graduate student[b]	Programming	Business > Psych, Humanities, Soc/Anthro
	Statistics	Psych, Business > Humanities, Math & Comp
	Spreadsheets	Business > Humanities, Math & Comp
	E-Mail	Business > Humanities
Undergraduate	Programming	Biol Sciences > Humanities, Psych, Soc/Anthro
	E-Mail	Math & Comp > Psych
	Presentations	Business > Psych, Soc/Anthro

[a] Psych, Psychology; Math & Comp, Math and Computing; Soc/Anthro, Sociology/Anthropology; Biol Science; Biological Sciences.

[b] Soc/Anthro for full and assistant professor and Biological Sciences for full professor and graduate student not included because of low sample sizes.

Table 5
Mean years of experience using computers to write academic papers as a function of academic level

Academic level	Mean	SD	*N*
Full professor	13.46	6.39	24
Associate professor	14.36	5.68	44
Assistant professor	10.03	3.60	32
Graduate student	6.74	3.57	35
Undergraduate student	5.96	2.38	214

Table 6
Mean years of experience using computers to write academic papers as a function of department

Department	Mean	SD	*N*
Psychology	7.22	4.00	78
Business	7.45	4.63	87
Biological Sciences	8.57	4.06	47
Humanities	10.26	5.30	50
Math and Computing	8.51	4.60	57
Sociology/Anthropology	6.88	4.15	26

A 2 (gender)×5 (academic levels)×6 (departments) ANOVA was conducted to determine differences in the use of computers relative to hard copies during the academic writing process. There were no significant main effects or interactions, largest $F(11,278) = 1.55$, $P = 0.114$ for the three-way interaction. Overall, most participants (71.1%) preferred to combine hard copy and active computer use when writing. Computer use alone (25.1%) and hard copy alone (3.8%) were much less preferred options.

2.4.1. Qualitative summary of open-ended questions about academic writing

Responses to each of three open-ended questions were categorized into general themes. Two questions addressed the advantages and disadvantages of using computers to write academic papers. The third question asked respondents to identify the advantages of using hard copies when writing. Two raters reading 20% of the responses for each question identified general themes. Reliability for these final theme categories was 90%. The list of themes was used by both raters to categorize another 20% of the responses with 85% agreement for coding the responses into themes. Proportions of participants endorsing each of the themes were then calculated. Samples of responses included within each theme and the proportion are reported below.

2.4.2. Advantages of the computer

The responses of faculty and graduate students were analyzed separately from the less academically experienced undergraduate population. Regardless of academic experience, there were three clear themes that supported the advantages of using the computer during the writing process.

An overwhelming proportion of each population supported the ease of editing as a critical advantage of using the computer (69% for faculty/graduate and 75.8% for undergraduate). Examples of these comments include "quick and easy editing," "It is very easy to move things around, cut and add," and "The computer makes it easier to make ordering changes and to check spelling."

The quality of the appearance of the finished product was perceived as an important benefit (34.5 and 36.1%, respectively). Comments included; "An advantage is printing drafts for other people to edit, which are easy to read, no sloppy handwriting," and "Computer text is more legible than my handwriting."

The third benefit was related to efficiency (31 and 27.4%, respectively). This ranged from comments such as "I can type faster than I write" to "It is more efficient." After these three main

categories the responses of faculty/graduate students differed from undergraduates. Among the faculty, there were 6 other categories, however, none of these categories accounted for more than 13% of the responses (Table 7).

The undergraduates had nine smaller categories, however, none of these categories accounted for more than 10% of the responses (Table 7).

2.4.3. Advantages of hard copy

Unlike the advantages of using the computer, there were no predominant or consistent categories that accounted for the vast majority of responses among faculty/graduate students and undergraduates (Table 8). Among the faculty and graduate students, the greatest consensus was that hard copy extended the amount of the document that could be viewed at one time (22.5%). Examples included both the ability to view entire pages and the full document. Specific examples include;

Table 7
General themes for advantages of the computer

	Faculty/graduate students (%)	Undergraduates (%)
Editing is easier	69.0	75.8
Appearance of computer copy is better	34.5	36.1
More efficient/can type better	31.0	27.4
Convenience of arranging files	12.7	4.6
Ability to make a number of copies	4.9	9.1
Able to save document on disk	7.7	3.2
"Think better" on the computer	7.7	2.3
Saves paper	2.8	1.4
Math functions & stats are simplified	2.1	0.9
Computer is easier to look at	0.0	2.3
Easy to see how much you have written	0.0	0.5
Can obtain information from Internet	0.0	0.5

Table 8
General themes for advantages of hard copy

	Faculty/graduate students (%)	Undergraduates (%)
Allows for full view of document	22.5	4.6
Limits physical strain	18.3	9.6
Portability of hard copy	16.9	21.5
Organization	14.8	20.1
Editing (can see changes in margins)	6.3	11.9
Time	2.1	15.1
Ability to make diagrams/sketches	9.2	2.7
Computer problems	4.2	9.1
Quality ("write better")	5.6	8.2
Making mistakes with computer is a worry	0.7	0.0
Using hard copy is a habit	0.7	1.8

1. "Easier to see the whole document, as in comparing text on page one and ten"
2. "Easier to read and scan, need to see more than half a page at once when editing."

Only 4.6% of the undergraduates acknowledged this as an advantage of hard copy. Among the faculty and graduate students, the three other themes that were important included ergonomic issues, such as limiting strain which is often associated with using a computer monitor (18.3%), portability of the document and components of the document (16.9%), and organization (14.8%). Sample statements include:

"Hard copy is easier on my eyes"
"Portability—can work on the paper anywhere"
"Hard copy good for organizing my thoughts."

Among the undergraduate students, portability (21.5%) also was a most critical issue followed by organization (20.1%) and time (15.1%). Examples include:

1. "Can write anywhere"
2. "I find it easier to write my initial thoughts down"
3. "Quicker than typing."

2.4.4. Disadvantages of computer

Overall, very few respondents indicated significant disadvantages associated with using computers to write, albeit there were some limited concerns and these concerns seemed most prominent for faculty and graduate students (Table 9). For example, faculty and graduate students indicated four themes where over 10% of the population perceived a problem whereas among undergraduates there were no themes endorsed by more than 8.7% of the population. Among the faculty and graduate students the most important limitations concern issues such as inconvenience (15.5%), monitor difficulties (14.8%), disruption of writing flow associated with computers (13.4%), and computer failure (12.5%). Examples include:

"The computer weighs too much to carry it around"
"Display constraints"

Table 9
General themes for disadvantages of the computer

	Faculty/graduate students (%)	Undergraduates (%)
Inconvenience	15.5	6.8
Monitor difficulties	14.8	3.6
Writing and thinking flow difficulties	13.4	5.9
Computer problems	12.5	8.7
No disadvantages	10.6	6.8
Computer causes physical strain	9.2	4.6
Time consuming	2.1	2.7
Poor organization (usually begin with no outline)	2.1	2.3

"At critical stages in the writing process I still need sometimes paper and pencil to connect with difficult concepts"
"I had major crashes that wiped out hours of work."

It should also be noted that 10.6% explicitly stated that there were no problems associated with computer use even though they were asked to identify problems. Among the undergraduates computer failure was the most highly endorsed theme but only by a small proportion of the full sample (8.7%).

3. Discussion

Overall, the majority of academics indicated that they used computers for writing academic papers. The majority of participants also used hard copy during the writing process. Therefore, both computers and hard copy were perceived to be essential in the writing process.

3.1. Computer equipment

Predominantly, these university populations used IBM-compatible computers at work with the largest monitors being used by academics in the math and computing departments. Experience with computers increased as a function of academic level suggesting that academics are using and have been using computers throughout their academic experience. In general, there were few differences in the types of computer equipment available to the respondents in this study.

3.2. Computer attitudes

Females were more likely than males to feel uncomfortable with computers and to believe that computers are mainly just tools rather than interesting in their own right. Reflective of their conception of the computer as a "tool," females in our sample were just as likely as males to use the computer for writing and for various work-related activities such as e-mail and statistics. However, they would be less likely than males to engage the computer out of interest alone. In contrast to past research suggesting that there are gender differences in computer use (Lloyd et al., 1987), our data suggest that females in the university setting are quite comfortable using computers in a "task-oriented" way. Of interest, regardless of gender, younger academics (i.e. undergraduates) view computers as intriguing in their own right as often as they view it as a tool, whereas faculty and graduate students tended to view the computer mainly as a tool, suggesting that computer use may be more engaging for upcoming academic populations.

For the most part, attitudes did not differ among faculty and graduate students across departments. As expected, however, undergraduates in the math and computing department were more comfortablewith computers than their peers in other disciplines. Overall, independent of academic level, individuals in math and computing were also more willing to view the computer as interesting in its own right while academics in the humanities and sociology/anthropology view the computer mainly as a tool. Given that computers are an integral part of both

math and computing programs, it is not surprising that individuals who select to be in these academic areas are also most likely to view the computer as intuitively more interesting to explore.

3.3. Tools to write academic papers

Experience in using the computer to construct academic papers increased with academic level. That is, full professors have not only had more experience with computers but that experience included using computers to help them write papers. What is most interesting, however, is that when all participants were asked to indicate the advantages of using computers and hard copy independently, they identified different reasons for using each of these alternatives. Among the responses for computers, one overwhelming preference was that editing was easier when using the computer. Two supporting alternate reasons included the improved quality of appearance and speed. Regardless of academic experience, these three qualities were consistently rated as the most important considerations.

When it comes to hard copy, on the other hand, the advantages were more disparate and appeared to differ between undergraduates and senior academics. Among faculty and graduate students, hard copy provided greater ease in viewing because the whole document could be viewed simultaneously, provided opportunities for better portability and organization, and reduced strain, albeit only a small proportion of the total population endorsed these reasons (less than a quarter). Undergraduates, however, supported only two predominant reasons. Similar to the senior academics, the most important issues were portability and organization.

Together, the themes for the advantages of hard copy reflect a concern with capturing the "sense" of the document. Haas (1996) described the "sense" of the text as encompassing the flow, organization, or interconnectedness of the paper. Having a good grasp of the flow of the paper permits writers to edit for quality rather than for surface-level features. In our study, participants indicated this kind of concern. For example, they suggested that the quality of their writing would change (i.e., writing better). Also, when referring to editing from hard copy, participants identified the opportunity to review previous revisions, corrections, reorganization, wording changes, and themes as the critical advantages rather than the stylistic changes alluded to for computer-based edits. Together, these themes recognize the importance of having access to the complete document simultaneously in order to improve the writing quality. Although features such as clipboards and scrolling allow some recursiveness when writing, simultaneous cross-comparisons among multiple pages are more effectively achieved with hard copy. This outcome suggests that for some people there may be a fundamental difference in the cognitive operations that are supported by hard copies and on-line computer writing. If this is the case, we would not expect to see much change in the use of hard copies and computers over time (i.e., a reflection of a transitional stage).

Although it has been argued that freeing the writer of low-level cognitive tasks such as checking spelling should allow more cognitive resources for higher level writing tasks (Bangert-Drowns, 1993), it is most likely that these higher level tasks may need more cognitive supports than computer software can presently provide. In particular, computer technology falls short in supporting memory and organizational demands faced by writers. For example, hard copy was perceived as offering ready access to multiple previous edits involving changes in thought. Being

able to compare these kinds of changes simultaneously allows for better comparisons and reduces the amount of information the writer has to retain. This means that the flow can be easily extracted with a cursory glance and that critical points can be juxtaposed as the writing progresses.

In summary, both computers and hard copy are valuable tools in the academic writing process. Given that individuals with different learning characteristics may require different kinds of tools to facilitate their writing, neither alternative is the panacea. When we look at who and when people choose to use computers or alternative tools, our findings suggest that we need more exploration of the interaction of cognitive variables on the writing task. Cognitive factors, such as memory and organization, may be the key to understanding when learners need computers to facilitate their writing or hard copy.

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Appendix

Attitudes towards computers scale

1 = Not at all typical of me
2 = Not very typical of me
3 = Somewhat typical of me
4 = Fairly typical of me
5 = Very much typical of me

Questions

1. I am comfortable using the computer.
2. While working on the computer, I worry that I may do something wrong (push the wrong buttons, insert wrong commands) that will foul up the computer program.
3. I like experimenting with new computer software.
4. I like experimenting with new computer hardware.
5. I seek assistance when I need to fix a problem with my computer.
6. Computers make me nervous.
7. I find computers fun to use.
8. When I get new software, I prefer to have someone else install it on my computer.

9. When I get new hardware, I prefer to have someone else install it on my computer.
10. When I have a problem with my computer, I use trial and error to try to fix the problem myself.
11. I avoid using the computer whenever possible.

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