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Taking Things at Face Value: Typeface and its Influence on Reading, Memory, Judgment and Time Perception

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TAKING THINGS AT FACE VALUE: TYPEFACE AND ITS INFLUENCE ON READING, MEMORY, JUDGMENT AND TIME PERCEPTION

By
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A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of the requirements of the Sally McDonnell Barksdale Honors College.

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ABSTRACT:

Differing typefaces, such as serif, sans serif, or script, offer varying physical characteristics and can aid or inhibit legibility. These distinctions between typefaces lead to fonts being deemed as either perceptually fluent or disfluent. As fluency of a text is altered, the notion is offered that processing changes occur, which can influence factors of reading a text. Altering fonts have previously been shown to influence reading speeds, memory, and time estimation judgment. This thesis tests the relationship of font type with these aspects, with the addition of another judgment portion regarding perception of text quality. Determining the aspects which can be impacted by fluency differences of varying typefaces was done by presenting the participants of this experiment with an essay in one of the three typefaces mentioned. Reading speed was timed and participants gave two judgment calls. The first judgment tested perception of text quality through grading the passage and noting if any mistakes were present. The second, a time judgment, was done by estimating the time they believed to have spent reading. Memory between font types was also tested by way of a ten question quiz. Ultimately, this thesis does support processing changes due to font fluency altering reading speeds and time perception, but there was no relationship between typeface, memory and perception of text quality.
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INTRODUCTION

Typeface, also commonly referred to as font type, has many variations. There are thousands of different fonts in existence but, for the purposes of this thesis, are placed into three main categories: serif, sans serif, and script. In serif fonts, each letter has a distinct marking, appropriately called a serif, creating the appearance of sitting on a line. Sans serif fonts lack these markings and do not have the resting line at the base of each letter. Script fonts, unlike the more streamlined serif and sans serif fonts, are calligraphic in their representation. These physical characteristics suggest that certain fonts can be easier or harder to read, which can influence the way that text is processed. In this thesis, the ways in which the physical features of different typefaces can influence reading speed, judgment of text quality, memory of information presented, and a retrospective reading time estimate will be studied.

In order to discuss the possible influence a font type may have, it is important to consider the physical characteristics of a font. In other words, the readability of a certain font is vital to its influencing power. Readability is encompassed by characteristics like legibility, or boldness, and size of font (Gasser, Boeke, Haffernan, and Tan, 2005). Studies have shown that as more attentional resources are allocated to the process of reading due to these physical factors, comprehension of the text material and reading speed is reduced (Song and Schwarz, 2008; Sanchez and Jaeger, 2015). However, these are not the only physical elements that may impact readability.

Other physical characteristics of font type can vary, and can be separated into distinct categories depending on characteristics of lettering. Two of these characteristics are spacing between letters (proportional or monospacing) and presence of base line
markings (serif or sans serif). In one study by Gasser and colleagues (2005), the influence of these physical traits on information recall was examined. According to the authors, the presence of serif markings and proportional spacing is initially suggested to enhance a text’s readability. The recall experiment presented participants with a text in varying font types. Four conditions were included: a mono-spaced font, a proportional font, a serif font and a sans serif font. Following participants reading the text in one of these typeface styles, they then were tested with a recall style question assessment. In contrast to other studies, Gasser and associates present the notion that recall is influenced by font.

However, the results interestingly only suggest that the presence of serif qualities, not differing letter spacing, in a font are important to a reader’s attentional span and can lead to a better recall of the information in a passage. The findings of this experiment indicated a difference in recall, with serif fonts being optimal by as much as 9% over sans serif fonts. As for why serif fonts seem to increase recall, the authors explain that it could be due to ease of text recognition. The base lines of serif fonts make rows of texts easier to perceive. Therefore, the “easier” serif fonts have better recall since lower attentional resources would be required to process the text’s information.

A second article concerning serifs and font legibility examined reading speeds of serif and sans serif fonts in comparison. Like the previous study, this report by Arditi and Cho (2005) initially listed the possible factors supporting the argument that serif fonts tend to be positive influences of legibility and, therefore, speed. First, serif markings are thought to help distinguish some letters from others. Second, serifs are also thought to possibly enhance articulation of individual letters by accentuating end strokes. Lastly, it has been implied that with these two characteristics (baselines and end strokes), serif
fonts might help readers distinguish letters faster, promoting more efficient eye movements and reading speeds.

However, Arditi and Cho also discuss the opposing view, which argues that serif fonts actually have little effect on legibility. Serifs are relatively small in comparison to letter size, in addition to mainly being ornamental. Taking visual acuity into account, the size threshold of serifs may not always be large enough to have an influence on letter recognition or even be greatly attenuated by the eye. To analyze this theory, relative legibility of font was assessed in three experiments. The first segment included varying serif line size, or lack thereof, during general letter identification. Fonts were either presented with altered line thickness in serif fonts or as sans serif fonts. The second trial measured reading speed between serif and sans serif fonts using the RSVP method (reading speeds using rapid serial visual presentation). RSVP consists of words presented one at a time, in sequence. In this scenario, more legible fonts should have faster reading times simultaneously allowing less legible fonts to inhibit faster reading. The third method measured reading speeds, again between serif and sans serif, utilizing scrambled text rather than continuous passages in order to prevent assumptions due to context from interfering with reading speed.

Results from the first trial showed a statistically significant effect of serif use, yet marginally. Only when the serif size was increased to 5% height did serifs yield higher legibility than sans serifs. This is more than likely due to the additional inter-letter spacing that the serif fonts require, however. The second and third trials saw no influence from serif fonts on reading speeds. The conclusion of this article indicates that serif fonts versus sans serifs do not actually aid in faster reading and legibility.
So far, studies involving serif versus non serif fonts and the impact each has on recall and reading speed has been discussed. These relationships between recall, reading speed and serif markings are the main interests of the current study. This thesis will also test these relationships, albeit with additional methods to be discussed. As well as observing the relationship between serif and sans serif fonts, the current study will also examine the third font type mentioned, script font. Comparing three font types (serif, sans serif, and script) will perhaps add a deeper understanding of the differences that can or cannot occur between fonts. As with the previous two articles discussed, this thesis will test informational memory and reading speeds, but will do so as a comparison between script fonts and straight-line fonts. With the addition of script font into analysis also comes more areas of interest for font type influence: judgment of text quality and reading time perception.

In today’s modern age, access to computers means more familiarity with type fonts, or at least more regular contact to different fonts than previous history has known. We come across these many font types in many aspects throughout daily life ranging from advertisements and office memos to textbooks and instruction manuals. Deciding which font type to use in these examples is generally considered an important facet of presentation. There are levels of appropriateness associated with particular fonts. In a professional setting, more traditional fonts (i.e. Times New Roman) may be selected versus casual fonts (i.e. Comic Sans). The purposeful selection of a font type can make or break the effectiveness of a first impression. Inappropriate font choice can potentially distract from the message being conveyed. Appropriateness seems to be a logical trait that is taken superficially from a font, but can it significantly influence a reader’s feelings
or judgment about a text? What else can be influenced by font type at first glance? Judgment of text quality and reading time perception are two possible options this thesis is interested in identifying.

The aspect of time perception influence from typeface is first mentioned in a study by Song and Schwarz (2008). In this study, participants were given an instructional text in either an easy (Arial, sans serif) or difficult (Brush, script) to read font, and asked to estimate the time they believed it would take to enact the task explained in the text. The idea behind this experiment promotes the concept of processing fluency, or the ease of which information can be processed. Simply put, straight-line texts should be easier to process over curved and cursive-like script texts.

Results indicated that processing fluency has an effect on prediction time and perceived difficulty of a task. The easier to read font (Arial, sans serif) produced a lower time estimate for the task, as well as a higher willingness to participate in said task. The indication that processing easier to read fonts leads to a lower task time estimate is of much interest to the current study. If font type has an influence on future time perception, can it impact retrospective time estimates as well? Instead of looking at estimates of a future task, this thesis will analyze whether a font could influence a participant’s retrospective reading time estimate. Asking a participant to estimate the time they believe it took to read the passage could be another indicator of whether a font influences processing fluency. Additionally, how does perceived task difficulty relate to judgment about the text’s information? This idea is studied with the presentation of two contrasting theories in the next article discussed.
Modeled after the Song and Schwarz (2008) experiment, Sanchez and Jaeger (2015) discuss the possibility of judgment bias concerning the information of a text stemming from the readability of that text. Relating perceptual fluency to judgment bias can be an important factor in the processing of a text. Two possible explanations for bias playing a role in judgment are discussed. According to the feeling-as-information theory, a more readable and perceptually fluent font should lead to a more positive judgment about the information presented, and vice versa. This theory would explain whether there is any value behind appropriateness of a font and judgment of information of a text, as this thesis will test. A second possible reason proposed explains that disfluent fonts and presentations could actually alter the way a text is processed. In context with the previous studies mentioned, if a text is hard to read, speed may slow as more attentional resources are allocated to the reading process, leading to a difference in processing which causes the change in time judgment.

Sanchez and Jaeger (2015) attempt to examine which of these ideas is more plausible in two experiments. The first experiment was modeled like the Song and Schwarz (2008) experiment, with a text being presented in either fluent or disfluent font type. In this case, the easier to read, perceptually fluent font used was Courier, a serif typeface. The hard to read, disfluent font used was Mistral, a script typeface. Participants read the text describing how to make a sushi roll, rated the difficulty of reading, and then estimated the time they believed it would take to make the sushi roll. The first results indicated that the script font had higher reading difficulty ratings, longer reading times, and also a significantly larger time estimate for the task. These results indicate that
although difficult texts take longer to read and relate to changes in judgment, they may not harm understanding of content.

However, the second experiment delved deeper into the question of whether judgment of task time estimation is influenced by reading behavior or subjective presentation difficulty. The experiment was repeated with the same methods, but with the addition of eye tracking. The results were much the same as the first. Eye tracking results indicated that although the average fixation time was larger, eye movements interestingly did not show significantly more fixations or regressions (i.e. backtracking) in the difficult to read (Mistral) condition. These results suggest that harder to read texts slow reading, in turn leading to a change in processing due to longer fixations. This further implicates that bias is produced by difference in information processing rather than simple judgment of text difficulty, corroborating Song and Schwarz (2008). The judgment aspect of this study still focused on time, but what effect, if any, would this change in judgment due to processing changes have on perceived text quality? Sanchez and Jaeger (2015) mention the feeling as information theory, but did not find evidence to support it. Ultimately, their experiment results indicated that changes in judgment stem from processing changes during reading difficult fonts.

Even with these findings not in support of the feeling as information theory, the idea still stands that there is a possibility of unconscious relation between appropriateness of a font (I.e. fluent presentation of an academic essay) and perception about the content of the text. This thesis will test the feeling as information theory as well, but from the perspective of essay quality judgments. This will be done with the method of participants grading an essay in various fonts. As mentioned previously, we come across varying
typefaces in differing methods, often in an academic setting. The feeling as information theory suggests that harder to read texts, like script typefaces, should have more negative connotations and receive lower essay scores.

The studies discussed have indicated that as a text is considered disfluent, reading speed slows. This lag leads to a longer processing time, which seems to suggest that certain judgments, like time perception, can be altered. Additionally, this thesis would like to confirm the findings of Song and Schwarz (2008) as well as Sanchez and Jaeger (2015), which claim that font does not influence understanding of content or recall of information (which is in opposition to the results of Gasser et. al., 2005). In essence, a hard to read text would slow the reading speed, therefore leading to more attentional resources being used in the reading process rather than comprehension process. This would also lead to a change in processing that could potentially alter the judgments made about a text, including perceptions about time and text quality. The expectation from previous results should suggest that as typeface progresses from serif, to sans serif, to script, fonts will have longer reading times, higher time perceptions, lower essay scores in reflection of judgment, and no impact on memory.
METHODS

Participants

131 undergraduate college students from the University of Mississippi participated in this experiment. Participants were recruited through the SONA system and awarded 1 hour credit to fulfill requirements for introductory psychology classes.

Design

This experiment was conducted using a between subjects design with three conditions. The conditions included presentation of a text in varying typefaces. The control group consisted of a serif font very commonly used, Times New Roman, chosen because it is the default for many users in academia. The second group, a sans serif condition, used Calibri as the font due to this typeface being the automatic typeface of Microsoft Word. The third and final typeface condition, script, was presented in Mistral. All typefaces were sized at 12 point font. Five dependent variables included reading speed, perception of text quality in the form of an essay grade and a tally of grammar mistakes noticed, retrospective reading time estimate, and a memory test presented as a quiz.

Procedure

First, participants were given an information and consent form to review. In agreeing with the consent form, participants affirmed that they were 18 years of age or older. They were then given instructions on how the experiment would run. The participants were told they would read an essay (see Appendix A), give it a grade, and answer a few questions about the essay. Once the essay was presented, participants were timed on how long they took to completely read through the text. After reading the essay,
participants were asked three pre-memory test questions. First, participants were asked to grade the essay on a scale of 0-100. Second, they were asked to estimate the time they believed to have spent reading the essay. Lastly, they were to give an estimation of the number of spelling and/or grammar mistakes noticed in the essay. Participants then took a ten question quiz regarding information within the essay as a memory test (see Appendix B).
RESULTS AND DISCUSSION

To compare the effects of font type in each condition, One-way ANOVAs were run for each dependent variable: reading speed, time estimate, essay grade, mistakes noticed, and quiz grade. Out of the five dependent measures, only two were deemed significant at the .05 level. These findings are only partially consistent with initial expectations. The results from this experiment indicate that varying typefaces do have an effect on reading speed and time estimates, but not on perception of quality or memory.

Differing reading speeds between typefaces were found to be significant $F (2,128) = 11.37; p = .0001$. As expected, reading speed was shortest in the serif condition ($M=121.35$ s), intermediate in the sans serif condition ($M=137.08$ s), and longest in the script condition ($M=161.72$ s); see Fig. 1. Further analyses of reading speeds between font types required the use of independent samples t-tests. As noted above, reading speed was faster in the Serif condition than in the sans serif condition, $t (84) = -2.13, p < .05$. In addition, reading speed was faster in the serif condition than in the script condition $t (84) = -4.55, p < .0001$. Finally, reading speed was faster in the sans serif condition than in the script condition $t (88) = -2.71; p < .01$.

Contrasting the results from Arditi and Cho (2005), these results indicate a difference in reading speeds between serif and sans serif fonts. In comparison, this difference found could possibly be due to the font used being a creation of the authors rather than an established and recognized font, as this thesis utilized. Also a possibility behind the serif condition holding the fastest reading condition is the general recognition of Times New Roman font. This font is perhaps one of the most used typefaces,
especially in the academic setting most of the participants would be accustomed to when
reading an essay. Applying this line of thought further, the significant difference
between both serif and sans serif in comparison to script condition is of much interest.
Reading speed does slow as text becomes more complicated. This result also supports the
notion that perceptually disfluent texts, like Mistral, are harder to process and slow
reading speeds. These results are consistent with predictions, as script typefaces
generally don’t have straight or fully upright characters to aid in letter recognition and
ease of processing. This finding is consistent with both Song & Schwarz’s (2008)
findings as well as those of Sanchez & Jaeger (2015).

An ANOVA also revealed a statistically significant difference in participants’
time estimates as a function font type, $F(2,128) = 5.66, p < .01$). As expected, time
estimates appeared to increase orderly with serif as the lowest, sans serif intermediate and
script types with the longest (see Fig. 2). At least numerically, Serif fonts showed the
lowest time estimates ($M=178.83$ s), followed by sans serif ($M=227.33$ s) and script font
($M=256.84$ s). As previously mentioned, disfluency of a text seems to be an indicator of
time perception in future tasks (Song & Schwarz, 2008; Sanchez & Jaeger, 2015). The
results from this experiment bring some support to the idea that processing fluency may
also influence retrospective task time estimates. With both findings in mind, there is the
suggestion that changes in processing due to text fluency can affect both future and
retrospective time estimates.

Yet, further analysis using independent samples t-tests were needed to determine
accurate differences between each typeface. Serif fonts led to lower estimates than sans
serif fonts, $t(84) = -2.34, p < .05$. Serif fonts led to lower estimates than script fonts, $t$
However, no statistically significant differences were observed between sans serif and script fonts, $t(88) = -1.15$, $p = .251$.

Reasoning behind this data offers the thought that perhaps serifs do impose some importance on fluency, therefore impacting time judgment. Understanding why this is goes back to the indication that perhaps serifs aid in letter identification and legibility, also supported by the results from reading speeds of this experiment and again opposing Arditi and Cho (2005). Additionally, the finding that sans serif fonts do not influence time estimates significantly as serif fonts do is a new proposition, as it contrasts with the results from Song & Schwarz (2008). If the indications of this thesis are correct, they suggest that serifs are an important factor in legibility, leading to faster reading and shorter time judgments.

Thus far, the hypothesis of this thesis has been supported by the data gathered. Perceptually fluent fonts demonstrate faster reading and time judgment. The second prediction regarding participants’ judgments was not supported. In light of the findings from Sanchez & Jaeger (2015), we expected to find lower perceptual judgment, in the form of low essay grades and high number of mistakes noticed in font types that led to slower reading speeds and longer retrospective time judgments. This idea was not supported by the results. Both the essay grades that participants provided for the essay, $F(2,128) = 2.72$, $p = .07$, and the mistakes that they reported noticing, $F(2,128) = .44; p = .66$, did not differ as a function of font type. The comparisons of means for each of these factors are shown in Fig. 3 and Fig. 4, respectively. The feeling as information theory is once again not supported, as was found by Sanchez and Jaeger (2015). Even though
typeface does indicate a change in processing, as has been shown by differing reading speeds and time estimates, it does not influence a judgment of text quality as predicted.

Lastly, this thesis also tested the effect of typeface on informational memory. Varying typeface did not impact memory performance, $F (2,128) = .81, p = .45$, alluding to the idea that processing changes during reading due to fluency of font do not influence comprehension. Although quiz grade results between fonts did not differ significantly, it is still interesting to note that, numerically at least, sans serif fonts scored lower ($M=6.3$) than serif ($M=6.8$) and script fonts ($M =6.55$), as is shown in Fig. 5. Ultimately, the results counter the claims of Gasser et al. (2005) and support the argument that recall and memory are not influenced by typeface (Song & Schwarz, 2008; Sanchez & Jaeger, 2015). This finding reinforces the idea of processing changes within fonts not affecting comprehension within a text.

Overall, the results from this study were generally supported by previous studies in terms of the effects of font fluency. With this corroboration, it can be concluded that as a font reaches disfluency and processing is changed, reading speeds and time perception will slow; alternatively, there is no evidence provided by this thesis to support an effect on judgment of text quality or informational memory. Even so, further research would be useful in determining the reasoning behind the contrasts that were found between this thesis and previous research. Additionally, further research regarding differences between all three typefaces as was studied in this thesis would be beneficial, as most previous studies have only gathered information comparing two of the three mentioned in this thesis. Lastly, another interesting facet to examine might be the comparison of differing fonts within a certain typeface. Some differences can be found between different typeface
families (serif, sans serif or script), but it would be interesting to discover if these differences are maintained within a singular typeface.
References


Appendix A: Essay used in experiment

The origin of Cognitive Science

Cognitive science is the study of how organisms process information as well as carry out life functions. The study of cognitive science is said to have been originated in the 1940’s and 1950’s when researchers in various fields of science began to develop theories on the mind based on “complex representations and computational procedures”. There are numerous branches of science whose theories contributed to the development of cognitive science. These subdivisions include cybernetics, theoretical computer science, linguistics, experimental psychology, and neuroscience.

Cybernetics, a term used by Norbert Wiener, is the study of control and communication in animals as well as machines. Some key events that took place in the 1940’s and 1950’s within the branch of cybernetics that contributed to the advancement of Cognitive Science were two article’s, “Behavior, Purpose and Teleology” by Arturo Rosenbleuth, Norbert Wiener and Julian Bigelow, and “A Logical Calculus of the Ideas Immanent in Nervous Activity” by Warren McCulloch and Walter Pitts, both published in 1943. These articles discussed regulatory processes and stimulated conferences about Circular Causal and Feedback Mechanisms in Biological and Social Systems. But to many, one of the most important events in the development of cognitive science took place in 1948. This was the year that Norbert Wiener published his book, Cybernetics.

Alan Turing was an English mathematician heavily involved in the development of theoretical computer science. In 1936, Turing invented what is known as the Turing machine. A Turing machine is a hypothetical device that represents how computation is done. All computational processes can be abstractly described using a Turing machine.

Linguistics is the scientific study of language. Before the 1950’s, linguistics was broken down into two main categories, historical linguistics and structural linguistics. Noam Chomsky, an American linguist played an important role in the development of linguistics. Chomsky founded transformational-generative grammar. Transformational-generative grammar is a highly influential system of linguistic analysis. Because of Chomsky and his contributions, the behaviorist accounts of language were challenged, human computations became the focus for linguistics, and focus was directed away from how grammar is learned to how grammar is a mental “organ”.

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Appendix B: memory quiz from experiment

1. Who was Alan Turing?
   a. A linguist
   b. A philosopher
   c. A mathematician
   d. A neuroscientist

2. Who published the book “Cybernetics”?
   a. Noam Chomsky
   b. Arturo Rosenbleuth
   c. Alan Turing
   d. Norbert Wiener

3. What is cognitive science?
   a. The study of how organisms process information and carry out life functions
   b. The study of logical thinking
   c. The study of control and communication in animals as well as machines
   d. The study of language and grammar

4. What is the important development that was made by Noam Chomsky?
   a. He discovered how to read people’s minds
   b. He founded a new field of linguistic study
   c. He invented the computer
   d. He developed a new language important for understanding human cognition

5. Which field of study was NOT discussed as an important part of the development of cognitive science?
   a. Linguistics
   b. Cybernetics
   c. Theoretical computer science
   d. Neuropsychology

6. What machine was invented that can be used to represent how computation is done?
   a. Turing machine
   b. Cybernetic machine
   c. Transformational-generative machine
   d. Feedback mechanism
7. When did the study of cognitive science originate?
   a. 1940s and 1950s
   b. 1900s and 1910s
   c. 1930s and 1940s
   d. 1980s and 1990s

8. What is linguistics?
   a. The scientific study of writing
   b. The scientific study of speech
   c. The scientific study of language
   d. The scientific study of thought

9. What was the purpose of this essay?
   a. To discuss the contributions of scientists in the 1900s
   b. To discuss the development of neuropsychology
   c. To discuss the contributions of psychologists to the invention of the computer
   d. To discuss the development of cognitive science

10. Which of the following was NOT a branch of linguistic study?
    a. Structural linguistics
    b. Historical linguistics
    c. Transformational-generative grammar
    d. Hierarchical linguistics