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DOES NUMERACY IN DIGITAL JOURNALISM INCREASE STORY BELIEVABILITY? EXPERIMENTS COMPARING AUDIENCE PERCEPTIONS FROM THE US, ZAMBIA, TANZANIA

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ABSTRACT

This exploratory study contributes to the literature on numeracy in digital journalism studies by theoretically incorporating the audience/news consumers. While most studies have focused on journalists' perception and role in the use of numeracy, this study examines how audience perceive stories with numerical values. Through an experimental design, and by comparing the United States, Zambia, and Tanzania, the study was able to demonstrate that news stories with numerical values diminished audience/readers' affective consumption. In other words, news stories with numerical values were negatively associated with audience appeal. However, individuals with a lower understanding of probabilistic and numerical concepts seemed to trust news stories with numbers more than those with a higher level of numeracy. This was especially true in Zambia and Tanzania where most participants recorded lower numeracy levels. The overall sample in all the three countries seemed to favor news stories with less or no numeracy.

Keywords: numeracy; digital journalism; audience perception; audience appeal; digital storytelling

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1 INTRODUCTION

The rapid transition from traditional to digital journalism across the globe has inevitably led to multipronged debates of the credibility of online news reporting (Ausserhofer, et. al., 2020; Ekström & Westlund, 2019; Lecheler & Kruikemeier, 2016; Cassidy, 2007). To improve and increase media credibility, several strategies have been suggested since the development of digital journalism. These strategies include but are not limited to nuanced and rigorous journalism education and training (Pickard & Williams, 2014), different reporting styles that befit digital journalism (Molyneux & Coddington, 2020; Ferrucci & Vos, 2017; Franklin, 2014; Vis, 2013; Westlund, 2013), as well as the use of number in journalism reporting. Accordingly, these strategies help provide augmented and substantial arguments in news reporting (Diakopoulos, & Koliska, 2017; Coddington, 2015; Appelgren & Nygren, 2014).

Defined as the “ability to understand and use probabilistic and numerical concepts (Peters, 2020)”, scholars continue to question the feasibility of delivering a message that most of the audience can resonate with (Stalsh & Borges-Rey, 2018; Nguyen & Lugo-Ocando, 2016). A myriad of studies suggests that most audience are less equipped with numeracy competence. In most of sub-Saharan Africa, for example, several studies have raised concerns about how the ideas of numeracy in journalism could be Western-oriented, and thus disregarding the needs of an African audience (Middleweek & Mutsvairo, 2020; Ugangu, 2020; Kerunga, et. al., 2020; Ezumah, 2019). Such studies suggest the idea of knowing the abilities that your audience possess in understanding your news stories – we write for our audiences and not for ourselves. Breit (2020), for example, calls for environmentally relevant approaches that ensure cognitive relevance through cognitive flexibility to allow the reportage of relevant information in and for a particular social context. This argument calls for the ability to understand your audience in your reporting.

This study contributes to the literature by exploring how the audience perceives the use numeracy in the news. The study used experiments to compare audience’s perception of numerical values in Zambia, Tanzania, and the United States. Several existing studies have taken a journalistic perspective to explore the importance of numbers in journalism stories (Lewis & McAdams, 2020; Borges-Rey, 2016). While this is important, a gap in research on how the audience perceives and feels about numbers has been created. Particularly, there is a dearth of research on the relationship between numeracy, audience attention to numbers, and their attitude to stories with numerical value. This study attempts to fill that gap. Does the quest for numbers in journalism aligns with the audience’s ability to interpret those numbers?

2 LITERATURE REVIEW

Numeracy as a concept in journalism studies has become popularized by data and digital journalism, or the gradual shift of editorial content from traditional approaches, such as print, to online or internet distribution (Jones & Salter, 2011; Kawamoto, 2003). While debates about the necessity of numeracy in journalism are still ongoing, some scholars such as Tiede, et. al., (2020) have classified two types of journalists that use numeracy in their stories: Those who use it for their actual ability and belief that they tell a compelling story (objective numeracy) versus those who just prefer the use of numbers even when they do not fully understand them (subjective numeracy). Most scholars hold the idea that numeracy, when used correctly in media reporting, does indeed help tell a compelling journalistic story. However, there is still a limited understanding among journalists and scholars on how numbers should be implemented in the news stories, and what that kind of journalism should be called (Cohen, 2019). For some, it is digital journalism, while others call such kind of reporting as ‘data journalism’. The major characteristics of the two terms are “numeracy” and “quantitative literary”, which have also been understood in ontological, rather than epistemological terms, therefore, delimiting a sphere of knowledge and competence (Harrison, 2020, p.26).

As Swain (2012) had earlier noted, “numeracy in journalism refers to the understanding of numbers and statistics for the purpose of minimizing common errors in journalistic reporting” (p. 2). This is consistent with several studies that perceive journalistic shortcomings as emanating from the inadequacy of skills in numeracy (Maier, 2002; Genis, 2001). A more closely and compounded definition comes from Peters (2020) who defines numeracy as “the ability to understand and use probabilistic and numerical concepts” (p. 5) among those with the ability to use numbers (objective numeracy) versus those who only prefer the use of numbers (subjective numeracy) regardless of their abilities. Generally, the process involves the use of huge datasets that are ‘quantitatively analyzed’ and interpreted either through visuals or narratives. As Appelgren & Nygren (2014) had put it, “data journalism stories are usually based on large data sets that often consist of public data or data collected with the aid of the general public, i.e., so-called crowdsourcing” (p. 394). Nonetheless, the plethora of definitions does not make it easy for understanding the distinctions between numeracy and digital/data journalism. What holds the two together is the quest for not only telling a compelling story, as Swain (2012) had suggested, but also for the purpose of telling a story that the audience understands and trusts as true (Gondwe, 2018; Appelgren & Nygren, 2014). This means that numbers that complicate a story to the audience are devoid of telling a true and credible journalistic story.

2.1 Numeracy as a form of credibility and trust in the news

Many scholars assert that numeracy in the news increases news story quality by creating a more in-depth approach (Borges-Rey, 2016; Appelgren & Nygren, 2014; Gray, Chambers & Bounegru, 2012, Maier, 2003). Maier (2002) asserts that innumeracy or the lack of numerical values in the news has been found to contribute to inaccurate and misleading news stories. For Maier, stories consisting of numeracy are more trusted than simple narratives with qualitative data. As he argues, stories of numeracy have provided a reliable confidence level of accuracy in reporting. Drawing from various findings Maier (2002) showed that empirical research supported his argument as indicated in the following statement:

For example, Charnley's seminal accuracy study in 1936 found that only 6.3% of factual errors reported by news sources involved "numbers wrong," ranking fourth highest out of 12 error categories.¹¹ In a recent study, Maier found that "numbers wrong" represented 14.6% of factual errors, ranking third of 13 error categories.¹² A content analysis of a Canadian daily newspaper revealed a very small proportion of numbers in news stories—about 3% of 2,053 calculations identified over a three-week period—contained mathematical errors or misrepresentations of data. (p. 922)

Other scholars have supported this observation, including most contributors in Nguyen's (2018) edited volume entitled, "News, Numbers and Public Opinion in a Data-Driven World". Central to their arguments is that numbers in the news provided readers with an understanding of what robust and thoughtful statistical reasoning can offer to journalism. However, several concerns can also be observed in the above arguments. First, the studies on accuracy of numeracy are not in comparison to other stories without numeracy. Second, several studies have shown that most people, because of being number-phobic, are likely to believe erroneous information presented with numbers (Peters, 2020). For example, Crettaz Von Roten (2016) pointed out that most statistical information in the media were used – this is because of the assumption that numbers amount to accuracy. Crettaz Von Roten observed through an analysis that most news stories provided misleading visual representations, incomparable data sets and misapplication of statistical terminology. This argument is consistent with Len-Ríos & Hinnant (2014) who found out that most stories with numerical values were replete with technical language, and that those with visuals seldom added to the understanding of the news. These conflicting arguments suggest that in both accounts, errors or inaccuracies lead to the lack of credibility and trust of the news media. This is because errors and

inaccuracies blur transparency in the news, therefore, impact the trust that people have for that organization (Fisher & Hopp, 2020).

2.2 Numeracy and journalism in Sub-Saharan Africa

Although the idea of numeracy in journalism stems way back in the history of news reporting, it is also true that most journalists around the world are number-phobic. This is also true in most sub-Sahara African countries where low levels of numeracy among journalists have been identified (Genis, 2001) As Brand (2008) had observed, “Low levels of numeracy among journalists in South Africa cannot be seen in isolation from broader social and educational problems facing the media in most sub-Saharan Africa” (p. 218). In support, De Beer and Steyn (2002: 13) argue that the ‘core knowledge needed by journalists is changing’, but the education and skills training of journalists have not adequately reflected this change. Some critiques have argued that an aversion to mathematics and the use of numerical values or quantitative data is a reason why some journalists choose journalism as their career (Gondwe, 2021a and b; Ferrucci, 2020; Harrison, 2020).

The early days of print media seemed to privilege numbers especially when it came to reporting military activities, mortality rates, and commodity prices (Harrison, p. 33). Such form of reporting required less manipulation or interpretation of data since it simply recounted numerical values in a binary. A few, but stipulated forms of reporting, such as “Financial/business reporting”, did indeed need some advanced levels of understanding. The increasing prevalence of sports journalism in the nineteenth century, too, led to more statistics appearing in newspapers, again rarely requiring numeracy skills on the part of the journalist. Equally, election results also gave totals for each party. However, such kind of reporting was not for everyone, but those with special interests to the topic.

Regardless, the landmark of numeracy in journalism is attributed to Philip Meyer’s 1973 *Precision Journalism* publication— now in its fourth edition (Meyer, 2002) in which the author idolized computer-assisted reporting (CAR). For Meyer (2002) the availability of datasets provided room for journalists to expand their sources from depending on humans, to extracting objective data from existing databases. Accordingly, he argued that “journalists had to be database managers, data processors, analysts and interpreters” (p.1). Similarly, Grundy et. al. (2012) had argued that, “If you thought getting into journalism was a good career choice because you hated doing mathematics at school, think twice” (p. 96). Despite this emphasis, the journalism curriculum did not fully emphasize the need for numeracy – therefore attracting a huge number of students that felt uncomfortable with numerical values. This trend was also transferred to

qualified journalists operating in the field. For example, MagScene (2020) observed that when most scholars and journalists are asked what skill other than writing is necessary for a good journalist, their response is as follows:

You need to be enthusiastic, determined, have great ideas and you need to be able to get things done. Incredibly talented writers simply don't make it if they can't meet their deadlines. In an age of multi-media journalism, you also need to be skilled across a range of platforms, as well as be the face of your magazine at various events and networking functions. All round communicators are in strong demand (p. 30).

Obviously, skills for analyzing and interpreting data continue to be less emphasized in the practical process of professional journalism reporting. If acknowledged, most consider numeracy as only a tool for measuring the effectiveness of editorial content (Harrison, 2020) and handing quantitative information. In one of his chapters, "Numeracy's Secret connection with life outcomes", Peters (2020) asks, "Why should we care if people don't understand or use numbers well? After all, their physicians, financial advisors, friends or family can straighten them out" (p.101). While this is a relevant question to ask and a relevant assertion to make, it is also arguably true that this question begs more answers, when it comes to the field of journalism. Probably, the most relevant question is, whom do we write for? As you might have observed in the accounts above, the ideas of numeracy across the historical development, have ignored the role of the audience. This is not to suggest that the use of numeracy and data in news reporting is irrelevant, but that audience perceptions of numeracy in the news stories are as important as the role of journalists in effecting credibility through numeracy. To fill the gaps in literature, we ask the following question:

RQ: *How do the audience/news consumers perceive news stories with numerical values?*

And thus, we hypothesize that:

H1: *News stories with numerical values diminish reader affective consumption of that news story.*

The rationale behind this hypothesis lies in the idea that most news consumers are uncomfortable with stories accompanied by numerical (Except a few that have the ability and special interest in numbers (objective numeracy). Therefore, the more numbers are added to a news story, the less the story will appeal to the audience.

H2: *That there is a relationship between objective numeracy and attention to numbers; and that the relationships vary between the United States and Zambia and Tanzania.*

Hypothesis two (H2) aims at exploring the relationship that exists between individuals possessing the ability to understand the numbers (objective numeracy) and the attention they put they have for the numbers found in the story. In other words, those with interest and the ability to understand numbers will be attentive to the details and meanings of numbers in the news story than those with less ability to understanding numeracy in news stories. Therefore, we ask the following question. The US is especially included for two main reasons: Convenience, and for the purpose of comparing numeracy levels in different countries outside Africa.

3 METHOD AND MATERIALS

3.1 Data collection process

This study employed an experimental design to examine whether numeracy in a news story increases story trust and believability from the audience perspective. Data for this study were collected from Zambia, Tanzania, and the United States through a survey experiment after receiving Institutional Review Board (IRB) approval of the project in May of 2020. The data collection period was June through August 2020. Participants from the United States were recruited with an incentive from the Amazon Mechanical Turk (MTurk) population using TurkPrime. According to Buhrmester et al., (2011), TurkPrime is a managerial interface that helps researchers better ensure that obtained data are high quality. This assumption is supported by Litman et.al., (2016)'s study in which the authors were show that how "TurkPrime GUI environment provides improved functionality over MTurk in six general areas: control over who participates in the study, flexible control over running HITs, more flexible communication and payment mechanisms, tools for longitudinal and panel studies, tools to increase sample representativeness, and enhanced study flow indicators" (p. 434). However, external validity may be slightly problematic for Mturk samples (Berkinsky 2011) as respondents self-select based on the title of the survey, projected amount of time to complete the survey, and level of compensation offered.

On the other hand, participants from Zambia and Tanzania were recruited from avid readers and followers of online media platforms, particularly the *Jamii Forum* (a popular online news media platform in Tanzania) and *Mwebantu* online news. Both platforms host more than 50

million participants, and with more than 5,000 daily active participants. Participants from Zambia and Tanzania were invited with a request message to respond to email with an expression of interest to participate in the study. In both the United States and the sub-Saharan case, a pre-test questionnaire was provided to assess the quality of our respondents in terms of readership, age group (accepting only those above the age of 18), gender (to ensure that both genders were significantly represented, and location (to ascertain that participants were indeed living in Sub-Saharan Africa, and especially Zambia and Tanzania where this study was conducted from). The experiments in the three countries were all hosted on Qualtrics which was able to randomly assign respondents to the control or treatment groups run in conjunction with each other. This technique allowed for true randomization in each experiment rather than flagging a respondent as control or treatment at the beginning and having them follow that path in each of the experiments embedded into the larger survey. Bondrunova, et. al. (2016) approaches were utilized for determining authentic respondents online.

3.2 Sample selection process

A total sample of 387 from the United States, 219 from Zambia, and 267 from Tanzania complete responses were obtained ($N = 873$). The average age for the three countries were 33 years for the US ($SD = 4.49$), 27 years for Zambia ($SD = 2.87$), and 35 years for Tanzania ($SD = 5.72$). Gender was also scientifically divided with 61.3% representing the female US participants, 53.2% representing female participants from Zambia, and 47.6 % representing females from the sample in Tanzanian. Median completion time for the study in the three countries was 245, 331, and 203 seconds respectively.

Condition assignments also varied by country. In the US, 173 participants were randomly assigned to a control group while the remaining 214 served as an experimental group. Zambia had 100 randomized participants to a control group and 119 to an experimental group, and Tanzania had 121 in the control group and 146 in the experimental group. Most of all, before testing the hypotheses, we accounted for missing data based on overall responses. Little's (1988) MCAR test was used and indicated that the data were missing at random, $X^2(318) = 319.87, p > .52$. Thus, cases with missing variables were dropped, resulting in an analytical sample of $N = 873$ participants.

3.3 Stimuli Development

The experimental design consistent of three distinct stages. Participants were invited to the study via Amazon MTurk and through direct online contact in Zambia and Tanzania. Particularly, the Zambian and Tanzanian participants were invited through online platforms and asked to respond to an email provided to them expressing interest to participate in the study. In both the US and Zambia and Tanzanian cases, the respondents were promised an incentive. The respondents on MTurk received \$ 0.15 cents and the Zambian and Tanzanian participants were entered into a draw to win \$25 for the first four selected participants ($\$25 \times 4 = \100). Second, respondents were asked to do a 10 -question quiz for the sake of assessing their knowledge and understanding of the COVID-19 pandemic. The criteria were that those who got above 70 percent of the results would be recruited for the study. Third, each of the recruited candidate was randomly assigned to either a treatment or control group. The Qualtrics was used to randomly assign respondents to the treatment or control group.

For each country, one treatment groups and one control group were generated for the experiment. The treatment groups were exposed to a news story about COVID-19 from the New York Times published on June 30, 2020 by Carl Zimmer¹. We picked a story that addressed the issue of a global pandemic and that was easy to manipulate for numeracy purposes. The idea behind was for all the participants to feel included in the story. This allowed for objective responses from the respondents. Therefore, we stripped of all the identifiers from the story – i.e., story source and author. Then we rewrote the same story in two forms. The first form included a traditional style by which we qualitatively rewrote the story to exclude all forms of numeracy. In other words, this kind of rewriting focused on giving the narrative without the numbers even when the numbers were in the original story. The second rewrite focused on numeracy in the story but deliberately infusing the story with inaccurate numbers, therefore, changing the whole narrative of the story.

On the other hand, the control group received the same but original data-driven news story, and the accurately qualitatively rewritten one that was also offered to the treatment group. Then both the treatment and control groups were asked to respond to the same survey provided to them. In each case, story believability was measured through message attitude, knowledge and understanding of the COVID-19 pandemic, appeal, and story trust or news trust. These variables were operationalized through various survey questions drawn from several scale measures.

¹ <https://www.nytimes.com/2020/06/30/science/how-coronavirus-spreads.html>

3.4 Measures and manipulation of variables

Since this research is cross-national, two measures were used for the purpose providing an objective assessment to the participants from three countries under study. 1. *Objective numeracy*: simply referring to the actual ability and skills to understand numbers in the news and 2. *Subjective numeracy*: as the preference for numbers in the news even when one has limited numeracy skills. The two measures were weighted on the variables of numeracy, message attitude, knowledge and understanding of the COVID-19 news story, appeal of the story, and news trust. Essentially, we developed a survey questionnaire aimed at gauge the readers' perceptions, attitudes, and trust of the news item presented to them. In other words, we wanted to know what news story the readers thought was more authentic, appealing, and credible. This was done by gauging the reader's reaction affect to the story provided, and how that news story influenced affective responses. The two affective measured were tied to numeracy, message attitude, knowledge and understanding of the COVID-19 news story, appeal of the story, and news trust.

Numeracy: Drawing from Hopp (2015)'s study, a seven-item item measure was constructed using items taken from scales previously validated by Lipkus, Samsa, and Rimer (2001) and Frederick (2005). Essentially, we wanted to examine the understanding levels of numeracy among the readers and whether their trust in numbers is informed by that understanding. Therefore, some questions asked were like, "Imagine that we rolled a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even (2, 4, or 6)? The chance of getting a viral infection is .0005. Out of 10,000 people, about how many of them are expected to get infected? Which of the following numbers represents the biggest risk of getting a disease? ___ 1 in 100, ___ 1 in 1000, _X_ 1 in 10". The responses for all the three countries are presented in the in the findings below.

Message attitude: Message attitude was measured on a six-item scale placed on a 7-point semantic differential scale. This scale had anchored items such as easy to read/not easy to read, Clear/unclear, reliable/unreliable.

Knowledge and understanding of the COVID-19 news story: We drew our assessment of the knowledge of COVID-19 from the 'Avert' COVID-19 Quiz (<https://www.avert.org/take-our-covid-19-quiz>). Avert is a website providing access to online testing of your knowledge of various pandemics, including COVID-19. Essentially, the quiz asked basic multiple-choice questions about the COVID-19. The idea is to assess the knowledge that individuals have regarding the COVID-19 pandemic. Although some questions were more frame in the US context, most of them were general

and, therefore, reflected one's knowledge of the pandemic. For example, questions like "True or False: A person who has no symptoms of COVID-19 is not a risk to others; People under the age of 35 can get infected" were asked. Responses were recorded as either a zero (0) for an incorrect response or a one (1) for a correct response.

Appeal: Stories were also examined through the appeal variable. That is, whether a story with numeracy was more appealing to the audience than the one without numeracy. This measure is important because it helps examine whether there is a rational reason for believing in a news story provided to the participants other than the fact that it has numbers. In other words, this question about appeal is asked for the purpose of gauging the support of one story over the other without the implications of the audience trust of a story based on numeracy or source.

Story/News trust: News trust is used as a variable because the nature of trust allows for the measurement of the general perception in theory and performance (Riggs, 2017, p. 41). While a question could be directly asked about how the participants think of a particular news story (i.e., whether they trust it or not), it is also questionable as to whether the respondents will give a biased response. To avoid the biases, news trust was measured on 12 items (each on 7-point scales) as Hopp, et. al (2020) and Kohring and Matthes (2007) had earlier assessed. Although this measure has been used in general terms, we twisted the questions to fit our objectives and attend to questions pertaining to COVID-19.

4 FINDINGS

To examine the impact of the predictor variables on our multiple dependent variables, path modeling was used. Our analysis of the fit indices indicated that the data from all the three countries did fit the model acceptably well. The US data was represented by $\chi^2 = 23.41$, $df = 17$, $\chi^2/df = 1.51$, $p > .13$; $CFI = .97$; $RMSEA = .02$ ($90\%CI = .00 .05$); $SRMR = .05$; the Zambian data by $\chi^2 = 19.62$, $df = 13$, $\chi^2/df = 1.09$, $p > .11$; $CFI = .95$; $RMSEA = .04$ ($89\%CI = .00 .03$); $SRMR = .07$; and the Tanzanian data had $\chi^2 = 20.83$, $df = 15$, $\chi^2/df = 1.22$, $p > .10$; $CFI = .94$; $RMSEA = .03$ ($90\%CI = .00 .06$); $SRMR = .05$, as their model fit.

Hypothesis 1 (H1) held that news stories with numerical values will diminish reader affective consumption of that story. The findings support H1 as observed in the heightened levels of negativity elicited in the affective consumption of the story among the respondents. After controlling for significant effects of numeracy in all our sampled data, the path between the manipulation (coded as 0 = low potential of diminishing reader affective consumption, and 1 = high potential) and audience perception of the story was generally significant, ($\beta = .62$, $p.01$). However, compared to samples from Zambia ($\beta = .79$, $p.01$) and Tanzania ($\beta = .66$, $p.01$) data from the US (β

= .42, $p < .05$) showed lower levels of significance to suggest that numerical values in the news story, though significant, had little effects in diminishing readers affective consumption of the story. Hypothesis 2 (H2) held that there is a relationship between numeracy and attention to numbers; and that the relationships vary in the United States, Zambia, and Tanzania. To measure this relationship, we looked at the significant effects of objective (actual ability to deal with numerical values) and subjective numeracy (Just a preference for numbers). After performing multilevel SEM analyses, findings indicate that individuals with higher objective numeracy felt more comfortable and looked for numeric information in the news stories than individuals with lower and/or subjective numeracy. This was especially true in data sampled from the United States where most individuals indicated higher levels of understanding probabilistic and numerical concepts in their everyday lives.

As **table 1** below indicates, participants in all the three countries did not do well in converting proportions into percentages. Particularly, only 38% (332 respondents) of the total sample (873 respondents) got the third question in the table below correct. This means that 541 respondents did get it wrong. Specific results for each country support the above findings indicating that that an average of 25% of the US sampled population failed to solve both basic probability problems and/or convert a percentage to a proportion as opposed to the 57% and 47% from Tanzania and Zambia respectively. This conclusion was arrived at after dichotomizing the item responses to the general and expanded numeracy questions as either correct (1) or incorrect scored (0). Essentially, the number of times respondents attended to numerical values in the news seemed to compulsively mediate the association of objective numeracy. However, variations were observed among the three countries. While respondents from the United States seemed to pay more attention to numbers, individuals from Zambia and Tanzania showed less interest in attending to the numbers in the story.

Research question one (RQ1) asked an ‘all-encompassing question’: How does the audience/news consumers perceive news stories with numerical values? In response we examined the attitude that the audience had to the message with numerical values versus one without numerical values, whether stories with numerical values appealed to the audience, and the trust shown by the audience for story with numerical values. Findings from all the three countries (USA, Zambia, and Tanzania) suggest that the relationship between audience perception of a news story and message attitude was moderated by numeracy in the sense that higher levels of numerical values in the news story amplified the negative relationship between audience perception and message attitude. Numeracy, $\beta = -.19$, $p < .01$, and message attitudes $\beta = -.14$, $p < .01$, were negatively related to how the audience perceived a news story in numbers

in all the three countries. This is also true for the appeal variable in the three countries in the sense that stories with numerical values were negatively and significantly perceived to have less appeal ($\beta = -.26, p < .01$) to the audience.

Table 1: Percentage of correct responses to Risk Numeracy questions

	<u>USA</u> (n = 387)	<u>ZM</u> (n = 219)	<u>TZ</u> (n = 267)
<u>Question</u>			
<i>General numeracy scale items</i>			
Imagine that we rolled a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even (2, 4, or 6)? <i>Answer: 500 out of 1000.</i>	68.2%	53.6%	59.4%
In the LOTTERY, the chances of winning a \$10.00 prize is 1%. What is your best guess about how many people would win a \$10.00 prize if 1,000 people each buy a single lottery ticket? <i>Answer: 10 persons out of 1000.</i>	78.36%	60.3%	55.4%
In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets to ACME PUBLISHING SWEEPSTAKES win a car? <i>Answer: 0.1%</i>	21.5%	7.42%	9.08%
<i>Expanded numeracy scale items</i>			
Which of the following numbers represents the biggest risk of getting a disease? ___ 1 in 100, ___ 1 in 1000, <u>X</u> 1 in 10	51.7%	44.3%	59.6%
Which of the following numbers represents the biggest risk of getting a disease? ___ 1%, <u>X</u> 10%, ___ 5%	85.1%	38.2%	47.8%
If Person A's risk of getting a disease is 1% in ten years, and person B's risk is double that of A's, what is B's risk?	87.9%	32.02%	40.3%
If Person A's chance of getting a disease is 1 in 100 in ten years, and person B's risk is double that of A's, what is B's risk? <i>Answer: 2 out of 100</i>	83.5%	46.8%	56.9%
If the chance of getting a disease is 10%, how many people would be expected to get the disease: A: Out of 100? <i>Answer 10</i> B: Out of 1000? <i>Answer 100</i>	96.4%	37.8%	86.7%
If the chance of getting a disease is 20 out of 100, this would be the same as having a ___% chance of getting the disease. <i>Answer: 20</i>	88.3%	55.6	43.2%
The chance of getting a viral infection is .0005. Out of 10,000 people, about how many of them are expected to get infected? <i>Answer: 5 people</i>	90.2%	59.4%	66.8%

Note: USA = United States, ZM = Zambia, TZ = Tanzania. Also, we drew from Lipkus, Samsa, & Rimer (2001) and performed the following “Before answering the numeracy questionnaires, as a practice question, participants were asked, imagine that we flip a fair coin 1,000 times. What is your best guess about how many times the coin would come up heads in 1,000 flips? This question was part of the general numeracy questionnaire by Schwartz and colleagues.⁶ The die question was used as a practice question in their study. Questions that were left blank were assessed as being incorrect” (p.40)

Specifically, findings indicate that numerical values in the news seemed to strengthen the negative effects of the appeal variable among the audience. More importantly, it was observed that numeracy was negatively associated with the appeal variable when evaluated on a simple slope. Particularly, in the data from Zambia and Tanzania, the appeal variable at two-standard deviations was above the numeracy score ($b = -0.73, p < .001$; at one standard deviation above the numeracy score ($b = -0.54, p < .001$); and at another one standard deviation below the mean numeracy score ($b = -0.17, p < .05$). However, the US data, the appeal variable at two-standard deviations was below the mean numeracy score ($b = 0.02, p = .81$) to suggest that numeracy was not a major general significant variable to audience appeal.

Ironically, the three countries under study seemed to have more trust in news stories with numbers in them. The trust was stronger among the Zambian respondents ($\beta = 1.34; SE = 0.63; p < .001$), and Tanzania ($\beta = 0.58; SE = 0.51; p < .001$), than the sample from the United States ($\beta = 0.51; SE = 0.43; p < .05$). This means that although numeracy did not seem to appeal to audience perception of a news story, their trust for the news item did not falter. Given the fact that there was a strong correlation between subjective numeracy and story trust (i.e., Zambia that recorded less in objective numeracy seemed to have more trust in stories with numeracy) it is likely that people trusted information without subjecting it to a critical lens.

5 DISCUSSION AND CONCLUSION

This study set out to better understand audience perception of numeracy in journalism. Throughout the literature, we were able to show how numeracy has become a necessity for journalistic practice and the quest for improved credibility. The study also identified the gaps brought about by such a quest – whether the use of numerical values coincides with audience perception of those numbers. Using data from Zambia, Tanzania, and the United States, we were able to demonstrate that the use of numerical values in a news story diminished story appeal. However, this did not seem to alter the trust the audience had on that story. Zambia, for example, where most individuals recorded understanding and interpreting of numerical values in the news story, showed more trust for the same news story than Tanzania and the United States that respectively recorded moderately higher understanding of numeracy. Overall, findings suggest that the audience perception of the news story was negatively associated to numeracy. However, the levels of perception differed in the three countries, with the United States (that had more participants with higher numeracy levels of understanding) recording less negativity of audience perspective of numeracy in the news, followed by Tanzania and Zambia respectively.

Two primary dichotomous implications emanate from this study's results. First, that numbers diminished audience/consumers appeal of a news story; and second that the less people understood the numbers, the more they seemed to trust a news story. Such findings pose a rather relevant question that Peters (2020) had earlier hinted on. Whom do numbers serve in a news story between the writer and reader? If it is the writer, then the implications have little or no effects. But if it is the reader and/or both the reader and the writer, then use of numeracy in the news has more implications that need to be attended to. Primarily, as journalism seeks to improve its credibility and believability using numeracy, there is also a need to understand what story appeals to the audience and whether the strategies used are designed with a purpose of telling a clear and concise story to the audience. Gondwe (2021) had asked, what does it mean to tell a journalistic story? Accordingly, it is by using methods that the audience understands better – going beyond the use of numerical values (unless they offer a better explanation) to include narratives that resonate with people's abilities to understand the essence of the intended message in the story. Just as most journalists are number-phobic, so are most audience members. Therefore, while numbers can improve the accuracy of a story, the fact that they limit readership and diminish audience appeal renders them useless. This is because journalists write for an audience – if that audience cannot understand what you are writing, then your message is irrelevant.

The study was posed with some limitations that which might have affected our results. First, the data collect process and the online nature of the measurement tools used, limited our ability to control the testing environments of our experiments. While the data collection process could be more established in the United States, Zambia and Tanzania's online information are posed with various intervening and confounding variables that might make the interpretation of data less generalizable. Further limitations might include the questioning of causal sequences with our predictor variables. Nonetheless, these limitations do not in any way discredit the reach findings of this study but call for an extensive and polished approach. Introspectively, the current study recommends possible pragmatic alternatives for merging journalists' ideas of improving news stories through numeracy, with audience's appeal and approval of such news stories. As Ashby (2017) had noted, "ensuring that both parties encounter the same amount of information diminishes the effect of numeracy on choice alignment" (p.135). Thus, there is need to find strategies that bring together a mutual understanding of numeracy between journalists and their audience. This could be done by using simplified visual aids that most audience could interpret without a complicated ability to understand and use probabilistic and numerical concepts (note: that's the definition for numeracy). For this reason, future research should continue

to explore and emphasize ways that “less numerate individuals can be nudged toward more efficient and deliberative information search, so that they too might become more independent and skilled decision makers” (Ashby, p. 135).

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REFERENCES

- Appelgren, E., & Nygren, G. (2014). Data Journalism in Sweden: Introducing new methods and genres of journalism into “old” organizations. *Digital Journalism*, 2(3), 394-405. doi.org/10.1080/21670811.2014.884344
- Ashby, N. J. (2017). Numeracy predicts preference consistency: Deliberative search heuristics increase choice consistency for choices from description and experience. *Judgment and Decision making*, 12(2), 128.
- Ausserhofer, J., Gutounig, R., Oppermann, M., Matiasek, S., & Goldgruber, E. (2020). The datafication of data journalism scholarship: Focal points, methods, and research propositions for the investigation of data-intensive newswork. *Journalism*, 21(7), 950-973. doi.org/10.1177/1464884917700667
- Bodrunova, S. S., Blekanov, I. S., & Maksimov, A. (2016, November). Measuring influencers in Twitter ad-hoc discussions: active users vs. internal networks in the discourse on Biryuliovo bashings in 2013. In 2016 *IEEE Artificial Intelligence and Natural Language Conference (AINL)* (pp. 1-10). IEEE.
- Borges-Rey, E. (2016). Unravelling data journalism: A study of data journalism practice in British newsrooms. *Journalism Practice*, 10(7), 833-843. doi.org/10.1080/17512786.2016.1159921
- Brand*, R. (2008). The numbers game: A case study of mathematical literacy at a South African newspaper. *Communicatio: South African Journal for Communication Theory and Research*, 34(2), 210-221. doi.org/10.1080/02500160802456155
- Cassidy, William P. "Online news credibility: An examination of the perceptions of newspaper journalists." *Journal of Computer-Mediated Communication* 12.2 (2007): 478-498. doi.org/10.1111/j.1083-6101.2007.00334.x

- Coddington, M. (2015). Clarifying journalism's quantitative turn: A typology for evaluating data journalism, computational journalism, and computer-assisted reporting. *Digital journalism*, 3(3), 331-348. doi.org/10.1080/21670811.2014.976400
- Crettaz von Roten, F. (2016). Statistics in Public Understanding of Science review: How to achieve high statistical standards? *Public Understanding of Science*, 25(2), 135-140. doi.org/10.1177/0963662515595195
- De Beer, A.S. and E. Steyn. 2002. Sanef's '2002 South African national journalism skills audit'. *Ecquid Novi* 23(1): 11-86. doi.org/10.1080/02560054.2002.10798725
- Diakopoulos, N., & Koliska, M. (2017). Algorithmic transparency in the news media. *Digital Journalism*, 5(7), 809-828. doi.org/10.1080/21670811.2016.1208053
- Ekström, M., & Westlund, O. (2019). The dislocation of news journalism: A conceptual framework for the study of epistemologies of digital journalism. *Media and Communication*, 7(1), 259-270. doi.org/10.17645/mac.v7i1.1763
- Ferrucci, P. (2020). It is in the numbers: How market orientation impacts journalists' use of news metrics. *Journalism*, 21(2), 244-261. doi.org/10.1177/1464884918807056
- Ferrucci, P., & Vos, T. (2017). Who's in, who's out? Constructing the identity of digital journalists. *Digital Journalism*, 5(7), 868-883. doi.org/10.1080/21670811.2016.1208054
- Fisher, J., & Hopp, T. (2020). Does the Framing of Transparency Impact Trust? Differences Between Self-Benefit and Other-Benefit Message Frames. *International Journal of Strategic Communication*, 14(3), 203-222. doi.org/10.1080/1553118X.2020.1770767
- Franklin, B. (2014). The Future of Journalism: In an age of digital media and economic uncertainty. *Journalism Studies*, 15(5), 481-499, DOI: 10.1080/1461670X.2014.930254
- Genis, A. (2001). *Numbers count: the importance of numeracy for journalists* (Doctoral dissertation, Stellenbosch: Stellenbosch University).
- Gondwe, G., & White, R. A. (2021). Data Journalism Practice in Sub-Saharan African Media Systems: A Cross-National Survey of Journalists' Perceptions in Zambia and Tanzania. *African Journalism Studies*, 1-16.
- Gondwe, G., Muchangwe, R., & Mwaya, J. E. (2021). Motivations for Social Media Use and Consumption in Zambian Online Platforms. In *Analyzing Global Social Media Consumption* (pp. 204-215). IGI Global. DOI: 10.4018/978-1-7998-4718-2.ch011

- Gondwe, G. (2021). News worthiness and Public trust in sub-Sahara African: Examining the impact of tabloid journalism in Zambia. *Journal of Media and Communication Studies*, 13(1), 12-22. doi.org/10.5897/JMCS2020.0720
- Gondwe, G. (2018). News Believability & Trustworthiness on African Online Networks: An Experimental Design. *International Communication Research Journal*, 53(2), 51-74.
- Gray, J., Chambers, L., & Bounegru, L. (2012). *The data journalism handbook: How journalists can use data to improve the news*. O'Reilly Media, Inc.
- Harrison, S. (2020). *A Study into the Value Placed on Numeracy as Symbolic Capital Within the Journalistic Field* (Doctoral dissertation, Liverpool John Moores University).
- Hopp, T. (2015). The effect of numeracy on the relationship between state reactance and message evaluations. *Communication Research Reports*, 32(4), 314-321. doi.org/10.1080/08824096.2015.1089855
- Jones, J., & Salter, L. (2011). *Digital journalism*. Sage.
- Kawamoto, K. (Ed.). (2003). *Digital journalism: Emerging media and the changing horizons of journalism*. Rowman & Littlefield Publishers.
- Kerunga, J., Rowe, E., & Gondwe, G. (2020). Journalism Credibility in the digital age—Examining shifts in paradigms. Available at SSRN 3641943.
- Lecheler, S., & Kruike-meier, S. (2016). Re-evaluating journalistic routines in a digital age: A review of research on the use of online sources. *New media & society*, 18(1), 156-171. doi.org/10.1177/1461444815600412
- Len-Ríos, M. E., & Hinnant, A. (2014). Health literacy and numeracy: A comparison of magazine health messages. *Howard Journal of Communications*, 25(3), 235-256. doi.org/10.1080/10646175.2014.922909
- Lipkus, I. M., Samsa, G., & Rimer, B. K. (2001). General performance on a numeracy scale among highly educated samples. *Medical decision making*, 21(1), 37-44. doi.org/10.1177/0272989X0102100105
- Maier, S. R. (2003). Numeracy in the newsroom: A case study of mathematical competence and confidence. *Journalism & Mass Communication Quarterly*, 80(4), 921-936. doi.org/10.1177/107769900308000411
- Molyneux, L., & Coddington, M. (2020). Aggregation, clickbait and their effect on perceptions of journalistic credibility and quality. *Journalism Practice*, 14(4), 429-446. doi.org/10.1080/17512786.2019.1628658
- Nguyen, A. (Ed.). (2017). *News, numbers and public opinion in a data-driven world*. Bloomsbury Publishing USA.

- Nguyen, A., & Lugo-Ocando, J. (2016). The state of data and statistics in journalism and journalism education: Issues and debates. *Journalism*, 17(1), 3-17. doi.org/10.1177/1464884915593234
- Peters, E. (2020). *Innumeracy in the wild: Misunderstanding and misusing numbers*. Oxford University Press.
- Pickard, Victor, and Alex T. Williams. 2014. "Salvation or Folly? The Promise and Perils of Digital Paywalls." *Digital Journalism* 2(2): 195–213. doi:10.1080/21670811.2013.865967.
- Riggs, T. S. (2017). *Using Experimental Design to Test the Effect of Campaign Donation Knowledge on Interpersonal Political Trust in the United States* (Doctoral dissertation, Central European University).
- Stalph, F., & Borges-Rey, E. (2018). Data journalism sustainability: An outlook on the future of data-driven reporting. *Digital Journalism*, 6(8), 1078-1089. doi.org/10.1080/21670811.2018.1503060
- Tiede, K. E., Bjälkebring, P., & Peters, E. (2020). Numeracy, numeric attention, and number use. http://www.sjdm.org/presentations/2020-Poster-Tiede-Kevin_E.-Numeracy-Attention-NumberUse~.pdf. Retrieved, December 12th, 2020.
- Vis, Farida. 2013. "Twitter as a Reporting Tool for Breaking News: Journalists Tweeting the 2011 UK Riots." *Digital Journalism* 1(1): 27–47. doi:10.1080/21670811.2012.741316.
- Westlund, Oscar. 2013. "Mobile News: A Review and Model of Journalism in an Age of Mobile Media." *Digital Journalism* 1(1): 6–26. doi:10.1080/21670811.2012.740273.