Analyzing Gaze Transition Entropy in Film Titles Versus Posters

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ABSTRACT

In this experiment, we are replicating the studies of Gaspar et al. and their work with studying the effects of recommended items on behavior[1]. However, this study will alter their previous work by focusing on gaze transition entropy as opposed to saccade paths between items. Additionally, our study will decrease the number of stimuli while continuing to represent the items in either text or image form. The recommended items, being text or image, will be grouped in a categorical manner to remain constant across stimuli rounds.

KEYWORDS

gazepoint, eye tracking, recommendation, entropy transition, visual bias, area of interest

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1 INTRODUCTION

1.1 Goals and Motivation

There are many different places that items are recommended to viewers on a daily basis with all the time spent online. One place that a viewer is bombarded with recommendations is on any online movie or TV streaming application. These applications have spent a long time developing upon ways to keep a viewer invested and watching their certain streaming app.

In our study, we would like to develop upon this idea and see how a viewers eye may initially react to certain film posters and film titles and the differences between these two initial reactions. This initial gaze transition will be what our experiment is based upon. Knowing what poster or title is immediately eye catching to the participant could be very helpful in determining what type of image or text should be used in movie recommendation systems built in to the numerous different streaming applications we have today.

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1.2 Background

As seen in Gaspar et al. study, "Attention bias poses a fundamental issue when analyzing implicit behavior of the users on the Web." [1]. They focused on both position bias and visual bias. By asking the participant to focus on the center and then cast their gaze to whichever stimuli immediately catches their attention, we will have a good measure of the the gaze transition entropy a viewer may have when using online movie recommendation systems.

Gaspar et. al used several strategies to combat the bias such as implementing a validation target to re-center the participants eyes between each wave of stimuli. Additionally, they positioned the stimuli in a pattern that they hoped would not influence each participant to initially fixate on a specific AOI every time. The reason for this was because they predicted there would be one AOI that had a higher frequency of first fixations.

The results of this experiment showed that the validation target did help with some position bias. However, the results also showed an interesting finding about their participant's initial fixations prior to stimuli being shown. Rather than paying attention to the center target of the screen, most participants fixated on the top of the screen. This shows that they encountered position bias that could potentially be avoided with more clear instruction on where participants should position their initial fixation between rounds of stimuli.

1.3 General Hypothesis

We believe that our data will reflect the same results that Gaspar et al. study concluded: the participants gaze will follow a circular sequence when the movie title stimuli is shown, while upon examining the movie posters, the sequence will be broken and the participants standard gaze path will deviate. We also anticipate that the participants will initially fixate on the center of the screen following clear instruction which will allow for more concrete results as to the gaze transition entropy when the stimuli are presented.

2 STUDY OF VISUAL BIAS

In our study, we chose to focus on visual bias and the interaction between user fixations with movie titles and film posters. This will aid in the understanding of which recommendation tools are most beneficial for film production companies.

We chose to differentiate our stimuli into two categories: text and image. In total there are eight stimuli of each category (eight titles, eight poster images). Each round would consist of a screen of four stimuli of the same category. So, in total, there will be 4 rounds of four stimuli per round being shown to the participant in alternating order of movie titles and movie poster images.

2.1 Study Scenario

Apparatus: For our experiment we will be using Gazepoint GP3 eye trackers provided by the university in the eye tracking lab. These eye trackers use infrared and have a sampling rate of 60 Hz as well a 0.5 – 1 degree of visual angle accuracy. We used 5 point calibration on all our participants. The monitors in the eye tracking lab are at a resolution of 1680x1050 and have a diagonal width of 22 inches.

Setup: In this experiment, a participant will be sat down at a computer with a Gazepoint GP3 eye tracker focused on them. They will be told to calibrate the eye tracker and then the proctor will confirm the calibration completion. The experiment will then start and the proctor will prompt them to focus on a cross at the center of the screen between stimuli. Subjects will also be told not to predict the location of any of the stimuli. As the participant views the stimuli, the proctor will ask them to look at whatever stimuli initially catches their eye. In our experiment, we will focus less on the position bias and more on visual bias and gaze transition entropy.

Stimuli: Our stimuli will be four different film posters or movie titles (Depending on what round the participant is on) arranged in a circular pattern around a cross that the participant will focus on prior to each round of stimuli being presented (See figure 1). Both the image and text stimuli were displayed in the same fixed dimensions (cards). The two rounds of image-based stimuli will consist of film posters of similar visual appeal. Additionally, the two rounds of text-based stimuli will be similar as well. This will allow for better comparisons and prove better results.

Experimental Design: Each participant will go a total of four rounds, having the image-based stimuli alternating with the text-based stimuli, until the viewer has looked through a total of 16 stimuli. Each movie title and film poster will only be shown to the participant once. In other words, no image or title will be repeated throughout the participation. This will reduce any potential errors in the results associated with memory. Each set of stimuli will only last eight seconds each, before the user is prompted to focus on a cross in the middle of the screen to prepare for the next round of stimuli.

Process: When participants view each set of stimuli, they are asked by the proctor about which stimuli interests them the most in order to have the subject to really examine each stimuli. Between each round of stimuli, participants were asked to fixate on a tiny cross in the center of the screen for 3 seconds before the set of stimuli was presented. This ensures that participants are not hyper-focusing on one stimuli, picking the same image due to the location rather than preference, and seeing the same order of images. Once each participant has completed the four rounds of stimuli presentation, they will be told they can leave and to keep the experiment private from other potential participants.

2.2 Data Collection and Preprocessing

Our study was performed in controlled, eye-tracking laboratory conditions in the Clemson University eye-tracking laboratory. Data from the study was collected via Gazepoint GP3 through the eye transition entropy location. This data will show evidence as to which film recommendation tools work the best for movie production teams. The participants of this study will go through a series

	Movie Type	Presentation	No. of Stimuli
A	Random	Text	8
B	Random	Image	8

Table 1: The above table depicts our strategy for stimuli generation. We are using an equal number of stimuli, since our goal is to compare data for image vs. textual stimuli we wanted there to be balance between the two.

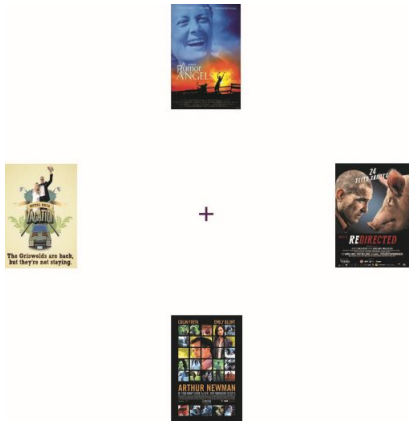

Figure 1: Example of the stimuli format that we will be using in the experiment. While the number of stimuli is different from the original experiment, the same circular layout is utilized to deter potential first fixation bias. After the stimuli is displayed, users had to fixate on the cross in the middle.

of setup steps. This includes calibration and validation of the eye-tracking machinery to ensure each round of the study is set to the proper positioning for each participant.

There will be exactly four Areas of Interest (AOIs) in our study, each representing a different movie poster or title. These will be analyzed after each round of stimuli to better understand which movie recommendation items seem to be the most popular among the participants. These AOIs will be compared to the observed fixations shown by each individual. If we see a pattern and match amongst the AOIs and participants fixations, it will show us conclusive evidence towards which movie posters/titles are the most visually stimulating and appealing. We chose to mimic the Gaspar et al. study and use the same error tolerance of 5px. This was set based on their previous observations and can be assumed to be fairly accurate and relevant to our study. Their experiment showed that a larger value of tended to lower the detection accuracy which could show more conclusive results. We will use this error of tolerance to account for any error in calibration or validation prior to the study being performed. This will ensure that any fixations within 5px of the AOI will still e counted as a fixation on that specific AOI.

3 STUDY RESULTS

There were a total of 11 participants in the study (9 males, 2 females); 10 participants listed their occupations as students (19-21 years old) while 1 participant was a college professor. A pilot study was

conducted with 1 participant, the professor, to identify problems and gain feedback on the overall experiment design. After this initial pilot study, some slight alterations to the technique were made and the rest of the participants all received the same treatment and instructions while participating. According to the results we found, most participants, after looking at the center cross and focusing their attention, would then dart over to one of the stimuli. There seemed to be no bias in what stimuli was initially selected. After looking at one stimuli, the participants would then, in general, follow a circular pattern while looking at all four stimuli. This was true regardless of if the stimuli was text or an image, which differs from our hypothesis and the Gaspar et al. experiment this was based on. Initially, we expected the participants to follow a circular pattern while looking at the text stimuli and when looking at the posters, their eyes would dart around and follow a more random pattern. According to the results though, this was not the case and a circular view pattern was the preferred method for all participants regardless of the stimuli type.

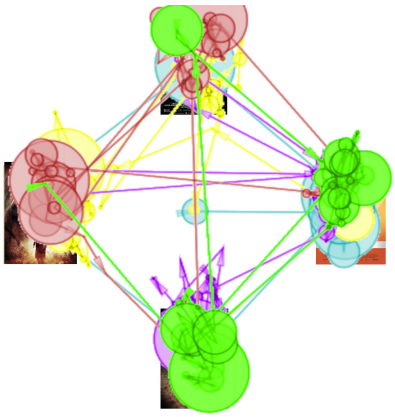

Figure 2: An example of some of the results graphing out the fixations and saccades of the participants while looking at one round of stimuli.

3.1 Position Bias

After learning from the mistakes and successes of the experiment done by Gasper et al., we chose to implement similar precautions to prevent position bias. First, we used a validation target that was positioned at the center of the screen. We informed our participants beforehand that between the various screens of stimuli, they'd be shown a screen that would bring their focus back to the center of the screen. This technique helped limit the effects of position bias on our participants. As seen in Figure 2, there were no noticeable fixations to show that any AOI had a higher frequency of having the first fixation than any other.

We believe that we were able to obtain these results due to our clear instruction between each round of stimuli. We learned from the Gaspar et al. experiment and chose to include textual instruction that ensured each participant's gaze would return to the middle of the screen. Rather than moving from one round of stimuli on screen to the next round immediately, we chose to include a buffer screen that gave the participant time to return their gaze to the cross hair in the middle. Opposite to the results of the Gaspar et al. experiment, the majority of our participant's initial fixations began in the middle of the screen, over the cross hair that they were directed to look at.

3.2 Fixation Size

As observed in Figure 2, all the participant's fixations and fixation paths are included. Specifically, this figure is showing one round of four poster image stimuli with each participant's associated fixations. The fixation paths mimic that of the Gaspar et al. experiment in which the participant's gaze followed a somewhat circular path with some deterrence in some of the participants. The participants are colored code as such: subject 1 as teal, subject 2 as red, subject 3 as green, subject 4 as yellow and subject 5 as purple.

The fixation size on each AOI does not show any conclusive evidence as to which stimuli attracted the first fixation. By analyzing Figure 2, it is evident that the positioning of the stimuli did not necessarily affect the initial fixation but rather it followed a similar pattern to that of the Gaspar et al. experiment. However, we believe that our participant's gaze path was even more of a strong circular pattern due to our decreased number of stimuli that we presented to the participant each round. This follows the prediction that visual bias will have a strong affect on our participants gaze path. Our results were able to show us that less stimuli per round added more visual bias for our participants. We believe this was because our participants were given more time to scan amongst the four stimuli presented and therefore causing them to follow a circular gaze path.

4 CONCLUSION

Our examination of attention bias in our experiment, with special focus on position bias and visual, .

Firstly, in terms of attention bias, our results differed from our original hypothesis. In our hypothesis, we believed that the data would match up with Gaspar et al. and we would find that when participants examined the text stimuli, they would follow a circular sequence, while upon examining the image stimuli, the sequence would be broken and participant's stand gaze path would change. Gaspar et al.'s finding did not reflect in our data.

We found that participants kept to a similar eye sequence pattern through both the text stimuli and the image stimuli. When examining the stimuli, participant's tended to follow a circular pattern around the stimuli, first checking each stimuli, before then breaking the pattern and bouncing around the stimuli as they waited for the next round of stimuli to begin. Nevertheless, participants always stuck to a circular formation upon initial inspection of the stimuli.

We believe that this change in eye pattern may be due to the decrease number of stimuli in our experiment. Whereas Gaspar et al. had stimuli displayed in sets of 8, we had decreased our stimuli to appearing in sets of 4 in order to simplify the experiment. As a result of the decrease stimuli, our layout looked more like a diamond formation than a circular layout. Further analysis and experimentation is necessary in order to consider the change in overall data results.

Secondly, our findings about position bias also differed from Gaspar et al. In the original experiment by Gaspar et al., they found that

subjects tended to start their gaze sequence on the AOIs at the top of the screen, despite the proctors instructing participants to focus on the center of the screen. We did not encounter such a finding in our experiment, with most of our participants starting their gaze sequence in the middle of the screen. However, we did find that a majority of subjects did tend to move up from the center look towards the top stimuli in their gaze sequence upon starting stimuli examination so, it appears that the people do have a tendency to focus on the top of the screen first.

Our participants gaze sequences started at the center of the screen, successfully deterring position bias. We believe that this change from the original experiment is because between each set of stimuli, we had a blank screen with only the cross in the middle for subjects to focus on for 3 seconds before the set of stimuli were displayed. We employed this strategy since our code was more simplified in comparison to Gaspar et al.

In the Gaspar et al. experiment, they had their code set up so that when subjects studied the stimuli, the stimuli would change by the participant focusing on the center of the screen for 4 seconds, a strategy that also served as a way to check calibration. Our setup was much more simple, with participants having 8 seconds to examine the stimuli before having a blank screen with only the cross for participants to focus on for 3 seconds before the next set of stimuli get introduced. This strategy appears to have successfully refocused subjects' gaze back to the center of the screen. Further tests are necessary to see if this pattern is replicable.

We strive to further understand the discrepancies between our data and the data of the Gaspar et al. experiment. Should we attempt another replication of the Gaspar et al. experiment, we would like to up the stimuli grouping to 8, however we would like to keep our experiment design quite the same, with breaks between each set of stimuli to refocus participants on the center of the screen. A deeper understanding of attention bias is necessary to truly comprehend visual bias between text and images.

REFERENCES

[1] Péter Gáspár, Michal Kompan, Jakub Simko, and Mária Bieliková. Analysis of user behavior in interfaces with recommended items: An eye-tracking study. In *IntRS@RecSys*, 2018.