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Understanding the Effect of Font Type on Reading Comprehension/Memory under Time-Constraints

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Abstract

This research study investigated the effects that font type and amount of time had on the reading comprehension. It was predicted that students restricted with time and given difficult-to-read font (Haettenschweiler) would perform more poorly because more cognitive resources are being utilized to decode the typography compared to an easy-to-read font (Times New Roman). Consequently, there would be fewer cognitive resources available to comprehend and remember the material. Previous research has consistently shown that subjects perform better from reading or memorizing words in difficult-to-read font. However, almost all previous research has consisted of short passages, thereby limiting ecological validity. Results indicate that students reading in Times New Roman scored better, on average, than those reading in Haettenschweiler. Furthermore, participants given unlimited time scored better than those with limited time

Keywords: font, memory, comprehension, reading, typeface

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Reading is often an essential process through which we acquire information. Yet, the

subjective cognitive experience of reading text is not often emphasized. **If this paper was written**

in a more difficult-to-read font, however, it may impact the reader and his/her perceptions and

understanding of this paper. Quality of font is not typically stressed in academic settings, apart

from guidelines listed in citation styles, but it could play an important role in learning and

education. Furthermore, the effect of font on reading comprehension and/or memory could be

applied to various fields such as marketing, business, and publication. Understanding the

relationship font has on recall and comprehension is valuable to ensure understanding of critical

information such as labels on medications, directions in instruction manuals, etc. In addition,

understanding how well we retain information after reading various font types, especially when

pressed for time, can help authors and publishers to make valuable choices to best reach

audiences. This paper will review the information currently established regarding the relationship

between easy-to-read and difficult-to-read font regarding reading comprehension and/or memory.

Additionally, this paper will present a new study conducted which will add to the lacking subject

matter.

Research that has investigated the relationship between fonts and reading comprehension

have primarily focused on the size of the fonts rather than the style (see, e.g., Brumberger, 2003;

Mai and Scholler, 2009; McNamara, Kintsch E. Butler-Songer, & Kintsch W, 1996; Missaglia et

al., 2017, Rhodes and Castel, 2008). Those studies that do examine typeface usually categories

fonts as serif versus sans serif. The term "serif" refers to typeface that possess decorative strokes

that extend from the letters, which can be in the form of a tail for letters, to crossings, to dots.

Serifs are usually more identifiable from one another due to their embellishments. Some common examples are Times New Roman, Rockwell, Georgia, and Baskerville. "Sans serif," on the other hand, is without the embellishment. Some common examples are Arial, Helvetica, Calibri, and Franklin Gothic. For further illustration, refer to Table 1.

Of the few studies that have investigated the influence of font type on information recall, data has shown that serif fonts significantly improve recall of information compared to sans serif fonts (Gasser, Boeke, Haffernan, & Tan, 2005; Halin, 2016; French et al., 2013). In their 2005 study, Gasser et al. gave participants a one-page discussion of tuberculosis in the form of an office memorandum, which was distributed in a health care facility. Font types varied by serif vs. sans serif and proportional vs. mono-spaced fonts. Proportional fonts sit so that the space used for each letter is proportional to the size of the letter. For example, "l" takes up less space than "m" in a proportional font but not in a mono-spaced font. Gasser et al. (2005) used Courier as the serif, mono-spaced font, Palatino as the serif, proportional font, Helvetica as the sans serif, proportional font, and Monaco as the sans serif, mono-spaced font. Since font type was being manipulated, font size was controlled at 12-pt. Participants were then tested on recall of important information present in the memorandum by using a test with six open-ended questions. Participants were not timed. The study found a 9% improvement in recall for important information when the memorandum was written in serif font. The type of spacing of the font did not affect performance. The researchers explain that serif fonts have markings that make rows of text appear to set upon a line, thereby making it perceptually more easy-to-read, and so less attentional resources are required for the process of reading. More attentional resources can then be devoted to attending to the message in the text, which results in deeper processing and an easier recall of the information presented.

In French et al. (2013)'s study, researchers gave a short passage about a fictional star to students prior to a lecture. They were given 90 seconds (an ample amount of time since the passage was only 5 short sentences) to read the passage in silence. After reading the passage, the science lecture continued for 35 minutes. After the 35 minutes, students were given a multiple-choice question test consisting of seven fact-based questions regarding the passage they had read previously. Students were unaware beforehand that they would be receiving a test on the short passage that they read at the beginning of the class. Students' responses were then linked to results from a national exam testing their aptitude, ability, and presence of learning disabilities. The researchers determined that all students read statistically significantly better when given a short passage in a difficult-to-read font, Monotype Corsiva, compared to an easy-to-read font, Arial. The average score for all students who read in a difficult-to-read font was 12.8% higher than students who read in an easy-to-read font. Furthermore, this effect was seen in all bands of learning ability, from high-ability to students to students lower on the spectrum. The mean score for students tested as most able was still 11.5% higher at reading comprehension when given a difficult-to-read font compared to their counterparts who read a passage in an easy-to-read font. Students with dyslexia who were given difficult-to-read fonts scored 19% than dyslexic students who were given easy-to-read fonts. This study indicates that there is a strong, positive relationship between difficulty in font style and retention of information in short passages, especially for those with dyslexia. Researchers explain that the improvement in retention is caused by greater cognitive processing, which is required for reading a disfluent font. However, it was not understood why students with dyslexia saw a higher improvement than their peers.

What is noticeable is that there is a larger gap between participants in the difficult-to-read condition compared to their easy-to-read condition in French et al.'s study compared to Gasser et

al.'s study. This discrepancy could be because of the choice of fonts used in the experiments. Monotype Corsiva (the difficult-to-read font used in French et al.'s study) is more difficult to read than Palatino and Courier (the difficult-to-read serif fonts used in Gasser et al.'s study). This increase in difficulty may have been why there was a much more pronounced effect observed in French et al.'s study. Of course, there are other methodological differences between studies that could also have led to the difference in outcomes. Regardless, both of these studies found that more difficult to read fonts led to better performance.

Other studies have indicated that when tasks require deeper cognitive engagement to process the information being learned, future recall and retention of the information improves (Craik & Tulving, 1975). Although it initially takes more time and mental resources to learn the information, because so many resources and connection are being made with the material, it is easier to retrieve than a task that does not require as much attention. These results coincide with the attentional resources theory proposed by Kanfer and Ackerman (1989). According to this theory, people only have so many attentional resources that they can devoted to a task. If a task is less demanding, then less attention will be allotted to the task. If reading a text is very easy, then attention will be prescribed to the activity. If reading text is a bit more challenging, more attention must be exerted to accomplish the activity of reading. When more attention and time is given to the text, this provides the opportunity for attention to the message of the text to be given more attention as well.

A notable finding between all applicable research was that memory and recall for participants reading serif was significantly better than participants reading sans serif. However, all studies mentioned either included superfluous time or no time restraints for participants while reading and testing. This could be a potential problem because it may be that participants given

serif simply spend more time reading the material than those given sans serif due to the physical characteristics of the text itself that may demand more attention. If this is the case, participants may be scoring better when reading serif because they need to spend more time reading the passage, not because the font makes the text any more memorable.

In sum, there have been few studies examining the effects of font type on reading comprehension and/or memory. The studies that have examined this issue have only done so using very short passages and have given participants superfluous time to such said passages (Gasser, Boeke, Haffernan, & Tan, 2005; Halin, 2016; French et al., 2013). These two issues made the research less ecologically valid then if these factors were taken into consideration. Dressler and McCormick (2018)'s study addressed the aforementioned issues such as superfluous time and passage length and is the basis for the currently presented study.

In Dressler and McCormick (2018)'s study, participants read passages in the fonts Arial (easy-to-read font), Times New Roman (easy-medium to read font), and Haettenschweiler (hard-to-read font). The three fonts were presented with a different passage, which was about 2-3 pages in length. Memory and comprehension were measured for each passage via a 10-question multiple choice quiz. An important aspect of the study was that participants were given a limited amount of time to process the material. More specifically, prior to reading the critical passages, researchers calibrated reading times for each participant based on an independent passage with a type of font (Monotype Corsiva) that was not used in the experiment. For each critical passage, the participant was given .80 of the time it took to read the calibration passage. Researchers found that there was no statistical significance between fonts, meaning that they were able to eliminate the font effect seen in previous research by controlling for time allocated to participants. These results are consistent with the hypothesis that participants in previous

literature may have only performed better when given a difficult-to-read font because they were given superfluous time to allocate attentional resources to the task. Since decoding readings in difficult font requires more attentional resources, the extra attention to the reading may have been what led to previous findings.

In Diemand-Yauman, Oppenheimer, and Caighan (2010)'s study, researchers investigated the extent to which disfluency can lead to improved memory performance. Participants were instructed to learn about three species of aliens (so that participants would have no prior knowledge), each having seven features, for a total of 21 features. They were presented information in either the disfluent font Comic Sans MS with 60% grayscale in 12-point or the disfluent font Bodoni MT with 60% grayscale in 12-point. The fluent condition was in the font Arial in pure black in 16-point (see Table 3). Participants were given 90 seconds to memorize the list and then distracted for 15 minutes with an unrelated task. A between-subject design was used. Then, participants took a test with seven of the features randomly sampled and asked questions about those features. In this study, researchers found that information in a difficult-to-read font was better remembered than an easy-to-read font in a laboratory setting. On average, participants in the fluent condition correctly answered 72.8% of the questions whereas participants in the disfluent conditions answered 86.5% of questions correct, on average. These results are opposite of results found in the study for which this study is based (Dressler & McCormick, 2018). Results are attributed to disfluency and its effect on information processing.

Diemand-Yauman et al. (2010)'s study found that those in the disfluent condition scored higher than those in the fluent condition. One explanation for the difference may be due to the way the information was presented. While Diemand-Yauman et al. (2010)'s study was presented in a short, straightforward list format, Dressler and McCormick (2018)'s study was presented in

a long paragraph format of about two pages. Thus, it may be that disfluent fonts are effective for short lists, but not large amounts of information. It may be that there is a threshold for which decoding disfluency is effective, after which it decreases in productivity, perhaps due to the fatigue of decoding for the reader.

Another explanation for the difference in results may be due to time. While 90 seconds does not seem like much time, it may actually be superfluous for the design since the lists are quite short and straightforward, meaning that those given the disfluent font have enough time to decode and memorize the information being presented in Diemand-Yauman et al.'s study whereas those under time-constraint in Dressler and McCormick's study did not. It would have to be determined whether or not 90 seconds in Diemand-Yauman et al.'s experiment consists of superfluous time or is restricting, perhaps by repeating the experiment and also manipulating time. Time is also an important factor to consider is if the font effect can wear off as readers become accustomed to a disfluent font. Further research could focus on investigating the long-term effects of using the same disfluent font and if there is a point at which maximization of font type and time can be achieved.

The currently proposed study aimed to expand on Dressler and McCormick (2018)'s study by manipulating time and font. Participants read two passages, one in Times New Roman (easy-to-read) and Haettenschweiler (difficult-to-read). The passages, which were about 2-3 pages in length, were the same as the ones used in Dressler and McCormick's study. Memory and comprehension was measured for each passage using 10 multiple-choice questions. For one passage, students were given a limited amount of time and for the other passage they were given an unlimited amount of time. The design was flawed, however, in that two additional conditions should have been added in order to create a within-subjects design. Specifically, participants

should have read four passages. Two of the passages would have been printed in Times New Roman and two others in Haettenschweiler, and participants would have had unlimited time to read one passage of each font type, and they would have had limited time to read the other passage. I predicted that participants would score higher when they had more time and when they processed the easier to read font. These predictions were based on the fact that more difficult-to-read font requires more attentional resources, thereby either fatiguing the participant or requiring attentional resources that could not be allocated as easily as that of the easy-to-read condition. I also predicted that students reading with unlimited time would do better than those with limited time because more attentional resources could be devoted to a task if more time could be invested into the task.

Method

Participants

Participants consisted of 24 undergraduate or master's students studying at Yeungnam University, a mid-sized collegiate institution in Gyeongsan, South Korea. While most participants were studying abroad (22), there were two students that were Korean studying at Yeungnam University as their home university. Students were recruited using flyers at the International Office, announcements in English-speaking classes, and personal invitation of international students directly. Students who participated were all voluntarily involved and did not receive compensation for participation. Students were required to read proficiently in English as a prerequisite for participation in the study. This was determined by their involvement in a collegiate level taught in English. Furthermore, participants were required to be at least 18 years old in order to give consent.

The mean age for students was 21.7 years old, ranging from 18 years old to 26 years old. Furthermore, there were more females who participated in the study (16 females, 8 males). Participants consisted of a range of nationalities including Dutch (2), Chinese (6), Ukrainian (1), American (2), French (2), Vietnamese (1), Polish (1), Chilean (2), Peruvian (1), Indian (1), German (1), Malaysian (1), Bulgarian (1), and Korean (2). Participants identified as Asian (11), White (8), Hispanic/Latino (3), and Black (2). Moreover, most participants identified as "Middle" class (13) for their socioeconomic status, followed by "Upper" (3), "Upper-Middle" (3), "Lower" (3), and "Lower-Middle" (2). Most participants were in their second-year of school (12), followed by third-year students (5), fourth-year students (4), a first-year student (1), and a sixth-year student (1).

The sampling method that was conducted was a voluntary and convenience sampling since students who participated consisted of those who self-selected into the study or agreed to participant in the study when prompted. Experiments were conducted throughout the summer of 2019 in the same location.

Materials

Materials for this experiment included two passages, each with 10 multiple-choice reading comprehension questions from the website CrackACT (http://www.crackact.com/act/reading/). Passages and questions were modified so that line numbers were not included (see Appendix A). Moreover, font modification was used, as designated by random assignment, using either Times New Roman or Haettenschweiler. In between passages and questions, participants were given a math verification test consisting of 20 questions. The examination was given in paper format as a packet using A4 paper and black and white ink. The packet was stapled in the upper left-hand corner. The first page of the packet

included a list of the participant's rights as a subject in a psychological experiment as well as a consent section where participants signed. The consent form was then detached from the data in order to protect participant privacy. A single black ballpoint pen was provided at the beginning for all participants to use throughout the experiment. Subsequent pages included directions immediately atop and then the appropriate documents (either passages, math verification test, or reading questions).

A quiet, well lit room was used as the environment for which participants were tested (a classroom), with the door slightly ajar so that participants felt comfortable leaving at any time. One table was used during the experiment with two chairs: one for the participant and one for the researcher. The researcher sat immediately next to the participant in order to give an air of observation while the participant was engaged in the exam (a tactic used in the hopes of encouraging students to stay focused at the task on hand). However, the researcher used a laptop before and after the examination for data collection purposes. The researcher doodled in a notebook while the participant was engaged in the exam during reading and questions sections in an attempt to reduce any anxiety associated with being stared at. The researcher also used a timer on a mobile device throughout the experiment with the device on airplane mode and the volume on silent in order to prevent disruptions.

Procedure

Prior to the experiment, the researcher determined the order of fonts presented to participants. This ordering was determined by random assignment. Once ordering had been determined, the researcher prepared materials in the correct font prior to the start of the experiment.

Each participant was greeted and invited to enter a quiet room with the researcher where the door was nearly closed to help drown out ambient noise. The researcher was rehearsed and prepped beforehand in order to say instructions and behave in the same manner to be as consistent among all trials as possible. Participants, then, were provided a document listing their rights as a participant, which was also orally presented by the researcher. The researcher then asked if the participant understood their rights and was willing to consent to the experiment. In addition, the researcher inquired the age of the participant prior to the study to ensure proper age of consent was met, or documented permission was acquired. If the participant agreed, the experiment moved forward.

To start, participants were presented with the first passage which would either be in Times New Roman or Haettenschweiler, depending on the in trial they were in. Furthermore, the passage would either be read with unlimited time or limited time, also depending on the trial. The trials were set up in such a way that a participant would not receive the same time condition and font condition twice. The order of conditions was arranged via random assignment for the first passage where a font and a time condition were randomly assigned. Then, the opposite conditions were applied for the second passage. For example, if Haettenschweiler and Limited was assigned for the first passage, then the next passage would be Times New Roman and Unlimited. Students who read passages with limited time were given a maximum of two minutes since that was the approximate average time need for most students to completely read the passages in a previous experiment using the same passages (Dressler & McCormick, 2018).

Participant read the instructions prior to beginning to read the passage, and the researcher also presented directions orally. The directions informed the participant that they would be reading a passage and to notify the researcher when they were done reading the passage. Next,

instructions were given on the math verification test to answer 20 simple math questions and determine whether each math statement was true or false. Lastly, Participants were given an exam with 10 multiple-choice questions based on the passage they previously read. The type of font remained the same across each passage, math verification test, and multiple-choice. Furthermore, all text size was 12-point and all material was double spaced. Once the questions were completed, participants had two minutes of rest. During this rest break they were permitted to leave the room, use the restroom, get a drink of water, etc. but were instructed to try to avoid reading.

Once the two-minute break was complete, participants were asked to do the same steps for the next passage, with the opposite font and time restriction this time. They also completed the math verification problems and the set of multiple-choice questions for the passage in the same font as in the passage. Lastly, participants completed a survey outlining their demographic background, with the option of not answering questions if they felt uncomfortable.

Design

The type of font used for each section (passage, math verification test, and multiple-choice questions), and the time allotted for participants to read passages were the independent variables of the study. The dependent variable was the proportion of multiple-choice questions answered correctly. Although the original design was intended to be within-subjects, this was not done appropriately, so adjustments had to be made for data analysis.

While an appropriate design would consist of having all participants engage in all conditions, this was not done. Instead, each participant was involved in two trials so that for the first trial they were exposed to one font and time constraint and for the other trial they were exposed to the opposite font and time condition. Specifically, for the font comparison, all the

participants were tested under both font types, but half of the participants in each condition were tested under unlimited time, and half were tested with limited time. Likewise, for the time comparison, all the participants were tested under both time conditions, but half of the participants in each condition were tested with Times New Roman, and half were tested with Haettenschweiler. Due to this error is design, data analysis had to be modified.

Results

Table 2 contains the means and standard deviations for each comparison. Two separate (one tailed) paired samples t-tests were conducted on the proportion of multiple-choice questions answered correctly. The first test compared the mean proportion correct of the fonts: Times New Roman and Haettenschweiler. The second test compared the mean proportion correct between the time conditions: Unlimited and Limited. The effect of font type was significant t (23) = 2.044, p < .027. Participants answered more questions correctly after reading passages in Times New Roman than after reading the passage in Haettenschweiler. The effect of time was also significant t (23) = 4.139, p < .001. The data shows that participants answered more questions correctly after reading passages with unlimited time compared to limited time.

Discussion

Comprehension scores were higher in Times New Roman than in Haettenschweiler (see Table 2). Therefore, it can be concluded that Times New Roman is, overall, a better font for increased reading comprehension and memory in extended text. In addition, students who took tests with unlimited time did better, on average, than students who were constricted with time. In this experiment, providing students with as much time as needed led to better test results. The experiment yielded two important results both of which were predicted. First, based on their test performance, participants comprehended passages presented in Times New Roman better than in

Haettenschweiler. Second, having unlimited time to read the passage led to higher accuracy on the comprehension test.

A large limitation of this study is the poor design. While the initial intention was to create a within-subjects design where all participants were exposed to all four condition, they were only exposed to half of the conditions necessary Had the design been completed within-subjects then all participants would had received all 4 conditions (Times New Roman/Limited, Times New Roman/Unlimited, Haettenschweiler/Limited, Haettenschweiler/Unlimited). Alternatively, a between-subjects design could have been conducted with various options such as either time being manipulated between-subjects and font being manipulated within-subjects or the time being manipulated within-subjects and font being manipulated between-subjects. Any of the above options could be conducted for future research as a continuation of the investigation on the relationship between font type and performance on reading comprehension and memory tests. Because the above outlined designs were not completed, this study could not examine the interaction between font type and amount of time. Had the study orthogonally crossed the two independent variables, the interaction could have led to testing of further hypotheses and yielded more compelling data. For example, with a proper design, it is possible that under unlimited time, the participants may have performed better with the difficult font; this would have replicated the previous findings in the literature.

Despite its poor design, some insight could be garnered from the present study. Results are consistent with the previous research study for which this experiment was based: participants performed worse when given passages and questions in the more difficult-to-read font, Haettenschweiler, as compared to the more easy-to-read font, Times New Roman (Dressler & McCormick, 2018). This study also may support the prediction that participants in previous

literature may have only performed better when given a difficult-to-read font because they were given superfluous time to allocate attentional resources to the task. Previous research has shown that more cognitive engagement leads to deeper processing, which helps in encoding and retrieval (Craik & Tulving, 1975). Since decoding difficult font requires more cognitive engagement and attentional resources, the extra attention devoted to reading the difficult font may have been what led to previous findings. If this is the case, it could be an explanation of why participants in this study performed better when given unlimited time compared to limited time. It would also explain why, on average, those with the difficult-to-read font scored worse. However, a proper within-subjects experiment would need to be done in order to test this prediction.

       According to Diemand-Yauman, Oppenheimer, and Caighan (2010), it is disfluency, the cognitive experience of difficulty associated with cognitive operations, that leads to deeper processing and better memory. For example, imagine reading this paper on a very poor photocopy: ink smeared, words blurry, some words missing due to low toner, and the words at the end of the page difficult to differentiation due to book binding. Then, if you compare that copy to a clear text, centered at the page with high contrast. One copy is clearly easier to read than the other. Research has shown that the ease with which we are able to access and process information, fluency, has impacts on our judgement and categorization of information (Oppenheimer & Frank, 2007; Tversky & Kahneman, 1973; Monin, 2003). Categorization involves an exemplar and a category. The more typical the exemplar is to the category, the stronger the representational link is between them, and the more easily the exemplar is categorized. However, if the exemplar is atypical to the category, more work must be done in order to identify, process, and categorize the information. The fluency of a subject matter

determines how we process and categorize. If something is more disfluent, then it requires

deeper processing to encode. Furthermore, the way we categorize information has effects on how

we can retrieve the information later, for example on an exam (Oppenheimer & Frank, 2007).

Therefore, fluency effects not only how we process information, but also how we retrieve it later.

Disfluency is the main explanation of why students who read materials in more difficult-

to-read fonts scored better than students who read in easy-to-read fonts in Diemand et al.

(2010)'s study. Disfluency can be produced by adopting fonts that are more difficult-to-read,

furrowing one's brow, or mixing symbols with letters in a passage (Alter, Oppenheimer, Epley,

& Eyre; 2007; Thomas and McDaniel, 2007). Thus, future research on font manipulation could

compare other means of inducing disfluency to see if there is a relationship between disfluency

in general and reading comprehension and memory, or it is fonts and time, specifically, then

have an effect.

Another theory that could explain results is the item-noise theories of recognition

memory (e.g., McClelland & Chappell, 1998). For the present study, the difficult-to-read font

could be analogous to a degraded condition. If unlimited time is present, then participants can

de-degrade the stimulus. However, when time is limited, participants may have to continue to

process the degraded stimulus. Thus, the noisier representation of the text is more difficult to

encode and form connections, making it more difficult to retrieve later. Because the degraded

stimulus is more difficult to process, it has a lower probability of being decoded and stored in

memory as compared to an easier font condition. Since answering a multiple-choice question

requires using memory, is it possible that this may be an explanation for the current results.

Another limitation of this study is its population. While having a diverse range of

students is certainly a benefit in that it provides more ecological validity, it is also presented its

own challenges. All students had a baseline understanding and command of the English language since all students were enrolled in collegiate courses taught in English. All participants had an adequate amount of reading, writing, and listening skills. However, reading and taking an exam in a second or third language can require more time and attention than if the exam was taken in one's native language. Since the pool of participants included students studying abroad and/or Korean students studying in English, those students who were from a country where English is not the primary language could have had a different experience in the amount of effort and attentional resources that needed to be spent in order to interpret text compared to native speakers. Speaking, reading, and writing tends to be more difficult in a non-native language. Therefore, the amount of attentional resources that students had to invest in a passage may not just be due to the font manipulation, but also due to the hurdle of overcoming how to decipher a different language.

Although it is difficult to know the extent to which these results apply to native English speakers, they could be generalized to a specific population: English language learners or those who have acquired English as a second language. Developmental psychologists could also investigate children starting to learn how to read and right all the way up to proficient adults in order to see if there is a relationship between mastery of a language and any font effects. There may be parallels between children learning to read and write, and those acquiring English as a second language in regards to the effect font has on their reading comprehension and memory.

The effect of font type may also interact with the proficiency of the participants. Diemand-Yauman et al.'s participants consisted of Princeton University students, a highly prestigious school assumingly full of erudite and academically motivated people. Dressler and McCormick's participants as well as the current pool of participants in this study, on the other

hand, consisted of average-level students who may become more easily frustrated or less motivated when presented with a difficult task compared to their counterparts at an Ivy-League institution. The interaction between reading proficiency and the font effect is exemplified by research that shows that those with dyslexia scored better with disfluent fonts than those without dyslexia (French et al., 2013). Thus, a more comparable pool of participants is more ideal when comparing experiments.

In conclusion, this current study indicates that the easy-to-read font, Times New Roman, produced a higher proportion of answer correct on reading comprehension questions overall then the difficult-to-font, Haettenschweiler. However, due to the poor design, it was unable to be determined if this was only in the case of limited time, or if it was also prevalent when participants were given unlimited time. If it was only prevalent in limited time, the results would be consistent with the hypothesis that the font effect, where students perform better in more difficult-to-read fonts, is only applicable given superfluous time due to the amount of attentional resources that are required of the task. There is also a time effect since those with unlimited time scored better those with limited time. However, the design of this study makes it impossible to make conclusions about this topic. Rather, an additional study would need to be done.

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probability. *Cognitive Psychology*, 5(2), 207–232.

Tables

Table 1

Comparing Serif Fonts to Sans Serif Fonts

Serif	Sans Serif
Times New Roman	Arial
Rockwell	Helvetica
Georgia	Calibri
Baskertville Old Face	Franklin Gothic

Table 2

Mean and Standard Deviation of Proportion Correct

Condition	Mean	Standard Deviation
Times New Roman	8.13	1.42
Haettenschweiler	7.50	1.69
Unlimited	8.33	1.37
Limited	7.29	1.62

Table 3

An Example of the Lists used in Diemand-Yauman et al. (2010)'s study

Disfluent Font	Fluent Font
The pangerish	The norgletti
• *Ten feet tall*	• Two feet tall
• *Eats green, leafy vegetables*	• Eats flower petals and pollen
• *Has blue eyes*	• Has brown eyes

Table 3 demonstrates an example of the disfluent stimuli on the left and fluent stimuli on the

right in Diemand-Yauman et al. (2010)'s study examining disfluency on recall.

Appendix A

Passages and Questions used in Experiments

In Times New Roman:

Instructions: You will read the following passage within the allotted time and then eventually answer questions on it to test your reading comprehension and recall. You are given a limited amount of time. Please read the passage carefully and then notify researchers when you need to move unto the next section. Once you are finished reading the researcher will take the passage away and you will be given a sheet with ten questions.

The light was so weak at noon that when Pelayo was coming back to the house, it was hard for him to see what it was that was moving and groaning in the rear of the courtyard. He had to go very close to see that it was an old man lying face down in the mud, who, in spite of his tremendous efforts, couldn't get up, impeded by his enormous wings. Pelayo ran to get Elisenda, his wife, who was putting compresses on the sick child, and he took her to the rear of the courtyard. They both looked at the fallen body with a mute stupor. There were only a few faded hairs left on his bald skull and very few teeth in his mouth, and his pitiful condition took away any sense of grandeur he might have had. And yet, they called in a neighbor woman who knew everything about life and death to see him, and all she needed was one look. He's an angel, she told them. "He must have been coming for the child, but the poor fellow is so old that the rain knocked him down."

On the following day everyone knew that a flesh-and- blood angel was held captive in Pelayo's house. With the first light of dawn, they found the whole neighborhood in front of the chicken coop having fun with the angel, tossing him things to eat through the openings in the

wire. The news of the captive angel spread with such rapidity that after a few hours the courtyard

had the bustle of a marketplace and they had to call in troops with fixed bayonets to disperse the

mob that was about to knock the house down. Elisenda, her spine all twisted from sweeping up

so much marketplace trash, then got the idea of fencing in the yard and charging five cents

admission to see the angel. The curious came from far away. The most unfortunate invalids on

earth came in search of health: a poor woman who since childhood has been counting her

heartbeats and had run out of numbers; a Portuguese man who couldn't sleep because the noise

of the stars disturbed him; a sleepwalker who got up at night to undo the things he had done

while awake; and many others with less serious ailments.

   Pelayo and Elisenda were happy with fatigue, for in less than a week they had crammed

their rooms with money and the line of pilgrims waiting their turn to enter still reached beyond

the horizon. The angel was the only one who took no part in his own act. He spent his time trying

to get comfortable in his borrowed nest, befuddled by the heat of the oil lamps and sacramental

candles that had been placed along the wire. At first they tried to make him eat some mothballs,

which, according to the wisdom of the wise neighbor woman, were the food prescribed for

angels. But he turned them down. His only supernatural virtue seemed to be patience. Especially

during the first days, when the hens pecked at him, searching for the stellar parasites that

proliferated in his wings, and even the most merciful threw stones at him, trying to get him to

rise so they could see him standing.

   It so happened that during those days there arrived in the town the traveling show of the

woman who had been changed into a spider for having disobeyed her parents. The admission to

see her was not only less than the admission to see the angel, but people were permitted to ask

her all manner of questions and to examine her up and down. While still practically a child she

had sneaked out of her parents' house to go to a dance, and while she was coming back through the woods after having danced all night without permission, a fearful thunderclap rent the sky in two and through the crack came the lightning bolt of brimstone that changed her into a spider. A spectacle like that, with such a fearful lesson, was bound to defeat that of a haughty angel who scarcely deigned to look at mortals. Pelayo's courtyard went back to being as empty as during the time it had rained for three days and crabs walked through the bedrooms. With the money they saved they built a two-story mansion with iron bars on the windows so that angels wouldn't get in. Pelayo also set up a rabbit warren close to town and gave up his job as a bailiff for good, and Elisenda bought some satin pumps with high heels and many dresses of iridescent silk, the kind worn on Sunday by the most desirable women in those times.

One morning Elisenda was cutting some bunches of onions for lunch when a wind that seemed to come from the high seas blew into the kitchen. Then she went to the window and caught the angel in his first attempts at flight. He was on the point of knocking the shed down with the ungainly flapping that slipped on the light and couldn't get a grip on the air. But he did manage to gain altitude. Elisenda let out a sigh of relief, for herself and for him, when she watched him pass over the last houses. She kept watching him even when she was through cutting the onions, until it was no longer possible for her to see him, because then he was no longer an annoyance in her life but an imaginary dot on the horizon of the sea.

Math Questions

Below are mathematical statements. Please circle "T" if the math problem and corresponding

answer is true. Please circle "F" if the math problem does not display a correct answer. This

section is untimed.

1.   4+5=9   T   F

2.   4-3=1   T   F

3.   2+3=6   T   F

4.   9-7=3   T   F

5.   1-1=1   T   F

6.   3+7=10   T   F

7.   8+1=10   T   F

8.   10-5=4   T   F

9.   6+1=7   T   F

10.   5-2=1   T   F

11.   3+5=8   T   F

12.   9-6=3   T   F

13.   2+8= 10   T   F

14.   9-4=6   T   F

15.   8-6=2   T   F

16.   7-4=2   T   F

17.   6+2=8   T   F

18.   2+2=5   T   F

19.   3+6=8   T   F

20.   4+5=8   T   F

1. The inhabitants of the town in which the story takes place are depicted as

   A. proud and stubborn people who are always arguing about religion.

   B. laid-back people who react to odd events with less surprise than one might expect.

   C. wise people who are always constructing elaborate theories about the universe.

   D. devious people who will do anything to make money.

2. The neighbor woman believes that the angel is a(an):

   A. angel of death.

   B. angel of good fortune.

   C. warrior angel.

   D. angel who can predict the future.

3. All of the following are described in detail EXCEPT:

   A. the ailments of the invalids.

   B. the girl who disobeyed her parents.

   C. the clothes bought by Elisenda.

   D. the crabs brought by the rainstorm.

4. The character of the angel can best be described as

   A. wise and loving.

   B. powerful but unforgiving.

   C. baffling and mysterious.

   D. pessimistic but determined.

5. Elisenda's idea to start charging people admission to see the angel is a(an):

    A. disrespectful decision motivated by greed.

    B. understandable decision motivated by necessity.

    C. risky decision motivated by poor business sense.

    D. weak decision motivated by her tendency to be influenced by others.

6. When they first encounter him, the townspeople treat the angel as if he is a(an):

    A. animal.

    B. impostor.

    C. impartial judge.

    D. bad omen.

7. All of the following are reasons why people became more interested in the spider girl than they had been in the angel EXCEPT:

    A. it is more obvious what moral they are supposed to learn from her.

    B. she is more willing to interact with her audience.

    C. she has been officially approved by local religious authorities.

    D. it is less expensive to see her.

8. Which of the following phrases indicates that the appearance of the angel is regarded as a somewhat normal occurrence?

    A. They both looked at the fallen body with a mute stupor.

    B. The most unfortunate invalids on earth came in search of health.

C. The angel was the only one who took no part in his own act.

D. they built a two-story mansion with iron bars on the windows so that angels wouldn't

get in.

9. At the beginning of the story, Pelayo is employed as a(an):

A. farmer.

B. fisherman.

C. bailiff.

D. architect.

10. The main point of the last paragraph is that after the departure of the angel, Elisenda feels:

A. remorseful about how poorly the townspeople treated the angel.

B. frightened about what the angel might do if he ever comes back.

C. optimistic about the new lifestyle that was made possible for her by the angel.

D. unburdened now that she doesn't have to worry about the angel anymore.

In Haettenschweiler:

Instructions: You will read the following passage within the allotted time and then eventually answer questions on it to test your reading comprehension and recall. You are given a limited amount of time. Please read the passage carefully and then notify researchers when you need to move unto the next section. Once you are finished reading the researcher will take the passage away and you will be given a sheet with ten questions.

The horseless carriage was just arriving in San Francisco and its debut was turning into one of those colorfully unmitigated disasters that bring misery to everyone but historians. Consumers were staying away from the "devilish contraptions" in droves. In San Francisco in 1903, the horse and buggy was not going the way of the horse and buggy.

For good reason. The automobile, so sleekly efficient on paper, was in practice a civic menace, belching out exhaust, kicking up storms of dust, becoming hopelessly mired in the most innocuous-looking puddles, and tying up horse traffic. Incensed local lawmakers responded with monuments to legislative creativity. The laws of at least one town required automobile drivers to stop, get out, and fire off Roman candles every time horse-drawn vehicles came into view. Massachusetts tried and, fortunately, failed to mandate that cars be equipped with bells that would ring with each revolution of the wheels. In some towns police were authorized to disable passing cars with ropes, chains and wires. San Francisco didn't escape the legislative wave. Bitter local officials pushed through an ordinance banning automobiles from all tourist areas, effectively exiling them from the city.

Nor were these the only obstacles. The asking price for the cheapest automobile amounted to twice the $500 annual salary of the average citizen-some cost three times that much-and all that bought you was four wheels, a body, and an engine. "Accessories" like bumpers, carburetors, and headlights had to be purchased separately. Navigation was a nightmare. The first of San Francisco's road signs were only just being erected, hammered up by an enterprising insurance underwriter who hoped to win clients by posting directions into the countryside, where drivers retreated for automobile "picnic parties" held out of the view of angry townsfolk.

The first automobiles imported to San Francisco had so little power that they rarely made it up the hills. The grade of Nineteenth Avenue was so daunting for the engines of the day that watching automobiles straining for the top became a local pastime. In the mid-1950s, Ford Motor Company was building not one, not two, but 18 varieties of Edsel, including a convertible and a station wagon. The designers came up with some interesting ideas. They created a push-button transmission and put it in the middle of the steering wheel, where most cars have a horn. And they fiddled with the front end: Where other cars had horizontal chrome grilles, the Edsel would have a vertical chrome oval in its grille. It was new! It was different! Unfortunately, it didn't work. It couldn't suck in enough air to cool the engine. "They had to keep opening up that oval to get more air in there," says Jim Arnold, who was a trainee in Edsel's design shop. "And it didn't look as good."

Edsel didn't have its own assembly lines, so the cars were produced in Ford and Mercury plants, which caused problems. Every once in a while, an Edsel would roll past workers who were used to Mercurys or other Fords. Confused, they sometimes failed to install all the parts

before the Edsel moved on down the line. Cars without parts can be a problem, of course, but other aspects of the Edsel juggernaut worked perfectly-the hype, for instance. The Edsel PR team touted the glories of the cars, but wouldn't let anybody see them. When they finally released a photo, it turned out to be a picture of the Edsel's hood ornament. And hundreds of publications actually printed it!

On September 4, 1957, proclaimed by Ford as E-Day, nearly 3 million Americans flocked to showrooms to see the Edsel. Unfortunately, very few of them bought the Edsel. "We couldn't even get people to drive it," says the C. Gayle Warnock, Edsel's public relations director." They just didn't like the car, They just didn't like the front end." But styling was hardly the worst problem. Oil pans fell off, trunks stuck, paint peeled, doors failed to close and the much-hyped "Teletouch" push-button transmission had a distressing tendency to freeze up. People joked that Edsel stood for "Every day something else leaks."

Another major problem was caused by bad luck: The Edsel was an upscale car launched a couple months after a stock market plunge caused a recession. Sales of all premium cars plummeted. Before E-Day, Edsel's hypemeisters promised to sell 200,000 cars the first year. Actually, they sold 63,110. Sales dropped below 45,000 the second year. And only 2,846 of the 1960 models sold before Ford pulled the plug.

Math Questions

Below are mathematical statements. Please circle "T" if the math problem and corresponding answer is true. Please circle "F" if the math problem does not display a correct answer. This section is untimed.

1.   4+5=9   T   F

2.   4-3=1   T   F

3.   2+3=6   T   F

4.   9-7=3   T   F

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8.   10-5=4   T   F

9.   6+1=7   T   F

10.   5-2=1   T   F

11.   3+5=8   T   F

12.   9-6=3   T   F

13.   2+8= 10   T   F

14.   9-4=6   T   F

15.   8-6=2   T   F

16.   7-4=2   T   F

17.   6+2=8   T   F

18.   2+2=5   T   F

19. 3+6=8 T F

20. 4+5=8 T F

1. Which of the following statements about automobiles in San Francisco in 1903. is best supported by Passage A?

      A. They were affordable for the average citizen but unpopular nevertheless.

      B. They were used more by tourists for sightseeing purposes than by citizens for practical purposes.

      C. They failed to capture the public imagination in spite of huge public relations efforts.

      D. They were considered a public nuisance by all but a small segment of the population.

2. Which of the following terms in Passage A is used more figuratively than literally?

      A. Puddles

      B. Monuments

      C. Bells

      D. Hills

3. The purpose of the quotation marks around the word accessories in line 29 is most likely to:

      A. suggest that the features were actually essentials.

      B. indicate that the word appeared in legal documents.

      C. emphasize that the word was widely misunderstood.

      D. clarify that inexpensive automobiles had some luxury features.

4. Which of the following statements best captures how Passage B characterizes the failure of the Edsel?

A. It happened gradually and went unnoticed at the time by the public.

B. It happened quickly despite promising initial sales.

C. It was on a huge scale, occurred swiftly, and was a public event of sorts.

D. It occurred when other automakers were doing well and therefore embarrassed Ford all the more.

5. The statement in lines 43-45 is typical of Passage B in the way it:

A. contrasts data about the Edsel with data about other cars of the 1950s.

B. conveys the obligation that Ford executives felt to involve consumers in the design of the Edsel.

C. combines an industry perspective on the Edsel with that of the typical consumer.

D. suggests the entire Edsel enterprise was marked by extremes.

6. Which of the following events referred to in Passage B occurred first chronologically?

A. E-Day ended.

B. The stock market plunged.

C. Edsel sales dropped below 45,000.

D. Edsel sales reached 2,846

7. As it is used in the passage, the term premium cars (line 86) serves primarily as a:

A. reference to what Edsels have become now that they are valued antiques.

B. name for a type of car that was ushered in by the makers of the Edsel.

C. label for a category of cars that the makers of the Edsel intended it to belong to.

D. derisive term used sarcastically by Edsel owners who were disappointed in their

purchase.

8. A similarity between the two passages is that they both:

A. examine their topics from a significant distance of time.

B. reveal the author's professional background as a way of lending credibility to the text.

C. assert that automobiles have contributed little that is worthwhile to society.

D. incorporate information about traffic and road conditions into a discussion of

automobile design

9. An element of Passage A that is not present in Pas-sage B is a reference to what aspect of the

automobile culture?

A. Related legislation

B. Public opinion

C. Economics

D. Quotations from industry experts

10. If publicity experts had been assigned to build enthusiasm for the cars mentioned in Passage A using the methods described in Passage B, the experts would most likely have first released photos to the press that showed:

 A. cars going up Nineteenth Avenue in San Francisco.

 B. a single detail such as a gleaming headlight or a polished door handle.

 C. the meticulous work done along the assembly line to ensure the quality of the new car.

 D. an attractive young couple smiling as they enjoy a car ride past horses grazing in pastures.