Cursive vs. Print

A Study in Letter Recognition

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ABSTRACT

The perception and recognition of letters is a vital aspect to one's everyday life. Be it a simple sign, a complex text, or a letter from a pen-pal, we process text everyday. An increasingly large percentage of the text we read is presented to us on a computer screen or on printed page, both of which almost exclusively uses print-style characters. Our exposure to cursive-style type has been steadily declining since the advent of the printing press. This experiment investigates the reaction time for character recognition, and looks into the differences in that recognition time for print text versus cursive text.

We devised a computer program to test the reaction times of subjects to cursive and print stimuli. We compared these findings with the subjects' own personal writing style in search of a correlation. Overall, every subject regardless of writing preference took longer to identify cursive letters than print. Our hypothesis was supported by the differences between the times, for cursive writers overall were able to identify cursive letters faster than print writers were.

INTRODUCTION:

In today's communication-intensive society, an important aspect of day-to-day life involves our handwriting. This behavior that seemingly goes unnoticed may actually reflect an important difference in cognitive processes. The goal of this study, as with others before it, is to determine if there is a significant difference when comprehending the characters that make up the words we read and write every day.

It has been suggested that familiarity plays a major role in cognitive processing. One theory, which we will discuss, supports the claim that cursive script is better recognized when an individual is more familiar with the cursive system. Yet another theory suggests that cursive writing takes longer to read because we recognize cursive words slower than we recognize print words. The latter claims that extra thought processes are needed to break down and translate cursive words into a recognizable form.

Eleen N. Kamas and Lynne M. Reder, of Carnegie Mellon University, recently wrote an article entitled *The Role of Familiarity in Cognitive Processing*. They formed four key assumptions about how our cognitive architecture is organized and memory is accessed. They refer to these hypotheses the "Featural Familiarity Hypothesis."

1. Memory is organized into a semantic network of connected ideas, with each concept and idea in memory varying in both long-term strength and short-term activation as a function of exposure (Lorch, 181).

Their first point suggests a connection between exposure and activation. If this theory were true, we would expect to notice a faster reaction time for writers exposed to text of their native style. For example, it would be logical to assume that one who writes in cursive regularly and exclusively would be more exposed to the cursive style, and therefore identify it faster because of higher activation.

2. The strength of concepts and connections between concepts is fairly stable, increasing slowly each time the concept or connection is activated, and decaying slowly from disuse; activation, on the other hand, builds and decays rapidly (Lorch, 181).

This idea indicates that exposure increases the strength of a connection to an idea. Therefore, when primed with an ambiguous stimulus that can be represented various ways, a person will represent or recall that stimulus in the form that has the most exposure/greatest strength.

3. Availability of information is a function of its current level of activation. The ease with which a fact becomes active depends on is baseline strength, and how much activation it receives from a connecting link to an associated concept (Lorch, 181).

This third assumption ties several concepts together. The baseline strength of a particular concept facilitates its activation, which in turn regulates the availability of information. To examine it in a more practical setting: if one writes a specific way, then their baseline strength will be higher. If told a letter, the subject should react faster to one they are accustomed to seeing because it is easier to activate a concept that has high baseline strength.

4. Retrieval from memory involves finding partial matches between the memory probe or representation in working memory and the structure in memory. Partial matches are based primarily on shared clusters of matching features, rather than features all in the exact same relationship in the probe as in memory (Lorch, 181).

This indicates that the individual difference in handwriting may not drastically affect reaction time because the mind needs only to match clusters of features and not the entire representation in memory.

Hypothesis:

From the theories cited above, we based our experiment on the following hypotheses:

1. In accordance to the familiarity claim, subjects who normally write in the cursive style will be able to recognize cursive style letters faster than subjects who normally print. On the other hand, subjects who normally print will be able to recognize print style letters faster than subjects who normally write in the cursive style.
2. Priming effect is the enhanced access to a particular stimulus or item of information, as a result of recent activation of or exposure to that stimulus (Sternberg, 241). In the process of spreading activation, subjects will be able to recognize a letter that matches the letter heard before the test faster than they will be able to recognize if the letter does not match the letter heard before the test.

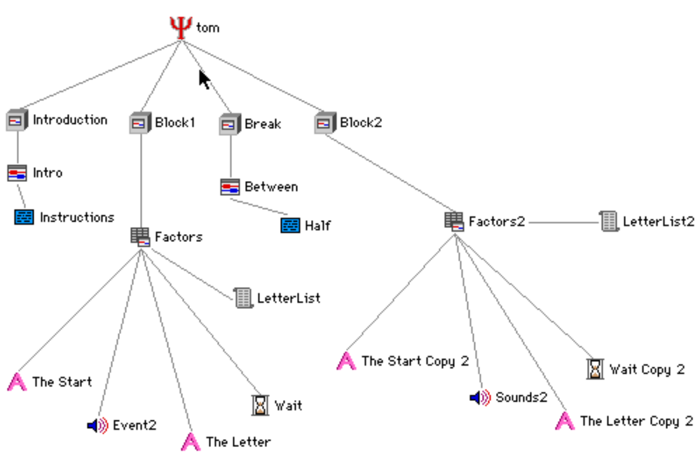
3. Because of increased exposure to printed text and computer type, cursive writers will recognize print style letters faster than printers will recognize cursive letters.

METHOD:

Subjects:

Our original goal was to have the same number of print writers as cursive writers. We also aimed to test an equal number of males and females in each category. Unfortunately, our subject pool was not divided so evenly. The final pool was comprised of twelve males that printed and four males that wrote in cursive, as well as six females that printed and seven that wrote in cursive.

All of the subjects were students at Carnegie Mellon University; eighteen of the twenty-nine total subjects were students in our Cognitive Psychology course, and the remaining eleven were volunteers. One important fact is that the sample was not entirely random. Due to the high exposure to computers that Carnegie Mellon students have, there could be a tendency for them to recognize print lettering on a computer faster than subjects of other age groups and locations. This exposure to computer type would (as the theories describe) raise the activation to such text styles and have a confounding effect on the experiment. Since we have no way to alter the backgrounds of our subjects, we must not focus on whether printers or cursive writers recognize print faster, but rather which group recognizes cursive the fastest.



Program:

In order to implement the experiment, we created an experiment module using PsyScope. First we created four trial blocks: one for the instructions, one for the first block of trials, one for the halfway notice, and one for the second block of trials. Each of the two instruction screens contained a paragraph of information, and a prompt to press any key to start the next trial. The trials themselves were identical in design, but relied on different stimuli.

The only difference between the two trials was the stimuli list. We carefully created two lists in order to account for all combinations of correctness and writing style. Every subject was given the same set of stimuli across the two trials, and when the reaction times were recorded they were associated with the letters that the subjects witnessed. The final data output for each person also included his or her name, gender and writing style. We did this in an attempt to account for potential confounding variables (gender) and to categorize our explanatory variable (writing style).

Running the Experiment:

Once the subject was positioned in front of the computer, the conductor of the experiment described the logistics of the experiment module. The subject had to acknowledge that he/she fully understood the instructions before the experiment began. The subjects were asked to wear headphones attached to the computer so that they could hear the auditory prompts. After the instruction screen was shown, they then hit any key on the keyboard, which started the first of two trials. Each trial consisted of sixteen tests. A test's procedure went as follows:

1. An audio presentation of a letter followed by the call word that distinguishes similar sounding letters from each other (example -- "a ... alpha").

2. After listening to the auditory cue, a visual target appeared in the middle of the screen for the subject to focus on.

3. When the audio letter presentation was complete, a lower case letter appeared at the focus point after a one-second delay. Once the letter appeared, the computer started to record the subject's response time to the stimuli.

4. The subject had to then decide if the audio cue matched the letter on the screen. The subject was to press the "q" key if the letters matched and the "e" key if they did not. The letters that

appeared on the screen were either print or in cursive. Once the decision was relayed to the computer, the elapsed time was recorded. The letter disappeared after the decision was made and the next audio stimulus was then given.

5. After finishing the first trial of sixteen, the subject proceeded to the second trial in the exact same manner.

6. The subjects were then told of our group's hypotheses and were allowed to ask any questions that they had relating to the experiment and our hypotheses.

We chose an array of fifteen letters to serve as our audio stimulus throughout the course of the whole test. A letter was used only once for each trial. These were distributed in a random order, so as to make sure that the subject would not notice a pattern. The audio stimuli matched the letters presented on the screen (considered "correct") on seven of the 16 cursive letters. Also, seven letters that were printed were correct. The other sixteen didn't match (considered "wrong"), with half in print and half in cursive.

	Trial 1			Trial 2	
Letter Heard	**Letter on Screen**	**Type of Writing**	**Letter Heard**	**Letter on Screen**	**Type of Writing**
N	N	Cursive	M	M	Cursive
S	W	Print	E	H	Cursive
U	U	Print	J	T	Print
E	E	Cursive	S	S	Print
G	A	Print	B	B	Print
Y	G	Print	W	W	Print
J	T	Cursive	Y	G	Cursive
Q	E	Print	N	M	Print
K	K	Print	F	S	Cursive
B	V	Cursive	K	S	Print
M	M	Print	R	S	Cursive
F	F	Cursive	Z	Y	Cursive
R	R	Cursive	G	G	Cursive
W	R	Print	U	U	Cursive
Z	Z	Print	Q	P	Cursive

RESULTS:

The first step in analyzing our data was to represent the question that we wanted to ask in the form of a one-sided null hypothesis and on one-sided alternative hypothesis. The table below represents the null and alternative hypothesis used in analyzing each relationship in the categories of "Print" format writing and "Cursive" format writing.

	Print		Cursive	
Comparisons	**Ho**	**Ha**	**Ho**	**Ha**
CC vs. CP	?1? ?2	?1? ?2	?1? ?2	?1? ?2
WC vs. CC	?1? ?2	?1? ?2	?1? ?2	?1? ?2
WP vs. WC	?1? ?2	?1? ?2	?1? ?2	?1? ?2
CP vs. WP	?1? ?2	?1? ?2	?1? ?2	?1? ?2

KEY
CC = see correct cursive form of spoken letter
WC = see wrong cursive letter other than the spoken letter
CP = see correct print form of spoken letter
WP = see wrong print letter other than the spoken letter

The chart below is the representation of the mean data points for each category being compared. The decision to reject or accept the null hypothesis is beside each category. Below the comparison is the resulting decision about how the data relates to one another. The significance level for analysis is .10.

Looking at the relationship of CC vs. CP in each of the four main categories (**see Appendix**), we can observe that CC is greater than CP for all categories. In order to determine if there were any effects of priming on reaction times, the relationship of WC vs. CC and CP vs. WP need to be looked at in both male and female categories. Unfortunately, the trends between cursive and print writers are inconclusive with the exception of the fact that it took all subjects longer to identify correct cursive letters than it does correct print.

An interesting phenomena that was observed is that women (regardless of print style) seem to have more trouble than men with discerning cursive characters overall. This is clearly seen by examining the conclusions (**see Appendix**) in which women took longer with cursive in three out of the four categories (CC vs. CP, CC vs. WC, and WC vs. WP). Considering there were many more cursive-writing women than cursive writing men in our sample (indicating perhaps that cursive writers make up a greater percentage in the female population) it is interesting that they do not identify cursive letters more quickly.

DISCUSSION:

After looking over the results, it is clear that the findings do not support much of our hypotheses. Priming effect was one of our claims that the experiment does support. When a primer — in our experiment the verbal cue before the visible letter — is presented to subject, the subject has an easier time recognizing the stimuli if the primer was closely related or matched the stimuli. The priming effect becomes evident when looking at the relationship between WC versus CC and WP versus CP. In most cases we see that whenever the verbal cue matches the letter shown on the screen (CC or CP), the recognition time was significantly faster than when the verbal cue did not match the letter shown on the screen.

These findings revealed that our first hypothesis was incorrect. Results show that recognition of print was faster regardless of the subject's handwriting style. These results are evident in the case of CC vs. CP and WP vs. WC. A possible explanation of these results was found in the study conducted by Chas Manso De Zuniga, Glyn W. Humphreys, and Lindsay J. Evett, human recognition of script text and print text was studied.

The theory they created dealt with whether or not reading script text required higher mental processing than printed text. There are two main differences between print and cursive. First, printed text in the same font and case will always appear the same. Second, typed text is not fluid, meaning typed words are not connected together, but segmented letter by letter (Besner, 11). There are also two factors that make handwritten text different from print: accommodation and ambiguity. Accommodation is the adaptation of the shape of the letters so that the next letter can be connected; ambiguity is the uniqueness of every cursive letter. No two words written in cursive are going to be the same (Besner, 11). According to their theory, script reading takes longer than print reading because while reading script, an individual must mentally segment and re-visualize each letter. Thus by reading cursive, an individual will utilize more visual processing, therefore taking more time to read in cursive. The extra processing required by cursive reader is defined as cursive normalization (Besner, 16).

This study contradicts our hypothesized conclusions based on familiarity and the ideas of the other article. However it is important to note this study because it explains the results of our study that do not correlate with our hypothesis. The experiment cited above supports our results because cursive style is more individualistic than print and also because parsed cursive letters are not often seen singularly, more often seen as a continuous flow in words.

Our findings clearly show that print letters are usually more highly activated than cursive or script letters. Even if the individual writes in cursive, it does not necessarily mean that they will recognize cursive letters faster than print. This finding may be attributed to the setting in which the experiment took place. When one sits down at a computer, they may be subconsciously primed towards printed characters. The setting lends itself to printed letters because they are so commonly seen on computers. We chose the Willhelga font because it so closely resembled a generic, cursive handwriting, however environmental priming may have counteracted that appearance.

In a world of rapid technology and the ever-declining medium of handwriting on paper, it is not surprising that college students would be more apt to recognize print letters. In a setting where computers outnumber humans, and research papers are a regular occurrence the way one writes on paper becomes less of a factor in cognitive processing. Just as previous studies have described, when one stops or less frequently activates a particular thought, its baseline strength slowly decays. Perhaps the experiment put forth in this report was less indicative of how people think about letters, and represents instead a sign of the times.

APPENDIX

d = reject the null hypothesis
n = accept the null hypothesis

TIMES ARE MEASURED IN SECONDS

Male – Print: sample means
number of subjects = 12

letter				**decision**
	CC	vs.	CP	
m	0.465		0.452	n
u	0.505		0.385	d
conclude: CC > CP				
	WC	vs.	CC	
e	0.491		0.492	n
f	0.571		0.691	d
r	0.731		0.625	d
conclude: can't tell				
	WP	vs.	WC	
j	0.478		0.625	d
y	0.505		0.465	n
q	0.745		0.518	d
conclude: can't tell				
	CP	vs.	WP	
s	0.518		0.465	n
w	0.518		0.691	d
k	0.386		0.598	d
conclude: WP > CP				

Male - Cursive: sample means
number of subjects = 4

letter				**decision**
	CC	vs.	CP	
m	0.525		0.640	n
u	0.730		0.658	d
conclude: CC > CP				
	WC	vs.	CC	
e	0.720		0.625	d
f	0.723		0.613	n
r	0.813		0.657	d
conclude: WC > CC				
	WP	vs.	WC	
j	0.902		0.710	d
y	0.740		0.831	n
q	0.881		0.713	d
conclude: WP > WC				
	CP	vs.	WP	
s	0.512		0.799	d
w	0.435		0.598	n
k	0.473		0.622	d
conclude: WP > CP				

Female - Print: sample means				
number of subjects = 6				
letter				**decision**
	CC	vs.	CP	
m	0.811		0.624	d
u	0.837		0.784	n
conclude: CC > CP				
	WC	vs.	CC	
e	0.571		0.961	d
f	0.917		1.183	n
r	0.718		0.825	n
conclude: CC > WC				
	WP	vs.	WC	
j	0.678		0.931	d
y	0.638		0.864	n
q	0.850		0.704	n
conclude: WC > WP				
	CP	vs.	WP	
s	0.655		0.770	d
w	0.532		0.678	n
k	0.665		0.763	n
conclude: WP > CP				

Female - Cursive: sample means				
number of subjects = 7				
letter				**decision**
	CC	vs.	CP	
m	0.651		0.545	n
u	0.904		0.625	d
conclude: CC > CP				
	WC	vs.	CC	
e	0.612		0.692	n
f	0.651		0.907	d
r	0.692		0.838	n
conclude: CC > WC				
	WP	vs.	WC	
j	0.705		0.718	n
y	0.558		0.731	d
q	0.505		0.798	n
conclude: WC > WP				
	CP	vs.	WP	
s	0.705		0.655	d
w	0.532		0.585	n
k	0.665		0.652	n
conclude: CP > WP				

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