# Simplifying Science: Evaluating Lay Summaries in Prominent Journals


## Abstract:

This paper aims to explore the quality of published lay summaries within reputable scientific journals: PNAS (Proceedings of the National Academy of Sciences) (Proceedings of the National Academy of Sciences), PLOS, eLife, and the Journal of Hepatology. Furthermore, which journals have different records for consistency and accessibility within their lay summaries. Lay summaries are the main method of concisely communicating scientific results to a general audience. This is to allow a wide range of audiences to understand and support the research without requiring extensive subject knowledge. Lay Summaries were distributed to different McMaster SCICOMM 2A03 tutorial groups at random and given a criterion to rate the lay summaries of each article, and then compile the results. The results were compared with each other and run through an ANOVA test to determine statistical significance within comparisons. Results showed that PLOS and eLife were rated the two highest overall, with eLife showing less variance in ratings between the two. Lay summaries are a key sector that bridges the gap between science and the public. Refining the quality of lay summaries can help gain public awareness and appreciation for scientific research that frontiers the quality of life now enjoyed by many around the world. It can also help fight against misinformation of the public by giving the public a confident way to verify information portrayed in media and journalism. Ultimately, the improvement and contribution toward lay summaries is a beneficial development for both the public and the scientific community.


## Introduction:

Lay summaries provide a crucial shortened synopsis of research articles that allow complex concepts and vocabulary present in the scientific world to be accessible and understood

better by the public. Although lay summaries are typically concise, they consist of straightforward and clear terminology commonly discussing the introduction of the paper, research questions, objectives, methods, results, a conclusion of the paper, implications and limitations.

Lay summaries are very important when it comes to connecting the scientific method of communication to the rest of the world. By using basic vocabulary and establishing a connection with the audience's interests, lay summaries can assist in engaging with the general audience. Clarity and understanding are made possible by writing simple words, using clear headlines, creating concise summaries, and explaining relevant concepts (Dubé & Lapane, 2013). Lay summaries can build relationships between the scientific world and the public audience, by allowing society to comprehend the implications of research studies. Public support allows the general audience to feel included, broadening the perspectives of scientific researchers. This inclusion can allow researchers to gain insight into societal concerns and objectives. Large audiences can enhance studies as they can be tailored to audiences at a global level. Research topics can then be used as a means to address more real-world issues and have more practical use. Researchers encounter several challenges, including time limits, concerns about political factors and public perception, structural issues, competitiveness, and other factors in which the public can assist researchers in their studies (Burns et al., 2021). If scientific findings are made more accessible, a larger audience can be developed to assist with future research. Both parties benefit from each other through accessible summaries. Moreover, the public can educate themselves without having to go through tedious scientific training in order to understand the findings of research reports.

It is important to simplify the complexity of scientific studies to allow larger audiences to access scientific papers without having to have significant knowledge to engage and understand

the research reports. Lay summaries have a tremendous resume of benefits however, many potential challenges may arise when constructing a lay summary. Due to the overall simplicity of lay summaries, inaccurate or defectively constructed lay summaries can cause oversimplification. Oversimplification can create misconceptions of the studies' findings as the conciseness of the summary leaves out vital information. This could lead to a distortion of understanding. On the other hand, if lay summaries are too complex and do not appeal to the public, there may be a lack of engagement which can result in a lack of connection between research findings and the public audiences. Additionally, lay summaries written in the passive voice may cause readers to distance themselves from the content. This is because the passive voice is often seen as more neutral and objective than the active voice (Chan & Maglio, 2019). Active voice is typically seen as the better choice for writing lay summaries. A poor lay summary can cause misinformation to spread due to inaccurate summarization of information. Various difficulties come with creating a lay summary. Simplifying jargon into simpler terms that target a wider and larger public audience can be difficult when scientific words are used to address the scientific audience. Another difficulty is maintaining the audience's attention by creating a lay summary that encompasses all key details while simplifying it enough to keep the findings engaging and interesting. A research study on agrammatism and conversational grammar by Beeke et al. called "Grammar without sentence structure: A conversation analytic investigation of agrammatism" displays how various grammatical styles of language and terms can assist in writing engaging pieces of literature. To engage with a broader audience, including those who have difficulties comprehending certain texts, lay summaries should avoid specific phrases. The results of the study showed that challenges in accessing verbs and creating sentences became worse as structural complexity increased (Beeke et al., 2007). Another study by Baram-Tsabari et al. titled "Jargon use in Public Understanding of Science papers over three

decades" displayed how jargon and a shift in the language of Public Understanding of Science (PUS) articles over several years through scientific papers can make the scientific text less accessible (Baram-Tsabari et al., 2020). This displays how important clarity is and how vital it is to avoid jargon within accessible summaries.

The rationale for this research study is to examine various lay summaries from four distinct journals. The Proceedings of the National Academy of Sciences, PLOS Medicine, eLife, and the Journal of Hepatology are among the journals included. The study's goal is to evaluate the effectiveness and dependability of lay summaries in these journals. The purpose is to determine how well these summaries fulfill the fundamental objective of making difficult scientific material understandable and appealing to the public. The study aims to evaluate the quality of published lay summaries and discuss whether different journals have different track records for accuracy and accessibility. These two research questions will provide a greater understanding of lay summaries. Lay summaries connect scientific studies and the public together. They encourage engagement and comprehension. Reaching the ideal balance is important since too much complexity or oversimplification might impact communication. Lay summaries should be written using specific techniques so that everyone may grasp the journal at hand, including those who find it difficult to understand certain passages. Other strategies include staying away from jargon, which can improve audience comprehension and connection. We'll use a variety of journals to improve the outcomes of our investigation.

**Methods:**

McMaster students reviewed lay summaries from four different journals: Proceedings of the National Academy of Sciences (PNAS), PLOS, eLife, and the Journal of Hepatology. The articles from each journal were on a wide variety of scientific topics. The lay summary was the specific section of each article that was manually reviewed. Fifty lay summaries were reviewed

from each journal. The summaries were divided randomly between the students to avoid sampling bias within the student reviews. Selecting a large portion of manual reviewers provided a more equitable score overall for each journal. The scoring process was divided into four categories:

1. "Does the lay summary accurately summarize the study methods, results and conclusions?"
2. "Does the lay summary accurately summarize the study rationale, implications and limitations?"
3. "Is the lay summary's writing clean, clear and logically organized?"
4. Average of Scores for "Is the lay summary's writing tailored to its audience and purpose?"

Each category was rated out of 5 for each journal and totaled for a combine score out of 20 per journal. Dividing the breakdown into different categories provided more descriptive statistics on outlined key aspects of lay summaries. The comparison of each category was to determine the aspects that made certain lay summaries better than their counterparts. Each category would visualize statically why certain journals had a higher rating in the lay summary than others. The score was graphed for each category, and the overall average score and then run through an ANOVA test, the results are displayed as follows:

**Figure 1:** Total scores of each journal from every category out of 20 created on GraphPad

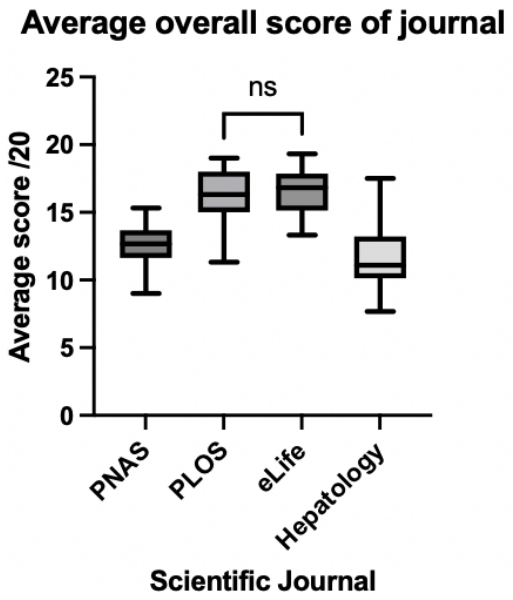



**Figure 2:** Total scores out of 5 in every journal for category A "Does the lay summary accurately summarize the study methods, results and conclusions?" created on GraphPad

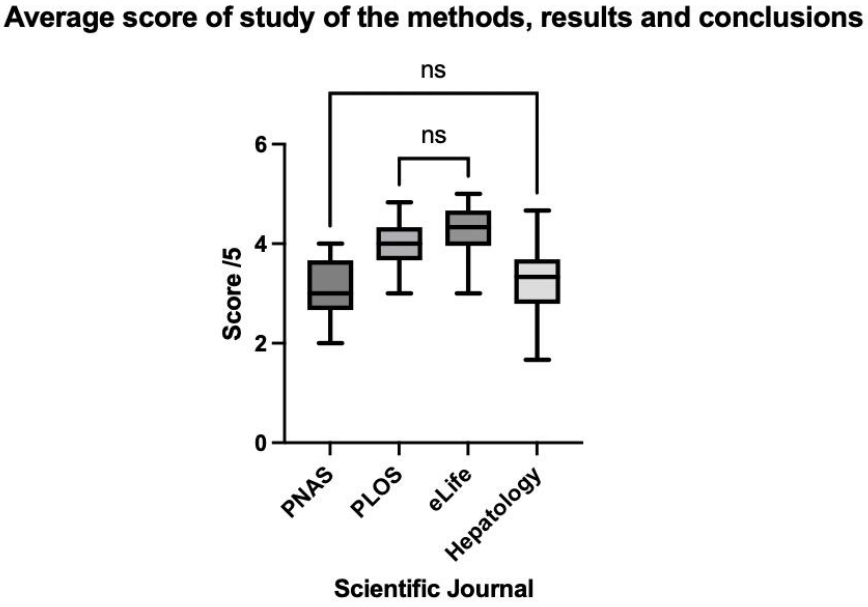


**Figure 3:** Total scores out of 5 in the scientific journals for category B “Does the lay summary accurately summarize the study rationale, implications and limitations?" created on GraphPad.

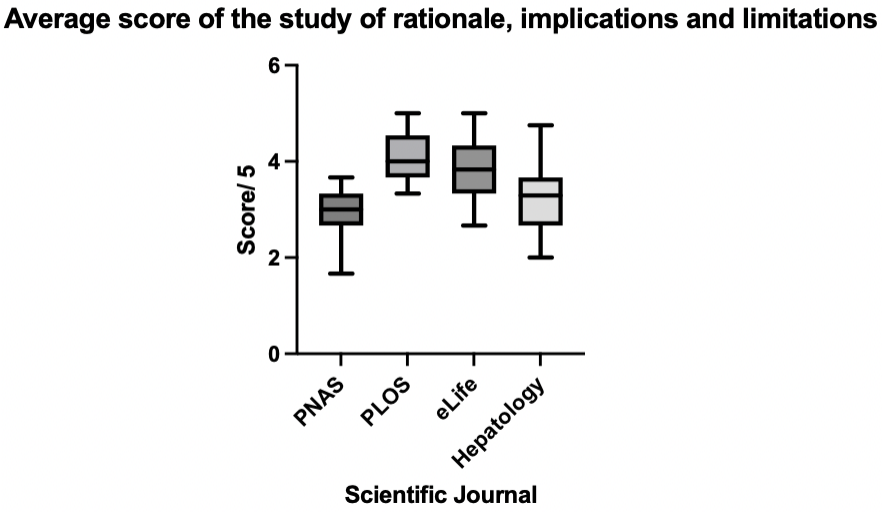



**Figure 4:** Total scores out of 5 in the scientific journals for category C "Is the lay summary's writing clean, clear and logically organized?" created on GraphPad.

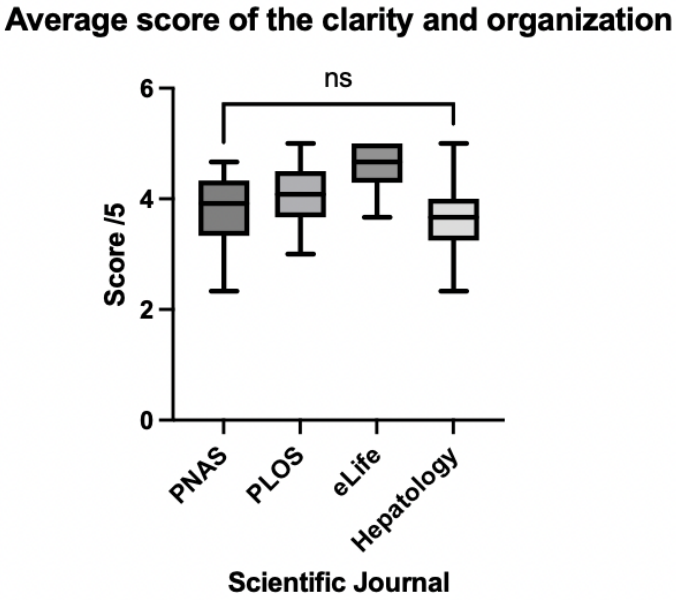
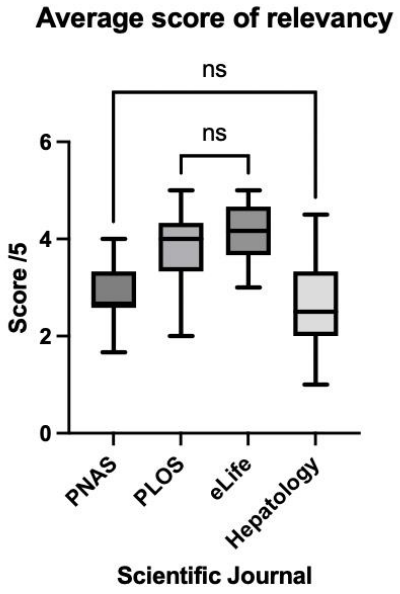


**Figure 5:** Total scores out of 5 in the scientific journals for category D "Is the lay summary's writing tailored to its audience and purpose?" created on GraphPad.




The figures were created in GraphPad Prism software. The box and whisker graphs were selected to visualize the distribution of the data to determine the median points within the comparisons. This form of visualization is used to help view distribution between the data points, making the large number of data points easier to visualize. An ANOVA test was run to determine the variance between the results. When the figures display the “ns”, it represents “not significant” meaning that the comparison between those sets of data is not significantly different and not to be used isolated in comparison to its specific “ns” counterpart in that category. The ANOVA test was calculated in the GraphPad software to avoid individual calculation error.

**Results:**

Through analysis of the figures created from the rating of the manually reviewed lay summaries, it appears that Elife journal and PLOS journal were tied for the highest score. The difference in the distribution of data done by the ANOVA test determined the difference to be insignificant to properly proclaim one journal statistically ahead of the other. Certain journals

had outliers in the score that was not representative of its average in that category. PLOS and Elife were ahead of PNAS and the Journal of Hepatology overall, with each pair being respectively insignificant in comparison to each other frequently. The distribution of the results in category A visualized the difference between PLOS and Elife with a higher score distribution than PNAS and Journal of Hepatology. This average score within the lay summary rating is consistent with the overall score data. The average score of the methods, results and conclusions of PLOS and Elife had a median distribution to be almost an entire point above PNAS and Journal of Hepatology. The overall rating of rationale, implications and limitations category had no non-significant differences in data, with PLOS rating higher on average, followed by Elife. However, in category 3, Elife had a higher score than PLOS. The highest scoring category overall was category 3, clarity and organization of the lay summary. Conversely, the lowest-scoring category was category 4 regarding clarity and relevancy. The results in the figures above depict that each journal has certain categories that specifically caused the overall score to increase or decrease significantly. PNAS and Journal of Hepatology scored comparatively poorly in comparison to its competitors, its strongest score being in category 3. While being organized well and clear on the points in its lay summaries, results show it lacked proper summarization of the overall article and was not tailored well to a general audience. The poor ratings in categories 2 and 4 specifically was the primary reason for the overall score being behind the competition. PLOS did comparatively well in every category, having a few lay summaries lacking in category 4, but the small percentage of outliers did not impact the mean score. In Elife journals, the overall score of its lay summaries was strong, often being on par with PLOS. The figures also depict fewer overall outliers in the score, allowing for the justifiable claim that the overall quality as a whole is more consistent than in PLOS. The Journal of Hepatology was by far the most inconsistent journal. They were competitively one of the lowest scores in each category but also

had significantly higher distribution in the data points compared to PNAS, its next closest competitor. The inconsistency in each article is a good pinpoint for the reason behind the poorer comparative quality of lay summaries. Ultimately, by analysis of the figures, it can be determined that the Elife journal has a statistically similar score to PLOS, but its average variance in data is lower via the whiskers on the graph.

**Discussion:**

The purpose of this study is to analyze the quality of the published lay summaries and to determine if different journals have different track records of accuracy and accessibility. Lay summaries may not appeal to the general public if they appear too complex. On the other hand, if the lay summaries are oversimplified, the reader could potentially misinterpret the findings. Journals that score high in the four categories give a good indication that the lay summary fulfills its purpose. The results show that the PLOS and Elife have the highest average score overall, which indicates a higher quality of lay summaries compared to other journals in this study. Both of these journals have consistent scores in each category, which leads to having the highest overall score. Meanwhile, the PNAS and Journal of Hepatology score consistently lower in each category with very small deviation between scores in each category. An important pattern to note is that the lower-ranking journals do not outperform in a single category in comparison to the relatively high-ranking journals. This indicates that for a journal to create a strong lay summary, it must fulfill these four criterias. Another important fact to note from the results is that the overall lowest-ranking category is four and the overall highest-ranking category is three.

These results help distinguish the higher quality journals and identify the key characteristics of successful journals. Identifying the lowest-scoring categories provides

actionable insight into specific aspects that researchers need to focus on when writing lay summaries. Advancements in the way lay summaries are written can have a significant positive impact globally. If society becomes more comfortable with science and understands the latest research studies, it can prevent the spread of misinformation. The consequences of misinformation are severe, and the latest example of it was seen during the COVID-19 pandemic. In Canada, COVID-19 misinformation has cost the lives of 2,800 people and the loss of 300 million dollars in hospital expenses (Major, 2023). Misinformation has contributed to over 2 million Canadians refusing to get a vaccine, and many of the hospitalizations could have been prevented if more people were willing to get vaccinated in the beginning (Major, 2023). This alarming data shows the gravity of the consequences that society faces when it is dissociated with science. Misinformation thrives because of this gap between science and the public, and better-constructed lay summaries can be the key contributor to fixing this pressing issue. A 2017 poll for the Ontario Science Center found that 43 percent of the people considered science to be a matter of opinion (Weber, 2019). In response to this data Jon Smol an ecologist in Queen's University says that this is not too surprising and that there is a clear disconnect between what scientists do and what the public perceives (Weber, 2019). This analysis highlights the necessity for the scientific community to push for higher quality lay summaries.

This study is a stepping stone to improving the quality of lay summaries and lays the groundwork for further research to be conducted. It is important to note that the results from this study are from McMaster University students and not necessarily from a wide variety of individuals who have different academic standings. Everyone that ranked the lay summaries possesses a high school diploma. This study does not include people who have not finished secondary education, nor does it include individuals who have obtained their undergraduate

degree, master's degree, or Ph.D. Lay summaries should be understood by everyone regardless of their education background. Individuals with different educational standings would give different scores for each category. Thus, the next step should be to conduct further research that includes people with a wide variety of educational backgrounds. This is crucial in gaining a more definitive ranking of each journal and gives a better insight on areas of improvement. Also, it is necessary to conduct more extensive research that encompasses ranking the lay summaries of more journals. The more journals that are analyzed with a wider variety of people ranking them can help gain a deeper understanding of the characteristics of a high-quality lay summary. Moreover, it helps in exposing more areas of improvement. Ideally, further research should aim to include participants from all over the world to understand if the standard of education in different countries impacts the way people rank scientific journals. Furthermore, more research done on this topic can garner awareness of the importance of lay summaries and the need to improve them. Another actionable step would be to contact the individual scientific journals and inform them about the results of this study so that possible improvements can be made. These next steps are necessary for changing the perception and understanding of science in society. Lay summaries and their widespread integration into the populus should be the next major development in bridging the gap between the science community and the global community.

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