Clickbait's Impact on Visual Attention – An Eye Tracker Study

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Abstract

In this paper, we have studied the impact of clickbait headlines on the distribution of visual attention on hyperlinked news articles. Visual attention is a driving factor in ad-based revenue models that support online journalism. Importantly, it is also an indicator of cognitive processes involved in reading and comprehension. We hypothesize that articles with clickbait headlines receive lesser visual attention when controlled for articles' content. This is based on the premise that a significant proportion of clicks on clickbait headlines are driven by readers' specific epistemic curiosity rather than knowledge acquisition. An eye-tracker setup was used to infer visual attention from the gaze-fixation analysis conducted on data from 60 participants. Our results suggest that clickbait headlines significantly reduce the visual attention on news articles. Though, article content comprehension measured by a recall test was comparable for clickbait and non-clickbait headlines. Our findings add to the discussions on the cognitive attention and the implications of using clickbait headlines for news publishers, newsreaders, and advertising agencies alike.

Keywords: eye-tracking, attention, visual-attention, clickbait

Introduction

Background

The modern journalistic landscape is evolving rapidly, as we witness an accelerating shift from traditional media to digital media [Franklin, 2014]. The driving factor here is a growing percentage of people that rely primarily on the internet for news consumption [Shearer, 2021]. As per the Reuters Institute's India Digital News Report, 2019, 56% of the sampled population under 35 years consume online news sources (including social media handles of news sources) [Zeenab Aneez and Nielsen, 2019]. This has dramatically eroded the financial barriers of entry and distribution in news media and has allowed for a democratization of journalism [Purcell et al., 2020] – today, small independent news sources can compete with traditional media houses for consumers on digital channels. On the other hand, this democratization has also led to a proliferation of questionable journalistic practices in a bid to attract eyeballs online and capture the elusive 'click' from readers, which is monetized by media houses through advertisements and subscriptions [Blom and Hansen, 2015, Molek-Kozakowska, 2013]. A common approach used by media outlets for this purpose is clickbait.

Understanding Clickbait

Clickbait is defined as catchy headlines that lure readers into clicking on them and are hyperlinked to accompanying articles [Chakraborty et al., 2016]. Facebook defines clickbait as "when a publisher posts a link with a headline that encourages people to click to see more, without telling them much information about what they will see" [O'Donovan, 2014]. That is, clickbait headlines rely on readers' specific epistemic curiosity, tapping into the observations made by Loewenstein in his Information Gap Theory[Loewenstein, 1994]. The text of a clickbait headline is framed in a manner that creates an 'information gap' for readers, who in turn proceed to click on the headline to fill this created information gap and satisfy their specific epistemic curiosity. Although the general perception is that clickbait headlines are limited to the fringes of news media, work published by Rony, Hassan, and Yousuf in 2017 has shown that mainstream news media also contains clickbait content. The percentage of social media posts having a clickbait headline being as high as 33.54% for mainstream news publishers [Rony et al., 2017].

The language and syntax of clickbait headlines are cleverly constructed to grab readers' attention. Headlines often pose a question, include spoilers or falsified/fake spoilers to arouse curiosity and get readers to click on the article. Additionally, clickbait headlines also use forward-referencing, where information present in the article is referenced in the headline, without providing any additional details [Blom and Hansen, 2015]. For example, *Lockdown extended in Odisha: This is what you're required to do*. In this actual real-world headline, the word 'this' refers to information that is supposedly present in the article, but no additional details on what the actual information has been provided in the headline.

While seeking readers' attention on social media and news websites in a digital environment with prevalent information overload, publishers' aspirations often extend beyond the benign intention of information sharing and knowledge transfer. A 2015 report by the Columbia Journalism Review discussed the case of an online news magazine which paid writers $100 per month, along with an additional $5 for every 500 clicks on their news stories [Murtha, 2015]. This trend of giving incentives to journalists to churn out clickbait headlines has led to a shift of writer focus, away from trustworthy value-added journalism, and towards the creation of digital serfs [Filloux, 2016]. Clickbait headlines have been shown to lower readers' trust in news items [Kaushal and Vemuri, 2021,

In J. Culbertson, A. Perfors, H. Rabagliati & V. Ramenzoni (Eds.), *Proceedings of the 44th Annual Conference of the Cognitive Science Society.*

Molyneux and Coddington, 2020]. Clickbait has also been shown to be a form of attention distraction for readers in cognitive studies; there is evidence that clickbait leads to higher stress, a bad mood, and lower productivity [Mark, 2014].

Attention and News Media

In the nascent years of experimental psychology, William James famously wrote, "Everyone knows what attention is. It is the taking possession by the mind, in clear, and vivid form, of one out of what seems several simultaneously possible objects or trains of thought.". In the decades since, attention has been widely studied with different experimental designs and approaches, yet an exact definition is debated in the research community [Lindsay, 2020]. McMains and Castner have defined visual attention as a set of cognitive operations that mediate the selection of relevant and the filtering out of irrelevant information from cluttered visual scenes [McMains and Kastner, 2009]. Hommel et al. put forward a compelling argument against the definition and usefulness of attention as a unitary construct [Hommel et al., 2019]. Nevertheless, despite the competing views and diverse definitions, the crux remains that attention is the flexible control of limited computational resources, which is of demonstrably high importance to information processing in the brain [Lindsay, 2020].

With the emerging prominence of digital news media, there has been active research on understanding readers' attention in online news consumption. Lagun and Lalmas explored readers' engagement with online news media through viewport time (position of the web page visible to the user at any point) data collected from 267,210 views on 1,971 pages of a major online publisher [Lagun and Lalmas, 2016]. They showed a strong positional bias in news reading.

Clickbait and Visual Attention

Digital news media results in an information overload for news consumers, given the number of sources – primary and secondary – and hence presents a cognitive challenge for readers to process the available information. This makes the maximization of visual attention on a news website or article the goal for media houses, considering the advertisement-dependent revenue model of most news publishers [Mings and White, 2000]. Besides impacting publishers' financial well-being, visual attention to news articles also has a direct role in the comprehension of news items. Partial consumption may lead to the propagation of half-truths, where readers contextualize consumed information with their bias and end up propagating misleading or outright false news.

There have been eye-tracking studies for understanding readers' visual attention on online news media sites, and print media [Leckner, 2012, Mosconi et al., 2008, Holsanova et al., 2006, Zambarbieri et al., 2008]. A 2017 study by Kruikemeier, Lechler and Boyer compared learning from news across different platforms and showed that visual attention on digital news media is more selective and not as diverse as visual attention on print media [Kruikemeier et al., 2017]. Gibbs and Bernas compared visual attention across newspaper, and TV-news oriented digital news media sites and reported variability in areas that attracted readers' attention [Gibbs and Bernas, 2009]. An eye-tracking study on print and digital news media showed that the form of news, as specified by design, layout, and visual cues, affects the patterns of interactive attention more than the medium itself [Bucher and Schumacher, 2006]. Our specific interest lies in understanding how clickbait headlines affect visual attention, keeping the cognitive heuristics of digital news credibility in mind. Such analysis will help understand whether clickbait negatively impact the financial sustainability of the advertisement-supported revenue model of journalism. To the best of our knowledge, empirical evidence for clickbait news headlines' impact on the distribution of attention to news articles and its correlation to motivation has not been presented to date. Hence, our work aims to investigate a) whether visual attention measures show a difference for articles with clickbait headlines, as compared to the same articles with non-clickbait headlines; b) whether the distribution of visual attention on articles varies when presented with a clickbait headline; and c) if the usage of clickbait headlines affects the cognitive recall of the articles' content.

Hypothesis

A noteworthy point in the context of visual attention on articles is Facebook's implementation of a filter on its platform in 2013, which identified and removed clickbait content by measuring the amount of time users spent on a page after clicking on a link [El Arini and Tang, 2014, Munger et al., 2020]. The underlying assumption here is that when users click on a clickbait link, they do not have a strong incentive to spend much time on the hyperlinked page besides satiating the curiosity which fueled their click. Hence, they will return to the platform quicker, resulting in reduced visual attention to the article. Through our work here, we wish to understand whether this behavior would hold in the event of news headlines that are clickbait in nature. We proposed the following hypothesis in this regard:

H_A : News articles with clickbait headlines receive lesser visual attention than news articles with non-clickbait headlines when the articles' content is controlled.

H_0 : The clickbait nature of headlines does not impact the visual attention that hyperlinked news articles receive.

Our study has quantified readers' attention through an eye-tracking setup, which records readers' gaze fixation. Gaze fixation has been used as a measure of readers' attention in eye-tracking studies on readings tasks [Ishimaru et al., 2016, Hernandez et al., 2017, Rayner, 2009, Frischen et al., 2007]. The importance a reader accords to a display area can be gauged from the fixation count or number of fixations, while fixation duration is a measure of the actual reading process. To support the data from eye movement, retention of articles' content is tested by a questionnaire.

We hope to understand the differences in the readers' attention distribution on articles with clickbait and non-clickbait headlines. The premise is that clickbait headlines selectively cue readers to focus on specific portions of a hyperlinked article – the segments that fill the information gap created by the respective clickbait headline. We have also collected credibility questionnaire responses for news articles from participants.

Methodology

Selection of Articles

Four Indian news articles were selected from the Webis-Clickbait-17 dataset of annotated news headlines and articles – a publicly available dataset used to train clickbait detection models. The articles selected dealt with news of the Indian context, since contextual familiarity is a pivotal component of the information gap that fuels the curiosity driving clicks on baiting headlines [Loewenstein, 1994]. Five independent human annotators annotated the articles as a part of the Webis-Clickbait-17 dataset preparation [Potthast et al., 2018]. Two of these selected articles had a clickbait headline, and the other two had a non-clickbait headline. Alternate headlines were generated for each article (a clickbait headline for an article with a non-clickbait headline and vice versa), and the headlines were pre-tested for 'clickbait-iness' using responses from 50 Indian participants recruited on Amazon's Mechanical Turk. It was also ensured that the word count of all the articles was less than 450 words to cap the average reading time at two minutes [Brysbaert, 2019].

Additionally, each article was divided into two areas of interest – the 'info' segment and the 'other' segment. This division was not visible to the participants but was used in our analysis to understand readers' visual attention distribution. The demarcation between the two segments was done based on the content referenced in the clickbait headline. The 'info' segment of an article contained text referenced in the respective article's clickbait headline, while the rest of the article constituted the 'other' segment.

Participants

60 English-speaking graduates (age - in years, $\mu = 24.05, \sigma = 3.85$) residing in India and familiar with Indian news who consumed news primarily in the English language were recruited to participate in the study with their consent for non-invasive eye-movement detection. Out of the 60 participants, 56 identified as male, and four identified as female. Participants were randomly divided into two groups – the control group and the test group. Participants in the control group were shown the chosen news articles with non-clickbait headlines, while participants in the test group were shown the same set of articles with clickbait headlines instead. A participation fee of Rs. 100/- each was provided to the participant.

Eye-Tracking Setup

Our study used the Tobii Pro X2-30 eye-tracking system to collect gaze fixation data at a frequency of 30 frames per second. The eye-tracker was set up in an isolated room with a display screen of 35.56 cm diagonal width. The participant was seated at a suitable distance from the screen (based on eye-tracker calibration feedback) and at a comfortable height to ensure a pleasant reading experience with optimum eye-tracking. Careful calibration was done to ensure that gaze fixations were being accurately recorded. Calibration was done with 5 points spread across the four corners of the screen and one at the center. The screen background for reading tasks was gray (RGB: 128, 128, 128) to avoid excessive strain on the eyes. A 10-second gap was provided between consecutive articles for the participants to relax their eyes. Tobii Studio internally uses the I-VT fixation filter algorithm to identify eye fixations [Komogortsev et al., 2010, Olsen, 2012]. As detected by the sensors, a cutoff of 80% eye data capture was applied to filter participants prior to the final analysis.

Experiment Flow

Two parallel tracks were created, one each for the control and test groups. While the articles were the same across both the tracks, clickbait headlines were used for the test group, while the corresponding non-clickbait headlines were used for the control group. These articles were presented in a random order for each participant to eliminate confound effects. Participants were informed that they were free to read the articles as they usually do with no specific instructions to focus on any part. This was to closely emulate the free-scrolling reading behavior prevalent in the consumption of digital news media. After reading through the four articles along with the eye-tracker setup, participants were provided with three questionnaires.

Surveys and Questionnaires

At the end of the eye-tracking study, participants of both groups were presented with the following three questionnaires:

Recall Test Two questions each from the four articles were presented to participants with four multiple-choice options, along with a 'Do not recall' option. These eight questions were used to assess participants' ability to recall details from articles read.

Trust in News Media Questionnaire The "Trust in News Media" multidimensional scale for the assessment of trust in news media was administered [Kohring and Matthes, 2007]. The measure is a standard scale identified using a factor analytical approach on four sub-components. Each represents an essential contribution to trust in news media – selectivity of topics, selectivity of facts, and accuracy of facts depictions, and journalistic assessment.

Demographic Survey The participants provided a self-report on demographic parameters like age and primary language of news consumption. This survey was anonymous and non-identifying in nature.

Data Analysis

Levene's Test Levene's test was used to assess the equality of variance for collected data as a critical assumption for parametric tests. When the equality of variance was violated, non-parametric tests were used instead.

D'Agostino-Pearson Test The D'Agostino-Pearson Test was conducted on all data collected to check for normality of the distribution. Normality of the distribution is a crucial assumption for parametric tests. Hence, when the assumption was violated, non-parametric tests were conducted instead.

One-way ANOVA Test The one-way ANOVA test was administered to study the significance and impact of independent variables on dependent variables for the effect of clickbait headlines on participants' recall scores, normalized gaze-fixation duration on 'info' segments, 'other' segments, and the entirety of the news articles. The pre-conditions of normalcy and equality of variance were verified before conducting this parametric test.

Kruskal-Wallis H Test The Kruskal Wallis H test was used as a weaker non-parametric alternative to the one-way ANOVA test when the assumptions of normalcy or equality of variance were violated for the data being analyzed. Notably, the Kruskal-Wallis H test was used to analyze the impact of clickbait headlines on the reported credibility of news articles, as the distribution was not found to be normal – violating the required pre-condition for parametric tests.

Correlation Test Pearson's correlation coefficient *(r)* was calculated for normalized gaze-fixation duration and participants' recall, as both the distributions met the required pre-condition of the normalcy of distribution.

Results

Gaze Fixation Duration

The observed distribution of normalized gaze fixation duration across all articles for both the control and test groups met the required criteria for parametric tests. Hence a one-way ANOVA test was conducted to evaluate the significance of differences. The normalized gaze fixation duration across all articles was found to be significantly higher ($F_{1,238} = 11.68, p < 0.001$) for the control group ($\mu = 0.37, \sigma = 0.23$) as compared to the test group ($\mu = 0.27, \sigma = 0.21$). This implies that the usage of a clickbait headline significantly reduced the visual attention received by articles.

Similarly, the normalized gaze fixation duration for 'other' segments across all articles was found to be significantly higher ($F_{1,238} = 9.81, p < 0.005$) for the control group ($\mu = 0.35, \sigma = 0.23$) as compared to the test group ($\mu = 0.26, \sigma = 0.22$). The normalized gaze fixation duration for 'info' segments of all articles was found to be higher for the control group ($\mu = 0.38, \sigma = 0.23$) as compared to the test group ($\mu = 0.33, \sigma = 0.22$), although in this case, the difference was only found to approach significance ($F_{1,238} = 2.83, p < 0.10$) *(Table 1)*. The results are plotted in *figure 2* and the heatmap representation plots are shown in *figure 1*.

Gaze Fixation Count

The observed distribution of normalized gaze fixation count across all articles for both the control and test groups met the required criteria for parametric tests. Hence a one-way ANOVA test was conducted to evaluate the significance of differences. The normalized gaze fixation count across all articles was marginally higher for the test group ($\mu = 0.48, \sigma = 0.25$), as compared to the control group ($\mu = 0.53, \sigma = 0.27$) but the difference was not found to be significant ($F_{1,238} = 2.15, p = 0.14$).

No difference was observed between the normalized gaze fixation count for 'info' segments across all articles for the test group ($\mu = 0.54, \sigma = 0.25$) as compared to the control group ($\mu = 0.56, \sigma = 0.27$). While the normalized gaze fixation count for 'other' segments across all articles was found to be significantly higher ($F_{1,238} = 3.99, p < 0.05$) for the control group ($\mu = 0.48, \sigma = 0.26$) as compared to the test group ($\mu = 0.42, \sigma = 0.25$).

Recall Test

The recall of articles, tested through a multiple-choice questionnaire with two questions per article was slightly higher for the control group ($\mu = 4.40, \sigma = 1.99$) as compared to the test group ($\mu = 4.23, \sigma = 1.87$), although the difference was not significant ($F_{1,58} = 0.11, p = 0.74$). A significant positive correlation was observed between recall and gaze fixation duration ($r = 0.21, p < 0.001$).

Other Results

The credibility of news articles, as measured through the Kohring and Matthes 'Trust in News Media' questionnaire, was found to be marginally higher for the test group ($\mu = 34.85, \sigma = 3.72$) as compared to the control group ($\mu = 32.85, \sigma = 4.65$), but the difference was not found to cross the threshold for significance ($H_1 = 3.30, p < 0.10$). 41 participants reported Social Media as one of their primary sources of news. Thirty-six reported News Websites, 30 reported Mobile-based News Apps, 15 reported TV News Channels, while only 9 reported Newspapers among their primary sources of news. The distribution of news sources is highlighted in *figure 3*. 59 out of the 60 participants reported a digital source of news – mobile news apps, news websites, or social media, amongst their primary news sources.

Discussion

The observed higher normalized gaze fixation duration for the control group as compared to the test group indicates that articles with non-clickbait headlines receive greater visual attention than articles with clickbait headlines when controlled for the articles' content. This observation is in agreement with our hypothesis. Noticeably, this result cascades to 'other' segments of the article but is not significant for 'info' segments of articles, implying that the parts of articles for which readers' have been cued by a clickbait headline receive compara-

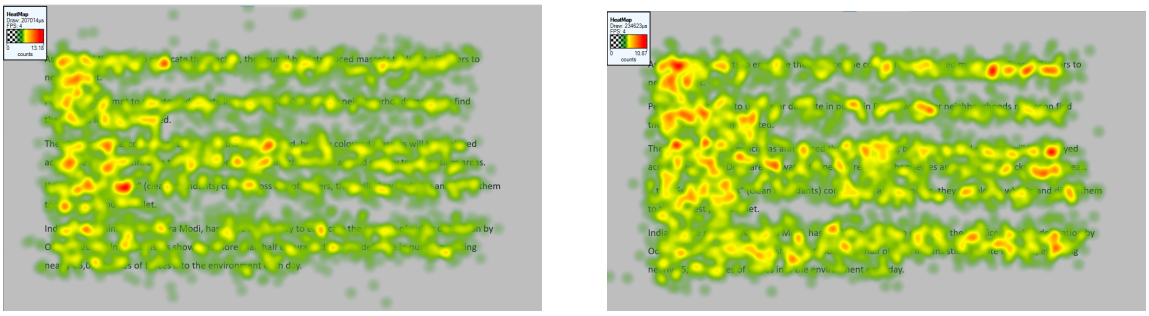

Figure 1: Heat-map of the fixation of all participants of the test group (left) and control group (right) on the same article, when presented with a clickbait headline compared to when presented with a non-clickbait headline respectively. A higher concentration of fixation counts is evident on the right, especially towards the bottom-most paragraph of the page, which was a part of the 'other' segment of the article.

Article Segment	Control Group	Test Group	Significance
Info	$\mu = 0.38, \sigma = 0.23$	$\mu = 0.33, \sigma = 0.22$	$F_{1,238} = 2.83, p < 0.10$
Other	$\mu = 0.35, \sigma = 0.23$	$\mu = 0.26, \sigma = 0.22$	$F_{1,238} = 9.81, p < 0.005$
Total	$\mu = 0.37, \sigma = 0.23$	$\mu = 0.27, \sigma = 0.21$	$F_{1,238} = 11.68, p < 0.001$

Table 1: Normalized gaze fixation duration across all articles for control and test groups. One-way ANOVA test was conducted to evaluate the significance of observations. Differences between the control and test group were found to be significant for 'other' segment across all the articles and the full text of all articles, while it was only found to approach significance for the 'info' segment of all articles.

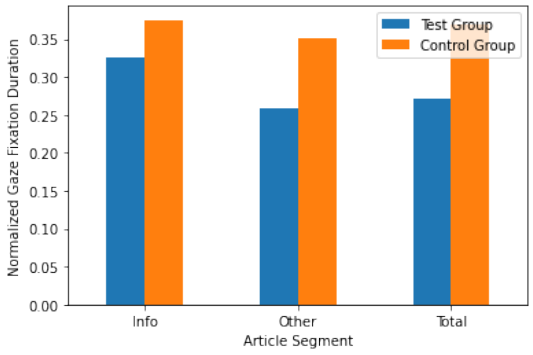

Figure 2: Normalized gaze fixation duration across all articles for the test and control groups. The reduction in gaze fixation duration when the same set of articles are presented with a clickbait headline instead of a non-clickbait headline are evident.

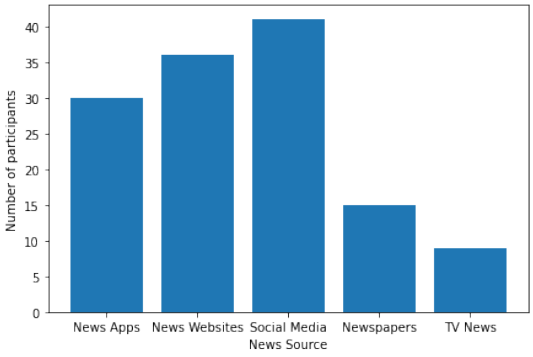

Figure 3: An overwhelming majority of the participants reported digital news media amongst their primary news sources. Additionally, 41 out of the 60 participants included Social Media in their reported primary news sources. Note that the number of participants presented here aren't mutually exclusive, participants were allowed to select multiple news sources.

ble visual attention, unlike the rest of the article. A driving factor behind readers' click on clickbait headlines is the satisfaction of their roused specific epistemic curiosity. The info segment of articles contains this information, which fills the information gap created by clickbait headlines. This aroused curiosity is not sustained for other segments of articles, and hence, overall, the visual attention received by an article is negatively impacted by a clickbait headline. The importance readers give to a particular section of an article, as inferred from fixation count data, also shows that the control group has higher fixation counts for 'other' segments of articles than the test group. This supports the observations for fixation duration, and together these findings validate our hypothesis.

A significant positive correlation was observed between visual attention and the recall questionnaire measuring article comprehension. This observation has also been seen in the existing body of research on attention and comprehension [Solan et al., 2007]. Though, no significant difference was observed in the recall of articles for the test and control groups. Despite articles with a non-clickbait headline attract-

ing greater visual attention, it only resulted in a marginally higher recall for the control group, which failed to meet the threshold for significance. This could imply that articles with non-clickbait headlines do not achieve higher comprehension despite attracting greater visual attention. This needs to be explored with a more extensive set of clickbait articles, more elaborate recall testing, and higher-order comprehension.

Existing research shows that clickbait headlines hurt the credibility of news articles [Molyneux and Coddington, 2020, Kaushal and Vemuri, 2021]. Although in the observations presented in this paper, we did not find a significant difference between the credibility of articles when presented with clickbait and non-clickbait headlines. A point to be noted is that due to the eye-tracking setup and the nature of the experiment, it was not feasible to include the 'Trust in News Media' credibility survey for each article separately immediately after the article was read. Hence, a single credibility questionnaire for all four articles read was presented after the recall study at the end of the experiment. This could have limited the number and the quality of responses to the credibility survey. Additionally, the small participant size and a perception of being observed in a lab experiment might also have impacted our measurements on credibility.

In agreement with many previous media and research reports, in our demographic survey we observed that 41 out of the 60 participants reported social media as a primary source of news. The proportion was an overwhelming 59 out of 60 participants for the tally on digital news source amongst their primary news sources. These observations are in agreement with existing research that points to an accelerating shift in news consumption from traditional sources of media to online news and digital media [Bergström and Belfrage, 2018, Purcell et al., 2010, Franklin, 2014]. While online news and the sharing of information on social media democratizes media and supports the right to free speech and expression, in light of the research on clickbait and fake news, there is a strong need to study readers' news consumption and comprehension of online information in depth. This also includes the impact of practices like clickbait and fake news on visual attention, especially with the dependence of digital journalism on advertisement-driven revenue.

With an overwhelming dependence of online news media on advertisement-based revenue [Kirchhoff, 2009, Holcomb and Mitchell, 2014], our observations raise concerns around the proliferation of clickbait headlines and its impact on the sustainability of ad revenue-based journalism. Additionally, the lower visual attention on articles due to clickbait headlines may also concern news publishers seeking meaningful reader engagement. A concerning observation here is the dilution of the news consumption experience for readers through lowered visual attention on segments of the article which are not referenced in the respective clickbait headline (*'other' segment*), which usually contains the context.

Conclusion

This paper looked at visual attention on news articles as measured using eye-tracking and gaze-data analysis and how clickbait headlines impact this visual attention. Additionally, articles' comprehension was studied through recall questionnaires. We observed that clickbait headlines significantly reduced the visual attention received by news articles when controlling for articles' content. This reduction was most evident in the segments of an article with information not tagged or referenced by its clickbait headline. A strong positive correlation was observed between visual attention and recall of articles, albeit the negative impact of clickbait headlines on articles' comprehension was marginal and failed to cross the threshold for significance. In the information overload of virtual spaces and diminishing readers' attention spans, the balance between 'clickbait,' article authenticity, and comprehensive knowledge sharing or reporting is essential for social and political stability. Clickbait can also morph into a tool for the rapid propagation of falsehoods and fake news. Given the seriousness and age of new media platforms, a consensus should be reached on how information is shared, and new metrics should be devised for credibility, trust, and authenticity.

Limitations

Due to restrictions on travel and interactions imposed by COVID-19, all of our data was collected from students with arguably homogeneous education backgrounds, medium of news consumption, exposure to clickbait, and age. Further experimentation is needed to draw conclusions on visual attention for broader sections of the population. Additionally, the design limitation on articles' length and recall questionnaire considered participants' motivation and sustained interest, limiting the set of articles administered.

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