

The Effect Of Pop Up Notifications On Reading And Reading Comprehension

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ABSTRACT

Distractions are more common than ever with every digital device having some sort of notification feature. Reading on these devices while a notification pops up causes a possible distraction that makes the user look away from what they were reading and read the notification instead. The goal of this study is to show how much these distractions negatively affect reading ability as well as reading comprehension. The results showed that there was in fact an increase in reading time as well as a lower level of comprehension when distractions were present, however these results were not significantly different from the results of a control. Future research would be necessary to show a strong relationship between distractions and reading ability.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**;

KEYWORDS

Notification, Task, Reading

ACM Reference format:

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1 INTRODUCTION

Technological distractions are rampant in society today; from text messages to the latest news notification. Distractions such as these can have a negative effect on completing even the simplest of tasks [3]. The amount of task time that is added due to technology shifting a person's attention is unknown by the average person. By informing a person just how much time they are losing on distractions they can take steps to rectify it. This paper aims to look at the simple task of reading and the effects desktop notifications have on it. Looking at where the reader's eyes go and what they fixate on will tell exactly how much attention the notification is given. Having task completion time as well as a comprehension test will show how much the task as a whole suffers from the distraction.

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The combination of this data will show whether or not steps need be taken to taper notifications. Introducing a technological distraction into a readers environment will have a negative effect on task completion as well as task comprehension

2 BACKGROUND

The quality of reading comprehension is in large part related to the amount of focus given to the task at hand. It has been shown that even before the prevalence of social media the effect of distractions has always been noticeable and in some cases quantifiable. Simple changes in one's reading process like a change in font cause a decrease in reading speed ultimately making the task longer. Younger generations have grown up with notifications randomly appearing on their screens but older generations have not been conditioned in the same way therefore are affected differently by pop-up notifications and may even take longer to comprehend the notification and return to their original task, especially when it is not related to the task in question [5]. While it may seem like notifications are solely to blame when it comes to distractions during work/study, there is also evidence showing that there is a significant decrease in reading ability and comprehension simply when the material is on a screen as opposed to on paper, the decrease is likely due to the increase in cognitive load which would attributed to the added navigational processes such as scrolling and clicking to new pages [1]. Performing a task while distractions are present taking away your attention and focus can lengthen the time to complete it. With technology running rampant in today's society it is common for a person to attempt to multi task. Having multiple applications open can lead to a diversion of attention from the task at hand. The negative effects of having an instant messaging conversation open while reading are a perfect example [2]. Notifications are said to be non-invasive and will not distract a person when presented. Mobile notifications, which are very short in duration, can still lead the mind to wander and task-irrelevant thoughts. This can damage how well a task is done along with the time to completion [3]. Simply presenting a notification causes a shift in attention, however the cognitive thought and physical action required have adverse effects as well. A person must decide whether they wish to dive deeper into the notification or choose to ignore it. This can cause a prolonged distraction for a person [6]. People know that notifications will distract them but keep them for the small information they can give. People feel like they are more aware of things due to notifications [4]. Notifications may bring a small value to a person but is it worth the amount of time lost due to them.

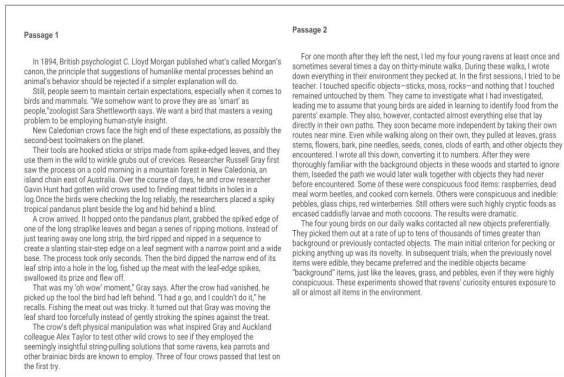


Figure 1: Two articles that will be shown to the user on a single screen

3 APPARATUS

Eye tracking data from the participants was collected by use of a Gazepoint GP3 pupil corneal reflection eye tracker which samples at a rate of 60 Hz, has a degree of visual angle accuracy from 0.5-1 degrees, and is calibrated using the 5-point calibration method. The Gazepoint GP3 was suspended underneath a Dell Professional P2213t 22" LED monitor; this monitor displayed the stimuli to the participants. The monitor has a resolution and refresh rate of 1680 x 1050 and 60 Hz respectively. The data was run through Gazepoint Analysis software v3.1.0 on a Dell Optiplex 9020 which contains an Intel Core I7-4790 3.6 GHz/ 8 MB cache processor, a nVidia GeForce GTX 745 4GB DDR3 video card, 16GB (8 GB x 2) 1600 MHz DDR3 Non-ECC Ram, as well as a 500GB 7200 RPM hard drive.

4 STIMULUS

The main stimulus for this experiment is two reading comprehension articles pulled from a SAT prep service. The articles are reformatted to fit together on one screen without the need for scrolling as seen in Figure 1. The secondary stimuli is very similar to the first except there is a notification shown in the bottom right corner of the window as shown in Figure 2. The notification can vary from a Facebook, Windows update, Twitter or Instagram notification. The placement of the notification was decided based on where a Windows operating system would normally show a pop up notification.

5 SUBJECTS

Our research group had twenty participants. The demographics were male and female ages nineteen to twenty-three all were college students.

6 EXPERIMENTAL DESIGN

This experiment is a single factor attempting to show the effect of popup notifications on reading ability and comprehension. The experiment involved a tutorial section and a single data collection section. The experiment consists of a control group as well as an experimental group. The control group will be tasked with reading the stimuli and then asked questions based on what they read. The

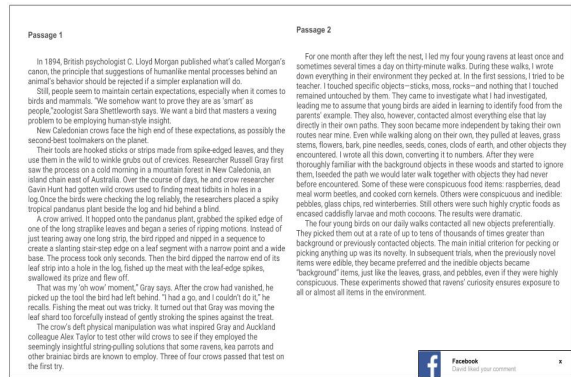


Figure 2: Two articles that will be shown to the user on a single screen with a notification box in the bottom right corner of the screen. Note the notification does not cover the article text.

experimental group will have the same task except "fake" notifications will periodically show in the bottom right corner of the screen and then disappear after 5 seconds. The stimulus serves as a task for the participants in order to collect data on reading ability and technique; the quiz afterward serves to ascertain the participants comprehension of the material as well as the notifications presented (for the experimental group). As a measure to avoid skew the mouse will be removed from the station so the participant may not attempt to interact with the notifications and will simply be forced to view or ignore them however they may.

7 PROCEDURE

At the beginning of the experiment, participants were seated and briefed using the script read by the experiment giver. The participant was given the opportunity to ask any questions and then asked to provide their age, occupation and sex. The participant was then asked to calibrate the eye tracker using 5-point calibration method. Once calibrated, the participant will be asked to read the two articles on the stimulus in 5 minutes or less. The word "notification" will not be mentioned so as to prevent bias. The stimulus will then be shown to the participant, the "notification" stimulus will involve multiple variations of the stimulus with timed notifications lasting 5 seconds each and then disappearing. After 5 minutes the stimulus will be removed from the display and the participant will be asked to take a short quiz regarding the material within the articles as well as the notification(s). After the quiz the participant will be thanked for their participation and the experiment will have concluded.

8 RESULTS

8.1 Time to Finish Reading

A time was found for each participant on how long it took them to complete reading the passage. The time to complete reading the passages for experimental and control had very similar distributions as shown in Figure 3. The mean, max, and min were found in seconds for both control and experimental, and control

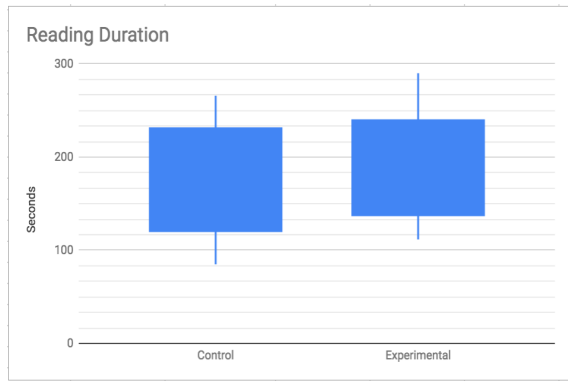


Figure 3: Above graph shows the min and max reading times as well as data within one deviation of the mean for both control and experimental

took less time all around than experimental (Control: Max=265.85, Min=84.9, Mean=175.746 Experimental: Max=289.9, Min=111.58, Mean=188.568). Although these times are all higher for the Experimental data set, the data was not found to be statistically significant ($t(10)=0.54$, p-Value = .30) thus the test hypothesis, notifications will significantly affect the reading time of participants, was not proven to be true.

8.2 Reading Comprehension

A reading comprehension quiz was used to measure participants knowledge of the passage they read. On the first two questions the control group received more correct answers, however on the third the experimental did better. Overall the control group had more correct answers than the experimental (Control = 21 Experimental = 15) this is shown in Figure 4. When tested on notification comprehension vs reading comprehension the experimental group recalled information about the notification better as shown in Figure 5. The amount of correct answers for each participant in the control group (mean = 2.1) when compared to the amount of correct answers for each participant of the the experimental group (mean = 1.5, $t(10) = 0.31$, p-Value = 0.38) was not found to be significantly different, thus the test hypothesis, notifications being present will significantly affect the participants' reading comprehension, was not proven to be true. Also to compare the reading comprehension answers (mean = 1.5, proportion of correct to incorrect mean = 0.5) and notification comprehension answers (mean = 1.2, mean proportion of correct to incorrect = 0.6) of the experimental group per participant was not found to be significant ($t(10) = 0.25$, p-Value = 0.4).

9 DISCUSSION AND CONCLUSIONS

The research group's original hypothesis was supported by data retrieved from the experiment, however the results were not statistically significant. The control group answered twenty-one questions correctly which was lower than expected. This could have been caused by question three, which was more difficult than expected. The experimental group had more correct answers on question three than the control. The research group was not able to identify why this anomaly occurred, however the difference only amounted

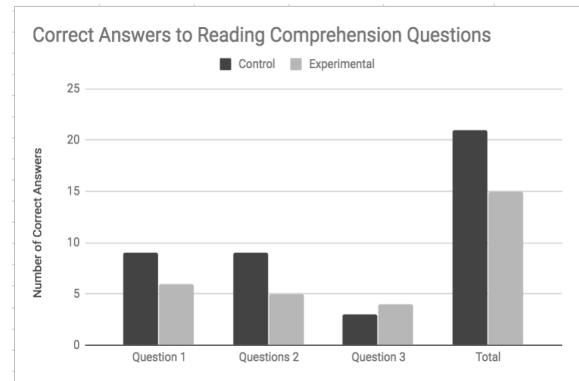


Figure 4: Above graph shows the amount of correct answers for experimental and control group

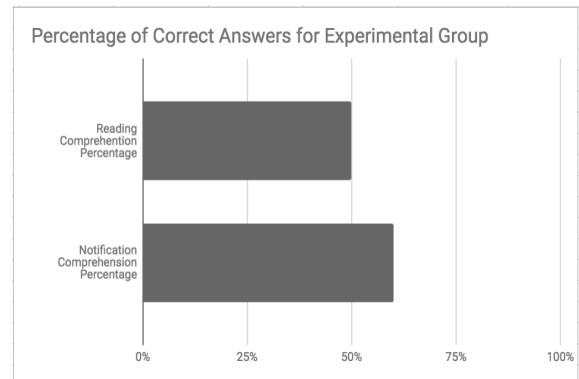


Figure 5: Above graph shows percentage of correct answers based on the passage or the distraction for the experimental group only

to 1. The average reading duration for the experimental group was longer than the control which was expected. The research group hypothesized that the difference would be much larger than recorded. Even though the difference in time to complete was modest, the researchers believe that the scan path of the participant was affected noticeably by the presence of a notification, diverting their attention. Figure 6 shows that without distractions a reader's scan path is more centralized and more focused on the passage. Before the notification appears the experimental groups scan path is very centralized and focused on the passage much like the control as shown in Figure 7. Once the distraction is introduced the user begins to fixate on that instead of the passage breaking their reading pattern as shown in Figure 8. When the reader stops fixating on the distraction they must find where they left off reading. The process of breaking from the passage to look at the distractions causes the reader to take longer to read the entire passage. The results, even though not statistically significant, support the hypothesis that introducing a distraction can affect a user's task comprehension and completion time. An interesting outcome of the experiment was the difference in comprehension between the reading passage and the distraction content. The experimental group appeared to

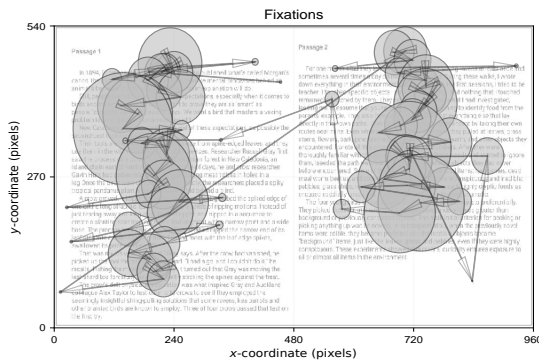


Figure 6: Fixations for a control participant

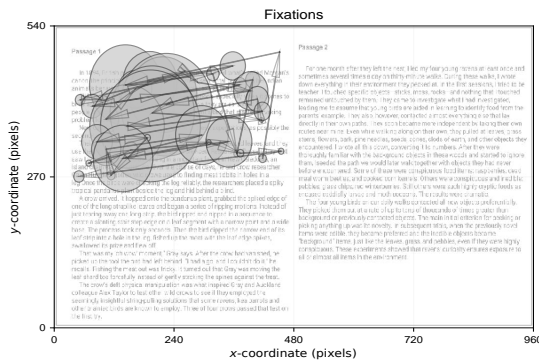


Figure 7: Fixations for an experimental participant before a distraction is introduced

have comprehended a larger proportion of information from the distractions than the actual passage. The research group would like to look into this phenomenon more for future work. Due to the small sample size for this study a larger sample size would be desirable for further work on the subject. In addition to a larger sample size it may benefit the overall quality of data if the reading passages contained more interesting subject matter, or less detailed questions in order to test for more general comprehension.

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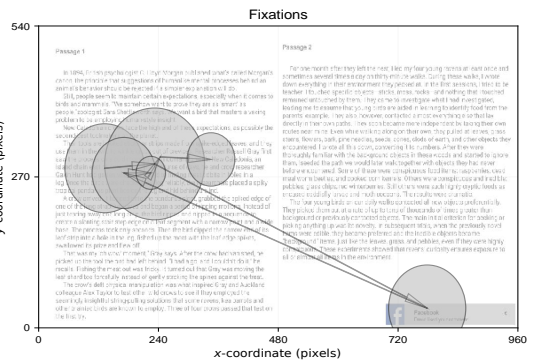


Figure 8: Fixations for an experimental participant when a distraction is present

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