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### Science for the Masses or Science for the Classes: A Dissection of Popular Science vs. a More Scientific Approach

Are we human or are we scientist? For those among us that dedicate their lives to scientific research, the answer might be tad more complicated than it initially appears. Scientists are held to a much higher, often unobtainable, standard of conduct than the rest of the world's population. They are to relay information, not emotion, if they wish to enter and/or remain in the scientific community. The merit of the scientist is based on his/her ability to gather and transmit hard facts which are almost completely devoid in ethos. Subsequently, not all scientific articles are created equal.

Some articles are constructed with the scientific community in mind and are held to the high standards mentioned prior while others are directed towards a more popular audience, the general public. These popular scientific articles have more free range in terms of their language and are more readily allowed to voice their opinions. For instance, popular scientific news source, Science Daily, published an article in October of 2018 entitled *Mammals cannot evolve fast enough to escape the current extinction crisis* addressing the dire need for increased conservation efforts in the face of a mass extinction event, the first of which they claim, in all of the Earth's history, is human driven. The article published by Science Daily utilizes emotionally charged language, even going as far as to address the reader directly through the use of inclusive pronouns such as directly addressing mankind as a whole with phrases such as "we humans" (Science Daily 2018). This is all done in an attempt to sway its audience into taking accountability for their own personal contributions (whether that be in terms of climate change or

habitat loss) to the mass extinction crisis. This, in combination with the overall optimistic, hopeful call to action the author concludes with, is aimed to provide the reader with the motivation necessary to become an active participant in conservation efforts.

On the other hand, *Mammal diversity will take millions of years to recover from the current biodiversity crisis*, an article by paleontologist Matt Davis from Aarhus University, centralizes around the notion that, while conservation efforts are important and do plenty good, only time can truly recover the lost phylogenetic diversity caused by negative human interactions. Davis's scientific article (from which the Science Daily article sourced its information) is a stark contrast, not in terms of content, but in the manner in which such content is conveyed. Traditional of scientific articles, Davis's research paper is very careful to avoid any hidden political agenda. In regard to his research, he simply states his reasoning for conducting, methods used, findings, and general conclusions. The use of "we", such as "we randomly sampled", is exclusive to the research team rather than the bulk of the world's population (Davis 1). Although there are some subtle implications in favor of conservation, Davis' article tends to focus more heavily on an appeal to logic rather than emotion, given that he is addressing the scientific community rather the general public. Unlike the general public, the scientific community values viable data, not ethos, and deems credibility accordingly.

The contrast in titles alone is indicative of where the focus of the article primarily lies. For instance, the use of the word "mammal diversity" in Davis's article reflects the concern over loss of phylogenetic diversity rather than the loss of the individual animal, whereas the Science Daily article simply refers to "mammals". Similarly, Davis' article refers to a "biodiversity crisis" whereas Science Daily prefers to call it an "extinction crisis". While both articles agree on the severity of the issue, their choice of diction is interestingly distinct.

The mere mention of the word “extinction” is sure to excite some heated and emotionally charged debates. For this reason, the Davis article uses it sparingly, so much so that he even expresses a degree of uncertainty regarding the mass extinction event as “potential” rather than in the definite and ongoing manner that the Science Daily article does evident in their statement that the “sixth mass extinction is underway” (Science Daily 2018). This is partly in line with the belief system established by renowned scientific philosopher Karl Popper, that attributes true science with that which attempts to disprove and find data which is contradictory to the hypothesis rather than that which is in agreement. In this way, the hypothesis is only proven true when the contradictory is absolutely disproven. Until then every hypothesis, no matter how strong the complimentary data, is left with a degree of uncertainty which cannot be neglected.

Although both titles hint at a problematic issue, the Science Daily article does a better job of placing emphasis on the severity of the situation, creating with it a sense of urgency. Portraying the mammals in a manner which makes them appear like helpless victims desperate for an “escape” is a strategic method of evoking empathy from the reader which would ideally give rise to action (Science Daily 2018). On the contrary, alluding to the possibility of recovery, even if it requires millions of years, only serves to dilute the situation at hand to avoid any unwanted conflict. This is exactly the intended effect of the Davis paper.

The use of graphic aids within a scientific paper can either work to assist the data conclusions or hinder them, while the credibility of the author thus follows suit. The illustration found in the Science Daily is complementary to the qualitative approach to research the author opted for. Despite the use of phylogenetic trees, this image is not one that would typically be included in a true scientific article. The implications of a mammal-less future serve primarily as a fear tactic, working in favor of conservation. For this reason, this image is more likely to become

widespread, as it is substantially more impactful on the emotions than a mere graph. In this case, the image fits the context of the article in that it is both remarkable and emotionally evoking.

On the contrary, the Davis article has numerous analytical based figures which seek to illustrate the data presented while indicating a quantitative approach to research in addition. In comparison, the Science Daily illustration appears rather over simplified. The Davis article includes figures which contain proper order names of organisms, percentages, and numerical values. There are scatterplots and bar graphs as well as phylogenetic trees similar to (yet more advanced) those found in the Science Daily article. The expectation is that the reader can properly interpret the figure and extract all necessary information contained within.

In terms of organization, the Davis paper is more consistent with the widely accepted form of a true scientific article. Within it are the seemingly minor, yet essentially mandatory, sections entitled “Materials and Methods” and “Acknowledgement”. The “Materials and Methods” section serves as a detailed description of how the research was conducted and analyzed, done for the sake of reproducibility. The intended purpose is that should another member of the scientific community wish to replicate this experiment, they could easily do so. The “Acknowledgement” section serves dually as a thank you to all those who helped contribute to and allowed for the study itself as well as reflecting sufficient background research has occurred.

This work up, when provided, helps add to the credibility of its author. In the case of Davis, its addition seeks to deem him a trustworthy authoritative figure in the scientific community, which in turn gives reason for the community at large to both accept his findings and to heed any conclusions he may have produced. It is precisely the inclusion of such written works, in unison with the bulk of the research work ups/findings, which help differentiate a true

scientific article from a popular science article (such as the Science Daily article) which usually choose to omit this information on the grounds that they are not necessary given the reference frame of the audience. In other words, the popular science author is notably assuming that the reader is not concerned with the reproducibility and/or contributions to the study, as they are surely willing to accept the data at face value.

In the introductory paragraph summarizing the overall content of the article, there appears to be significant differences between that of the Davis and that of the Science Daily. For instance, the Davis article provides the research question which the study hopes to address which is: “can mammals evolve fast enough to recover their lost PD on a human time scale?” (Davis 1). On the other extreme, the Science Daily article draws general conclusions in its introductory paragraph (which also serves as its summary). The answers are thus dictated without the need for a central question. Instead, this summary places emphasis on mankind’s shared responsibility in respect to climate change and raises the need for concern within the reader.

In a similar fashion, the sections containing the concluding paragraphs are vastly different in their lasting impressions. The Science Daily article chose the title “Prioritizing conservation work” while the Davis article went with “Avoiding a Mass Extinction”. “Prioritizing conservation work” is a last-ditch call to action during which a tonal shift can be noted to occur. Throughout the article, the tone is more representative of a cautionary tale. Upon its conclusion however, the reader is uplifted with a more optimistic outlook of the future, one in which they might feel compelled to action rather than belittled by the negativity and their own sense of helplessness. In claiming that the research team (from which they sourced their data) “doesn’t have only bad news” and that “data and methods could be used...so that we can prioritize conservation efforts”, the author leaves the reader with a little taste of optimism and

many possible applicable solutions to counteract the effects of climate change and habitat loss (Science Daily 2018).

In alignment with a typical scientific article, the “Avoiding a Mass Extinction” section found in the Davis article comes to a factual (and rather emotionally neutral) conclusion in which the recommendations for further research are stressed in addition to increased conservation efforts. The overall message of increasing phylogenetic diversity (PD) loss Davis runs across in this section does give reason for the reader to be concerned, and although it is not as direct as the Science Daily article, there is a sort of indirect call to action. Despite the fact that “extinction is part of evolution”, Davis claims it is the “unnatural rapidity of current species losses” that “forces us to address” the extent of the possibly irreversible damage that we are causing as well as its implications for our planet’s future (Davis 5).

Educator and YouTube vlogger Hank Green once remarked that “to look at the world with a scientific eye is to observe with no preconceived notions”, yet what does this mean in regard to the scientist? Can he truly disregard his preconceived notions of the world? Are any of us truly capable of putting our personal biases and perspectives aside for the greater good of scientific discovery, or are we merely victims held captive by our own humanity? Popular science would indicate that we are biased creatures who seek to prove what we believe rather than to disprove it. In the interest of time, it neglects the contrary evidence and can manipulate the complementary for its own agenda. On the other hand, science which seeks to be unbiased always strives for perfection even if it tends to fall short. In acknowledging alternative data as well as possible limitations of their studies, scientists learn to put aside their personal dogmas. They become accustomed to focusing solely on the hard facts before them, perpetually and

relentlessly in the pursuit of greater knowledge. The burden of the scientist is a great one indeed, eased only in the fruits of its labor.

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