MACS 30200 – Perspectives in Computational Research Final Paper

The Aesthetics of Knowledge Consumption: Does aesthetics matter in popular science communicaton?”

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Abstract

Individuals' perceived value of other individuals and objects in the world around them are affected in substantial ways by aesthetic appeal. This is no exception in science communication, where a paramount concern is improving the engagement of wider audiences in scientific content. In today's modern society, much of the consumption of scientific knowledge by individuals outside of scientific circles comes from the internet and popular science media. This study attempts to discern a significant relationship between computational aesthetic measures and two key website metrics of popular science news websites - visits and the time each reader spends on the site. We collect aesthetic measures by applying computational models in examining web articles from 25 scientific news outlets, appraising them on HCI/UX factors such as colorfulness, stylistic consistency, and screen equilibrium. We find no significant relationship between these measures and average website hits, but some significance of document consistency and screen equilibrium in predicting average linger time.

Introduction and Literature Review

When Ludwig Wittgenstein first wrote in *Philosophical Investigations* - posthumously published in 1953 - that ”Ethics and Aesthetics are one”, the far-reaching implications of this statement (especially on other yet-to-be-invented fields of study) were unlikely to have been in his imagination. Many scholars since have dissected and debated this phrase regarding its claims on both ethics and aesthetics, but one thing is in general agreement - the link drawn by Wittgenstein between ethics and aesthetics is based on the fact that they both have to do with the idea of *values* (Collinson 1985 and others). Indeed, humans perceive the environment with an eye for ”beauty”, and as much as one would like to ponder value as an instrinsic quality, the importance of aesthetics on at least the initial perception of value has been extensively elaborated upon and studied - qualitatively and experimentally - by many scholars, from art critic John Berger to psychologist Leslie Zebrowitz (Berger 1972, Zebrowitz 2008, Jacobsen 2010). As a philosopher who was mainly concerned with human communication, Wittgenstein’s statement aptly resonates today within fields of study that seek to reconcile or delineate form, function, aesthetics, and value.

Aesthetics, in terms of the assessment of ”beauty” and ”visual niceness” in stimuli, has been shown to have an effect on human attention, initial impressions, and behavior (Zebrowitz 2008, Wang and Pomplun 2012). It follows that the communication of science, when taken as part of the grand collection of human communicative acts, also needs to concern itself with aesthetics. Studies in science communication that attempt to examine mechanisms and failures in communicating scientific knowledge have been very focused on embedded contexts, deficit models, and public science literacy (Nisbet and Scheufele, 2009). The deficit model posits that the interpretation of factual information occurs in the same way across all individuals in an audience, and thus any failure of communication is a failure of the specific communicator in question, or public lack of literacy or irrationality (Bauer, 2008). While the deficit model is a widely upheld way of conceptualizing case studies in science communication, it is less helpful in certain aspects pertaining to the construction of metric-based solutions to communication failures. A chicken-and-egg problem exists with the alienation of the public as ”not literate enough” or irrational (Nisbet and Scheufele, 2009), because this issue is exactly what better science communication is supposed to address. Moreover, this largely categorical framework does not accomodate for specific, metric-based analysis of the format of the communicative process. In this respect, an area that has not been given much attention is the aesthetics of the communicative artifact (Gombrich, 1960), and given the modern technological context, specifically those artifacts that draw the attention of modern consumers of information; those platforms through which such individuals seek and receive information - the internet, and popular science media content creators.

Design is equivalently important in material objects and virtual artifacts, as keenly demonstrated by Donald Norman - ”Design is really an act of communication, which means having a deep understanding of the person with whom the designer is communicating.” (Norman, 2013) Unfortunately, scientific circles are highly bounded networks with communicative paradigms less pliant with individuals in the wider network of the world. Hence is of paramount importance, if one is concerned with knowledge dissemination in the modern world, that one pays attention to the aesthetics of how this information is communicated to the wider world. Measuring image and page aesthetics has been a largely interdisciplinary ground with limited contextual focus. In this study, the focus is on webpage aesthetics, specifically pages of science media articles. Non-computational measures such as the VisAWI (Moshagen and Thielsch, 2010, 2013) are widely used in User Experience (UX) and commercial contexts to evaluate user perceptions of website aesthetics, but these usually require a controlled lab setting and proper sampling of participants, resources that may not always be available for studies in science communication media. This is particularly relevant to the circumstances of this study, which had to be executed over the course of ten weeks. Moreover, the dimensions of these constructs are not necessarily directly translatable into aesthetic corrections. Fortunately, the development of these tools have also helped to inform and iterate computational measures, which have developed largely within the fields of HCI and computer vision. The VisAWI, for example, assesses aesthetics on the four dimensions of Simplicity, Diversity, Colorfulness, and Craftsmanship. Another inventory by Jiang et. al (2016) categorized aesthetics into five factors: Unity, Complexity, Intensity, Novelty, and Interactivity. We can see these concepts intertwined in HCI literature and computational measures of aesthetics. In Ngo, Samsudin, and Abdullah (2000), 5 measures are outlined:

Screen Balance: A measure of how well layout elements are centered on a page, based on weighted space.
Screen Equilibrium: A measure of how well layout elements gravitate towards a center of origin.
Screen Symmetry: A measure of how symmetrical the placement of layout elements are.
Screen Sequence: A measure of how well the screen elements adhere to natural eye movements.
Screen Order and Complexity: A derivative from the above measures and adapted from Birkhoff (1933).

These measures definitely have their counterparts in the previously mentioned non-computational dimensions and factors. In addition to Ngo's five, Rigau, Feixas, and Sbert (2007) add what is known as Kolmogorov Complexity and Shannon Entropy to the mix, both of which are pixel-level analyses, adapted from physical and algorithmic models, of order and complexity within an image. Machado et. al (2015) developed an artificial neural network which allowed measures of edge density, image compression, and to some extent colourfulness to predict human ratings of image complexity. A combination of these measures will be adopted in this study to analyse the pages of science web articles, although not all measures will be incorporated. For example, the relevance of image compression measlures may be diminished when we consider the overall composition of a webpage and how it is displayed and accessed. What measures are included in the final model will be further discussed in the Methods section.

There have been studies that have utilised predictive models that incorporate computational measures of aesthetics. One such study deployed an experimental framework where participants gave ratings on their first impressions on websites which varied on Colourfulness and Visual Complexity (Reinecke et. al, 2013). The collected data was then fed into a mixed-effects model that was used to predict ratings based on the above two measures of a page. While the model was successful to an extent, this study, like many others in the field of HCI and computer vision (Altaboli and Lin, 2011), was one that applied to a very general context of web page or a computer screen, but misses the nuances of things that applied to specific types of displays and pages - online science communication, for example. Moreover, Reinecke and her colleagues modeled the variables on ratings of first impressions, which is not the sole or paramount concern in information transmission. Yet, this study paves the way for the potential and legitimacy of building predictive models from computationally derived measures of aesthetics.

In examining the aesthetics of a science web article or science journalism, one should be concerned with the aesthetics of the text itself in addition to the picture being displayed. After all, science media is hugely driven by the content, and any attempt at measuring its aesthetics should not neglect the content in favour of solely focusing on appearance. Here, text aesthetics does not refer to how the text is positioned in the layout or arranged in a space, but rather to stylistic concerns. Any textual form subject to human reading that is concerned to some extent with providing a level of engagement or enjoyment subjects itself to the critical eye of the beholder (Gallagher, 2005). This is obviously a key concern for popular science media and public science communication as a whole. Unfortunately, it remains difficult to computationally examine text stylistics and ”well-written-ness”. However, document-to-vector models and software packages such as Gensim (Rehurek 2011, Rehurek and Sojka 2010) provide researchers with one avenue of examining the ”aesthetics” of a group of text artifacts - via their semantic distance from one another.

What does semantic distance add to the concept of the aesthetics of text? In examining products from a single company, one large concern is the branding of the product (Malik et. al, 2013). In the case of media and text products, this can be conceptualized as stylistic consistency over time (Knapp and Ehlinger, 1961). Consumers of a media product become loyal consumers because of the type of reward that they get from the particular style of content, or ”brand”, of the specific media outlet (Brinkman, 2017), and hence it behooves the content creator to understand what style of content their audiences are partial to. Simply put, one might like to go to BBC Earth, as an example, to read articles because he or she likes the way in which the articles are written. In this study, it therefore makes sense to consider the semantic consistency of articles that belong to a specific media outlet, in the sense that the more consIstent they are, the more likely they are to be well-tailored to their current audience - and hence, consistency can act as proxy measure of article aesthetics. This study will draw from previous work that has made use of document-to-vector models - building a corpus from the set of articles in the space, and deriving semantic similarity of each document within the space (Turney and Pantel, 2010).

Objectives

Given the above, the study attempts to show that there is an indelible association between aesthetics and how well science news websites perform, and in doing so, establish the importance of aesthetics in the communication of science to the public. Website performance is measured in this study by how many visits the site gets, as well as how long users spend on the site on average. Two hypotheses are tested:

H_1: There is a significant relationship between aesthetic metrics of science web articles and the readership of the media outlet they are from.

H_2: There is a significant relationship between aesthetic metrics of science web articles and how long users spend on the website on average.

Methods and Descriptives

The methodology deployed in this study attempts to define predictive models of *reader linger time* and *average site visits* of online science news outlets, based on input variables that measure the aesthetics of articles that originate from the outlet in question. The exogenous variables for the models are similar, and are shown in the table below

Multi-level model

Table 1: Model variables

Variables	Symbol	Exogenous/Endogenous
Average Site Visits	V	Endogenous
Average Linger Time	L	Endogenous
Semantic Consistency	c	Exogenous
Kolmogorov Complexity	ω	Exogenous
Shannon Entropy	α	Exogenous
Edge Density	x_1	Exogenous
Colorfulness	x_2	Exogenous
Screen Equilibrium	x_3	Exogenous
Screen Sequence	x_4	Exogenous

This study defines the multilevel regression models similarly as follows (beta values are estimated separately for each model for readership and linger time):

$$V_ij/L_ij = \beta_{0j} + \beta_{1j}c + \beta_{2j}\omega + \beta_{3j}\alpha + \beta_{4j}x_1 + \beta_{5j}x_2 + \beta_{6j}x_2^2 + \beta_{7j}x_3 + \beta_{8j}x_4 + \epsilon_{ij} \quad (1)$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}Z_j + \upsilon_{0j} \quad (2)$$

For article (i = 1, 2, 3 ... 30) and media outlet (j = 1, 2, 3 ... 25). Z_j refers to the number of years since a specific media outlet j was inaugurated, as of April 2018.

Figure 1: Representation of multi-level model

A squared term for Colorfulness is included in the model, as previous studies have shown that some level of colorfulness in a website does credit to its aesthetic appeal, but very high levels of colorfulness generally result in lower aesthetic ratings (Reinecke et. al 2013 and others).

The average monthly site visits and average linger time data were obtained from *SEMRush.com*, a proprietary service that provides traffic estimates based on search engine crawls. Bear in mind that these are not exact estimates, but was the most available data obtainable within a limited timeframe - which produces some limitations in the results estimated. Below are bar charts of the distributions of each dependent variable of 12 of the most popular science media websites.

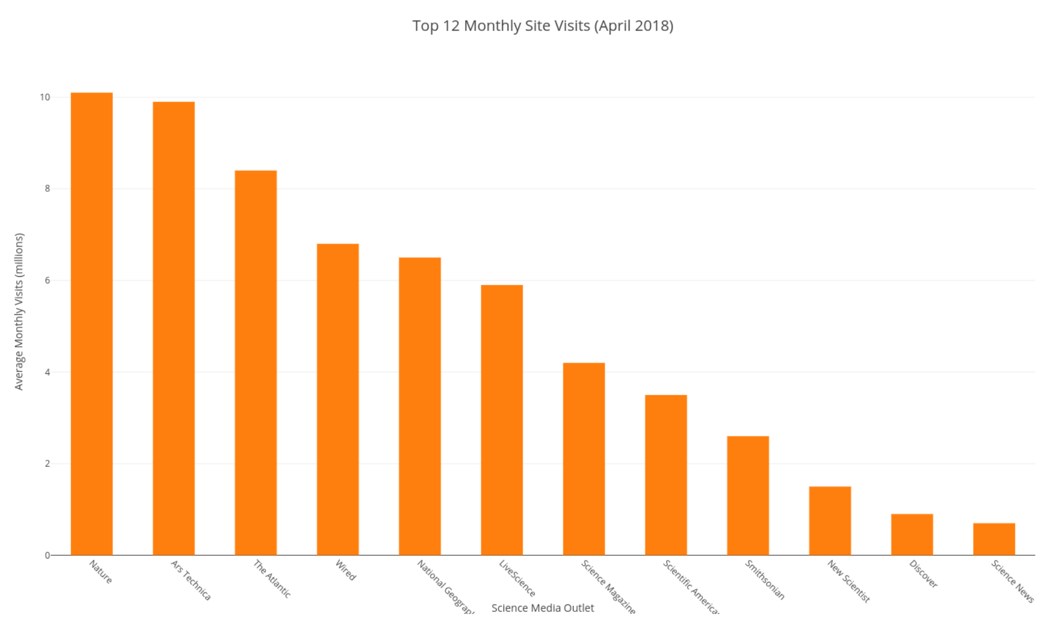

Figure 2

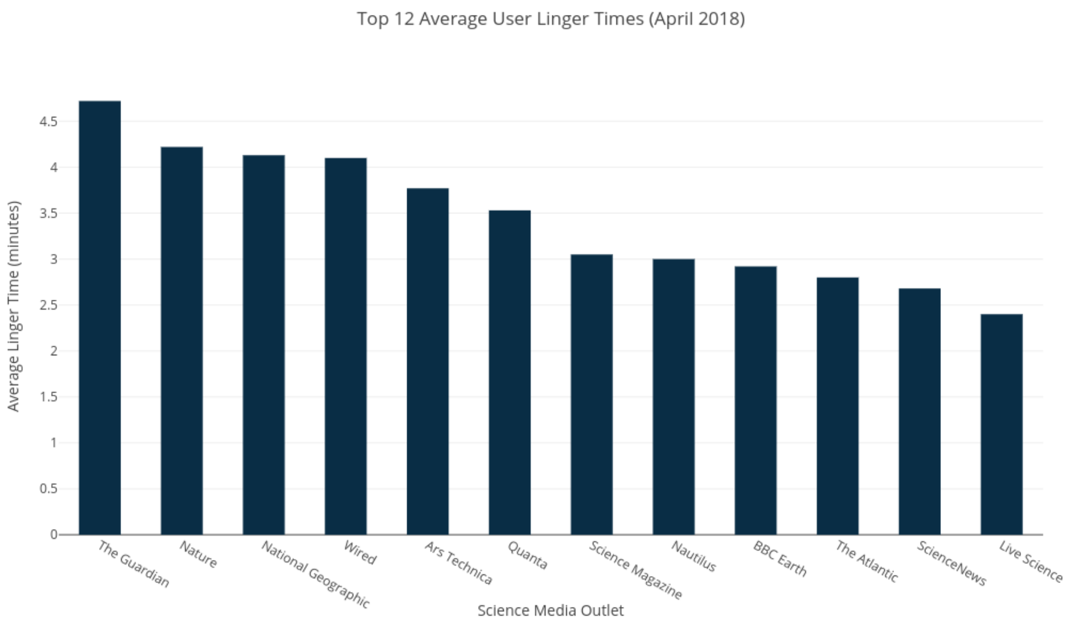

Figure 3

25 news sites are considered in the dataset, and they are categorized into three sets based on disparities in dates of establishment and monthly visit estimations. The means of monthly visits for the sets are *18.55 million, 4.43 million, and 457.7 thousand* respectively. The standard deviations of visits are *15.75 million, 1.89 million, and 272.36 thousand* respectively. The means of linger times for the sets are *3.88, 2.74, and 2.60 minutes* respectively. The standard deviations of times are *0.71, 0.97, and 0.56 minutes* respectively. It is readily observable that Set 1 has a large standard deviation for visits, likely due to the inclusion of *The Guardian*, which pulls about 4.5 times more visitors per month (45.8 million) than the next runner-up. At this point, the outlet is considered an outlier and will not be included in the analysis. These 25 sites were sourced from various

Extracting Data and Computing Aesthetic Measures

The extraction of the text data was performed by adapting the *boilerpipe* Java library (Kohlschtter, 2009), a library developed for Boilerplate removal and text extraction from HTML pages. URLs of science media articles are passed into the code, which then pulls the main article text from a page. An example output of running the code on a National Geographic article is shown below, and example code is also available on Github [1].

> New Zealand's newest sinkhole may be one of its largest. It extends down more than six stories. From end-to-end, it measures just about the length of two football fields. The sinkhole is so large it even exposed 60,000-year-old volcanic soil.
>
> New Zealand volcanologist Brad Scott told a local news outlet it was the largest sinkhole he had ever seen and that it had potential to get even bigger. The feature appeared on the country's North Island after a long period of record heavy rains. A local farmworker rounding up cows discovered the opening, narrowly avoiding falling into it while riding his bike. Speaking with New Zealand's Newshub outlet shortly after the sinkhole appeared, farm manager Colin Tremain said he plans to erect a fence to prevent cows from falling in.
>
> It's not the first sinkhole to recently open up in the region. Nine additional sinkholes have formed there in the past few years. New Zealand has several major fault lines running the length of the country, and sinkholes are thought to be more likely to occur near fault lines where soluble rocks wash through. The new sinkhole opened up over pumice terrain, but it's only one of many sites around the world where the ground is prone to collapsing underfoot.
>
> Where Sinkholes Happen
>
> According to the U.S. Geological Survey , sinkholes open up when groundwater doesn't drain from the surface and dissolves the rock lying underneath. Limestone and salt beds are often the sources of sudden sinkholes. While New Zealand's new sinkhole has tall, vertical walls that make it look more like the Grand Canyon, some sinkholes form a rounder bowl shape. Their formations are often dramatic. As water erodes the ground underneath sinkholes over time, the weight of the land that remains on top eventually becomes too much, and it collapses. In regions where people have built homes or businesses, the sudden collapse can be deadly. Entire homes have been swallowed up by the Earth.
>
> In the U.S., Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania have the terrain most conducive to forming a sinkhole, says the USGS's website.
>
> (This is how one sinkhole opened up in this Florida community.)
>
> While less common, sinkholes can also be caused by human land development. Activities like construction and pumping groundwater can make the ground less stable and a sinkhole more likely.
>
> Around the world, any region that has easily dissolvable terrain could potentially develop sinkholes. Mexico and Belize are built on an abundance of soluble rock. Parts of Italy, Slovenia, Croatia, and Russia are also prone to sinkholes.
>
> China is home to the world's largest cluster of sinkholes and the region's terrain has, over thousands of years, yielded enormous rock towers and one of the world's largest systems of caves. [2].

Extracting image data of the websites was performed using the *PhantomJS* Javascript API. PhantomJS enables the automation of screenshot capturing by operating as a headless browser. There were several difficulties that had to be resolved during this process, one of which was some websites that had overlays or advertisements that would obstruct and grey out the content of interest, resulting in 'shadowed' screenshots. When building the javascript code, it was straightforward to develop a workaround for some of the websites, but not for the others. Hence, to standardize, screenshots with inverted backgrounds were 're-inverted' using color manipulation in PhantomJS, resulting in a white background and readable black text. This occured in 2 out of the 18 domains. Example code and output for

[1] https://github.com/LeosonH/MACS30200proj

[2] https://news.nationalgeographic.com/2018/05/new-zealand-sinkholes-volcanic-fault-lines-science-spd/

this process is also on Github, but running it requires pre-installing PhantomJS dependencies on one's machine.

Text aesthetics is operationalized as document congruence for each article , which is implemented using the *Gensim* Python module. For each of the articles from a specific news media outlet, a corpus is built out of all the other sampled articles from the same source, excluding the one in question. The corpus and the article are then vectorized, and a similarity score computed using TF-IDF for each article against the corpus. The model wmployed is Deerwester's Latent Semantic Analysis (Deerwester, Dumais, and Harshman 1990), which takes into account the uncertainty of latent semantic structures that bind different words with similar meanings to each other.

Image aesthetics is conceptualized as the various constructs mentioned at the beginning of the writeup, and computed using a combination of *OpenCV* in Python and *EBimage* in R, both of which are open source image analysis and computer vision tools. Due to the multifarious algorithms being implemented, only Screen Equilibrium (x_3), Shannon Entropy (α), Colorfulness (x_2), and Screen Sequence (x_4) are briefly explained below. For a more in-depth look into the various measures, see Ngo 2000, Rigau 2007, and Reinecke 2013. Screen Equilibrium is operationalized as:

$$(x_c, y_c) = (\frac{\sum_i a_i x_i}{\sum_i a_i}, \frac{\sum_i a_i y_i}{\sum_i a_i}) \tag{3}$$

, where (x_c, y_c) is the center of the screen, a_i is the area of an element i on the screen, and (x_i, y_i) is the position of the element i on the screen. The Euclidean distance between the computed value and the center of the screen is then standardized between 0 to 1 to form a measure of equilibrium.

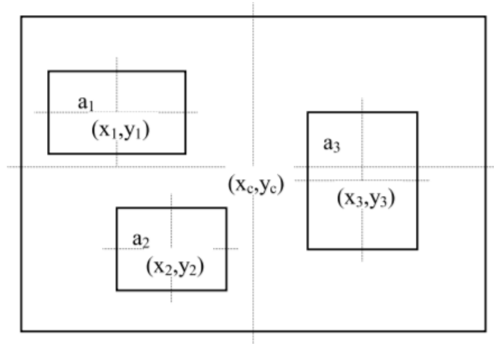

Figure 4: A screen in equilibrium (Ngo et. al, 2000).

Shannon Entropy is operationalized by adapting the classical entropy model as follows:

$$Entropy = \sum_k p_k \log p_k \tag{4}$$

, where p_k is the probability that the difference between the grayscale DN values of 2 adjacent pixels is equal to i. Colorfulness is operationalized by first defining the opposing color spaces:

$$rg = R - G \tag{5}$$

$$yb = \frac{R - G}{2} - B \tag{6}$$

Then define the standard deviation(μ) and mean(σ), before computing the colorfulness metric C (Hassler and Susstrunk, 2003):

$$\mu_{rgyb} = \sqrt{\mu_{rg}^2 + \mu_{yb}^2} \tag{7}$$

$$\sigma_{rgyb} = \sqrt{\sigma_{rg}^2 + \sigma_{yb}^2} \tag{8}$$

$$C = \sigma_{rgyb} + 0.3 \times \mu_{rgyb} \tag{9}$$

The computed values are then standardized to a value between 0 and 1 based on the total range of colorfulness scores to obtain the input values for the final model. To measure screen sequence, we first define weights of screen elements based on natural human visual targeting as well as the area taken up by these elements. Ngo et. al and others found that a top-bottom-left-right hierarchy exists in human visual targeting on computer screens, which leads to this weight scoring:

$$weight = a \times q \tag{10}$$

Where a is the pixel area taken up by a screen element and q = 4 , 3 , 2 , 1 corresponding to the quadrants (upper left, upper right, bottom left, bottom right, respectively). Once the highest weighted element is found, we plot paths following this hieraracy across the screen till we reach the last node. The elements along these paths are then measured for the area they take up among all the clustered elements on the screen to obtain a measure of sequence ergonomics.

Applying Linear Discriminant Analysis on the derived measures reveals that Kolmogorov Complexity and Edge Density load negligibly to the overall variance of the model, and hence were dropped. The refined model is thus as follows:

$$V_ij/L_ij = \beta_{0j} + \beta_{1j}c + \beta_{3j}\alpha + \beta_{5j}x_2 + \beta_{6j}x_2^2 + \beta_{7j}x_3 + \beta_{8j}x_4 + \epsilon_{ij} \tag{11}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}Z_j + \upsilon_{0j} \tag{12}$$

Descriptives

Presented below are figures that represent descriptive data based on the currently collected measures of interest. Due to space constraints, only data for the 5 outlets presented above will be displayed in the figures to follow, except Figure 4, which shows the top 6 rated by Colorfulness.

Table 2: Document Consistency

Media Outlet	Average Document Consistency
National Geographic	0.76
Wired	0.63
Live Science	0.73
Science Magazine	0.54
Scientific American	0.71

Document consistency scores might have some variation depending on factors such as the number of writers in each media outlet, how diverse their working team and areas of expertise are, and whether or not there has been recent changes in the editorial make-up of the company. However, it is not unreasonable to assume that ”consistency should stay relatively consistent” over time, given that the science writers of a specific organization are embedded within the same company environment and brand, and are likely to have to go through similar training and screening processes.

In the case of screen equilibrium, the scores should not vary much from article to article, since most articles from one website should be formatted in a similar manner. This was indeed the case. The variation between media outlets was also much smaller than that of document consistency, which also makes sense, since web article formatting is more likely to be more similar between outlets than writing style.

Table 3: Screen Equilibrium

Media Outlet	Average Screen Equilibrium
National Geographic	0.79
Wired	0.86
Live Science	0.76
Science Magazine	0.76
Scientific American	0.82

Differences in colorfulness *within* a particular media outlet is definitely more significant (due to inclusion of different pictures, page elements in each article), and hence it is of paramount concern to average out these differences.

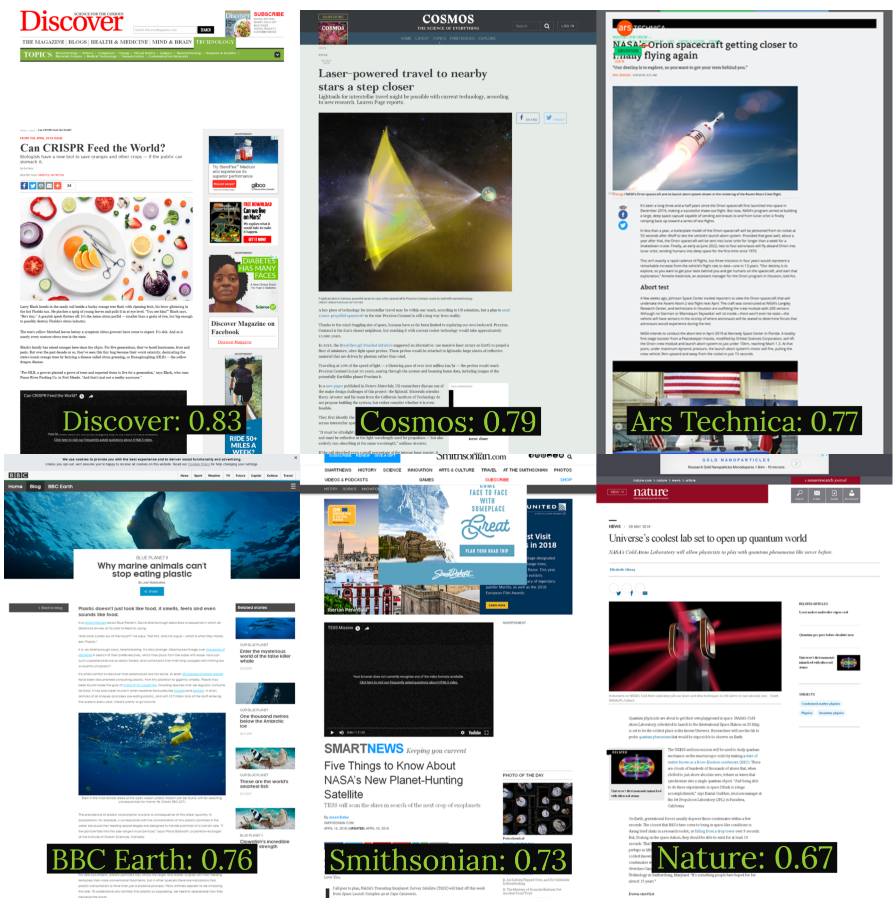

Figure 5: Standardized Average Colorfulness Scores, Top 6

Results

Table 4: Coefficients for Average Monthly Site Visits

Fixed Part	Coefficient (s.e.)
Intercept	0.12 (0.20)
Document Consistency	0.51 (0.33)
Shannon Entropy	0.76 (0.48)
Colorfulness	0.31 (0.22)
$Colorfulness^2$	1.10 (0.97)
Screen Equilibrium	1.73 (0.90)
Screen Sequence	1.34 (0.78)
Time Since Inauguration	0.31 (0.08)*

The table of errors indicates for the model concerning average monthly site visits, only the time since website inauguration is significantly correlated with the site visits. This makes plain sense, as the longer a website has been around, it should accumulate a large baseline readership as opposed to more recently created websites. Unfortunately, none of the aesthetic variables were significant at the 0.05 level, although some are marginally close. This is possibly due to the errors in estimating the montly visits which will be elaborated on in the next section. The random part of the model is also omitted from the table, given that for each article nested within a specific media outlet, the dependent variable posseses a non-varying value, allowing for the specification of an all-contextual, no-individual model. The robusteness of this model will also be discussed in the next section.

Table 5: Coefficients for Average User Linger Time

Fixed Part	Coefficient (s.e.)
Intercept	1.01 (0.72)
Document Consistency	0.70 (0.12)*
Shannon Entropy	0.33 (0.21)
Colorfulness	0.64 (0.40)
$Colorfulness^2$	0.55 (0.34)
Screen Equilibrium	0.52 (0.10)*
Screen Sequence	0.33 (0.22)
Time Since Inauguration	0.11 (0.10)

From this table we can see that stylistic consistency and screen equilibriumexhibit a significant relationship with how long users spend on a website. Even though the other variables do not exhibit statistical significance, this posits plausible relative strength of the relationship between the abovementioned variables and users' willingness to spend time on the site. Plotting both screen equilibrium and stylistic consistency against user linger time does reveal an apparent strong positive correlation, as can be seen from the contour plot (Figure 6) on the following page.

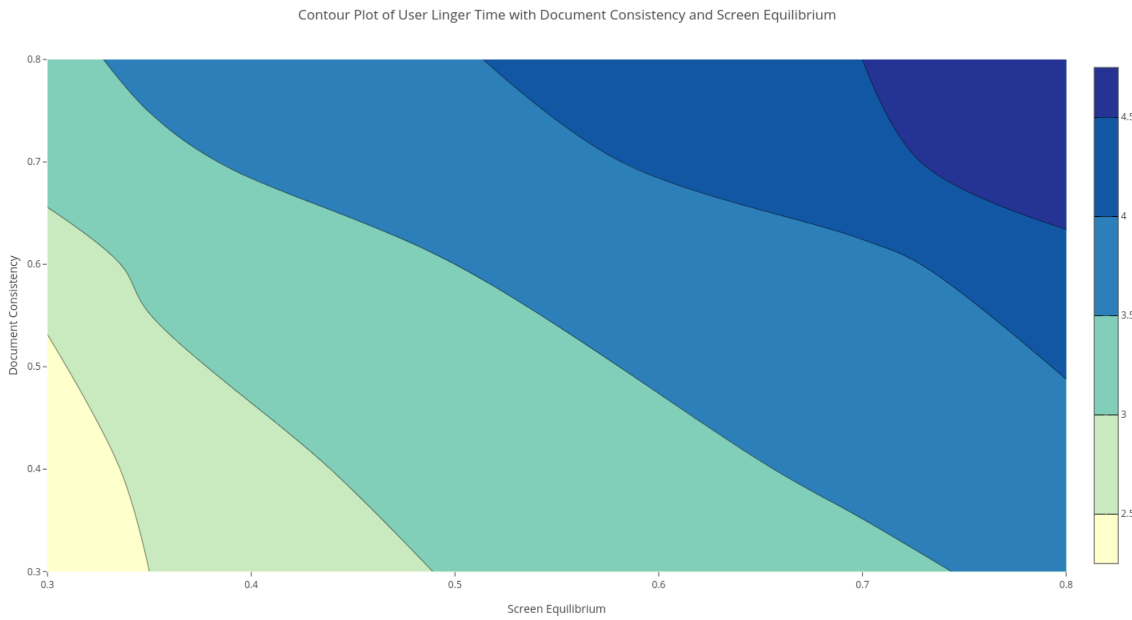

Figure 6

Discussion

While the results do not seem to expouse a large amount of potential for the association of computational aesthetic measures with basic web metrics, there is promising association between some of the measures and how long users spend on the site, which agrees with previous studies that some level of aesthetic appeal does impact how attracted individuals are to a particular webpage and our perceived credibility of such a page. As these are paramount to any communicative endeavor, the study proposes that user-centred design should be a mainstay in the academic study of science communication as well as in the industry of science media. Moreover, this limited timeframe study has several limitations that should not undermine the relevance of its research question.

First, only two dependent metrics were studied - readership and user linger time - and these were obtained using estimated methods, with unpredictable errors. Given more time and resources, the best course of action would have been to obtain organic data from the media outlet proprietors themselves, which would give the most accurate estimates of the metrics of interest. Moreover, these estimated methods only allow for the extraction of domain-wide statistics, and not at the granularity of page-based statistics, which also limits the robustness of the model.

Secondly, all the aesthetic measures were computationally measured. While this provided a good testing ground for many automated algorithms in HCI, it would have been beneficial to also include some human-based measures, as aesthetics is after all something that originates from human judgment.

The above is also compounded by a lack of more text methods in measuring the aesthetics of the text content in the articles. While stylistically appraising text is still a complicated task computationally, document similarity could have been used alongside other methods such as word frequency analysis, domain-specific word distribution, in order to provide a more granular measure of how the reading public might perceive and experience the style of writing from a particular media outlet.

Lastly, while a total 750 data points were collected, these articles were only spread among 25 different science news outlets. Given more resources, a larger amount of data from a wider variety of sources could have been obtained and analyzed as part of the dataset. Given a sufficient amount of data, learning models could be deployed to discern non-parametric and non-linear relationships possibly present in the phenomenon.

Future studies might benefit from studying a larger variety of news outlets, possibly across different cultures and languages. Organic data of the dependent variables should also be obtained from the outlets in question. A new set of dependent variables could also be studied - average site hits may not be the most indicative of ”successful science communication”, but variables such as page activity, content retention, perceived reliability, are also potential variables of interest that could be strongly associated with the aesthetics of a page and of good science communication. As Wittgenstein eloquently puts, ”Knowledge is in the end based on acknowledgement” - knowledge that is acknowledged will be a greater public good, than that which is ascetic and inaccessible.

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