Sahan Chowdhury

1. Introduction: Topic and Evaluation Policy

Title: Health impacts of noise pollution

Description: Find documents that look at the various health impacts of noise pollution.

Narrative: The focus is to find health effects of noise pollution. Documents that discuss other aspects of noise pollution such as environmental or societal impacts, may only be regarded as relevant if it addresses health implications. On the other hand, documents that only discuss noise pollution in non-health related contexts are not within the scope of this topic.

2. Facet Analysis

The facet analysis for the topic above was completed using a facet classification framework of PMEST or also known as colon analysis. This facet framework was developed by Shiyali Ramamrita Ranganathan in 1933. The classes of this facet are.

-**Personality** which focusses on the individuals and groups affected by the issue of the topic.
-**Matter** regards the physical characteristics of the problem
-**Energy** class includes the operations and activities
-**Space** regards the location and where the topic occurs.
-**Time** refers to how to problem changes over time as well any key dates that relate to the topic

With the above in mind my framework was created as follows.

P	**Personality**	Individuals, Health effects, Human
M	**Matter**	Sound levels, Noise sources, Health implications
E	**Energy**	Sound waves, Health impacts, Noise pollution
S	**Space**	Indoor setting, Outdoor environments, Industrial zones
T	**Time**	Chronic exposure, Long-term

The choice of the PMEST framework allows to systematically analyse the various approaches of noise pollution health impacts. It is regarded as a universal sorting system and is also the most comprehensive facet framework in this instance as it considers all the relevant aspects for the topic and its description. PMEST framework encompassed all the necessary dimensions to address the topic, compared to other facet classification frameworks, and as a result I proceeded with PMEST. For the personality class I chose the terms 'Individuals' and 'Health Effects' as these describe the personality (person) of the topic description, we aim to capture the demographic affected by noise pollution and the health effects noticed. For the matter class 'Sound levels', 'Noise sources' and 'Health Implications' was chosen as these describe the physical property of noise pollution and health effects. The energy class influences the matter class and were placed with 'Health implications', 'noise pollution' and 'sound waves' these are the process and activities. The narrative of the topic is more concerned

with the general aspect rather than a specific location, as a result both indoor and outdoor setting were labelled to the space class. Finally for the time class 'Chronic exposure' and 'Long Term' were assigned although the impact of this class is not as significant as the other classes, it is still a useful facet for considering temporal dimension of noise pollution health impacts, giving a holistic understanding of the topic.

3. Search Strategy

In the initial stages of developing search strategy, I used a traditional Google ranking web search since this is a popular search engine and contains a diverse array of information sources. I started with the query "health effects of noise pollution", which yielded 112,000 results, in contrast the query "noise pollution health effects" only returned 30,800 results. The disparity amongst the two queries underscores the significance of word order in search queries. "Health effects of noise pollution" gave more relevant and precise articles and documents which were relevant to the topic compared to "noise pollution health effects" which displayed documents and articles regarding noise pollution reductions action plans. To expand the search result, I attempted to experiment by adding more key words through adapting the first query. It seemed the search number significantly increased to 1,670,000 results with the query "The effects of chronic exposure to noise pollution on human health within both indoor and outdoor environments." This incorporated all facets identified in the facet analysis, and this seemed to have enabled the search to be more specific, furthermore it enabled the search engine to contextualise and show relevant articles, however It was also noted that adding repetitive terms and terms that were closely connotated for instance "...health effects, stress, physical and phycological..." affected the search results, in fact not finding any searches. This could be due to the excessive overlap and redundancy in the keywords. These initial findings laid the foundation for selecting the best search strategies for a Boolean and ranking search.

Boolean Queries

All Boolean queries were carried out on 2dsearch, a visual search tool for creating Boolean search strategies, except for ProQuest, which is an online search platform with its own interface to create Boolean strategies. The visual search (2dsearch) tool was very simple to use, and it allows to spot any mistakes easily, such as punctuation and grammar, whereas in a command line this can easily become a tedious process. It can also be easily adapted until needed, this made it easy to create an iterative process to identify the best search queries, enhancing the efficiency of the search strategy. However, for initial search implementation I opted for ProQuest as this gives the option to create complex searches that can be easily adapted and compare different Boolean strategies. Both building blocks and successive fractions strategies were implemented, however in the end successive fractions was chosen, as this allows for step-by-step refinement going along the classes of the facet analysis, furthermore it would be easier to adjust the searching criteria during iteration this way. Through implementing successive fractions in ProQuest, the following was created where each set corresponds to a facet category.

Sahan Chowdhury

{Set 1} = ("noise pollution" OR "sound pollution")
{Set 2} = (Set 1) AND ("health effects" OR "health impacts OR "public health")
{Set 3} = (Set 2) AND ("Indoor environment" OR "Outdoor Environment")
{Set 4} = (Set 3) AND ("long term exposure" OR "Chronic Exposure")

The energy and matter class were combined into one set due to the commonalities within the context of the topic. The use of Boolean operators 'AND' and 'OR' was used to construct queries, alongside phrase searching to treat query terms as a singular unit. The total results were 117, however the results were not adequate, there was only a small number of search results discussing the topic of health effects due to noise pollution, as a result the approach was modified as shown below.

{Set 1} = ("noise pollution")
{Set 2} = (Set 1) AND ("health effects")
{Set 3} = (Set 2) AND (Indoor and Outdoor)
{Set 4} = (Set 3) AND (long term)

Despite reducing the search scope with simpler terms, the total search result increased up to 1883. Changing "Indoor environment" to just 'Indoor' would result in less precision but since the aim was to look at either outdoor or indoor perspectives, this adjustment helped contextualise the search. Furthermore, the removal of the apostrophe for the time and space set allowed for a broader search. However, the results were yet not satisfactory in fact no search result was deemed relevant. Further modification was needed.

The search strategy was modified again. The modifications were adopted by looking at relevant articles and looking at common words, these words would be included in the query, for instance many articles referred to health impacts rather than effects. Queries that led to more irrelevant searches would be removed, this was done over several iterations and the use of successive fractions helped to build up through each set. Truncations or also known as wildcards were used for flexibility in capturing variations of terms. The use of proximity parameters in this instance 'NEAR/3' was used by specifying 'health' must appear within 3 words of 'effect' or 'impact', this would return a vast array of results that focus on noise pollution which include 'health' and 'effects/impacts'. Apostrophe was also removed from set 2 since we are no longer dealing with a single term. Furthermore, the space set *(set3)* was adjusted rather than indoor and outdoor, it was changed to cit* (city/cities) with a wildcard, to encompass both indoor and outdoor environments, 'city' is a common terminology used in relevant papers. Finally, the final set was refined to 'time', to ensure the search was not limited to specific timeframe or specific health issues. These changes made over several iterations created the final Boolean query as shown below.

{Set 1} = ("noise pollution")
{Set 2} = (Set 1) AND (health NEAR/3 effect OR health NEAR/3 impact*)*
{Set 3} = (Set 2) AND (cit)*
{Set 4} = (Set 3) AND (time)*

The total result was 8878, this is already a major improvement from the earlier strategies, and the number of relevant articles has increased. For Google, Startpage and Bing, the same Boolean queries were used in ProQuest using 2dsearch, however the apostrophe was removed from noise pollution, as this seemed to improve precision.

(noise pollution) AND (health NEAR/3 effect* OR health NEAR/3 impact*) AND (time*) AND (cit*)

Ranking Queries

'The effects of chronic exposure to noise pollution on human health within both indoor and outdoor environments'

For ranking queries, I chose to pursue with the query developed earlier (shown above) This seemed to be the best query as it covers all the facets, and it ensures the search system is concise ensuring high accuracy and precision in the search results. 'Health effects' was split into separate terms; however, the context remained the same. This query was used on all the ranked searches.

4. Evaluation

After all search queries for both Boolean and ranked queries were carried out on all the search systems, it was recorded in the evaluation sheet shown in *figure (1)*. The figure contains all evaluation metrics for each search service and query type for the top 10 searches, each search result was denoted with either a 1 (relevant) or 0 (irrelevant), this was dependant on the topic relevance along with the narrative which was described in the introduction. Specifically, this examination considered whether the search result explicitly discussed health effects of noise pollution.

Relevance was also determined by looking at key word matches were documents that included the terms 'noise pollution' and 'health effect/impact' ensuring the content aligned closely with the topic. Source reliability, i.e. search results that had multiple citations or were peer reviewed was also another key metric in determining relevancy. There were several key assumptions made prior to carrying out search to ensure consistency; all spam documents were documents that are promotional, unrelated and contain excessive advertisement. Duplicate documents (RT) are instances of where the same document appears in the search result, broken links (LB) instances is where the link of the document does not work and not retrieved document (NT) are documents that are referenced or indexed but not accessible through the search service.

Firstly, looking at the ranked based web searches, which included Google, Bing, Social searcher and Startpage. Initial findings suggests that there was a consistent high P@5 with all the ranked web-based searches scoring 1 across the board, all P@10 were considerably high and all EAP's were greater than 0.55. This highlights how well the ranked web searches performed. My topic of choice also seemed to align well ranked web-based searches, given the extensive online documentation on noise pollution and

health issues. The comprehensive nature of the query was also a vital component for the success of these ranked web searches.

For my chosen search system I decided on a ranked online search, Google scholar. Since web searches performed so well, I wanted to investigate an online search system. Google scholar attained an EAP of 0.47, not performing as well as the other ranked web searches. Many of the documents from Google Scholar overlapped with the web searches. The highest precision amongst the top 10 searches was with Bing web search P@10 of 0.9 and EAP of 0.89, this was also most notably deemed the best search service for my topic choice. None of the web ranked searches had spam nor a unretrievable document, however, Startpage did have an error link, although from the document title it seemed as this wouldn't have changed the final evaluation results as the topic of the document seemed irrelevant based on the title.

Moving onto ranked multimedia evaluation, relevancy was based upon the level of information on the images and videos. The topic of health effects due to noise pollution is a very specific topic, so it was crucial to ensure that the multimedia content provided substantial information relevant to the topic. For videos, watching the videos and finding the segment in which the video discusses the topic was how relevancy was determined. Since all the videos were relatively short it was easy to navigate through the videos and evaluate. There was 2 images services and 2 video services. Image services were evaluated from left to right due to the grid layout, this was also applied on Bing videos. Google images performed quite well with respective P@5 and P@10 of 0.8 and 0.7, compared to Bing images of 0.6 for both metrics. With regards to the images most were concise posters or leaflets and led to a relevant article or paper regarding health issues of noise pollution, however there was 2 instances of spam found in Google images that were completely off topic. In the case for the Bing Images, while relevant images were found, some lacked substantial information, making it difficult to denote the image as relevant or irrelevant. Despite this it was concluded to be relevant based on the criteria of relevancy. As for the video searches YouTube and a Bing Videos had a relatively low EAP of 0.23 and 0.26 respectively and this was not surprising considering this was quite a technical topic. However, YouTube did have a higher p@5 and p@10, majority of the searches were regarding air pollution, furthermore the results that were relevant were videos to raise awareness and not informative guides on the health implication of noise pollution. Google outperformed Bing in multimedia ranked searches.

As for Boolean search, visual searches were used on Google and Bing using 2D search. Both Google and Bing scored precision at 5 images and 10 images much lower than that of the ranked search. However, there was a significant disparity among the estimated average precision for the two search systems. Google scored an EAP of 0.7 for Boolean search compared to ranked which was 0.73, a marginal difference. In contrast Bing Boolean search EAP was 0.2 compared to that of the ranked of 0.89, in fact Bing Boolean search performed the worst among all searches, it also only retrieved 5 results of which 2 were deemed relevant. The superiority of ranked searches over Boolean searches may be attributed to the advanced ranking algorithms and quality of backlinks in ranking web searches. ProQuest, an online Boolean search, also performed quite

poorly having a precision at 5 images and 10 images respectively 0.4 and 0.5, and a relatively low EAP of 0.28. It seemed that Boolean web search deployed on Startpage performed the best amongst all Boolean search strategies obtaining a P@5 of 1 and P@10 of 0.8, in fact Startpage was the only Boolean search which performed better than that of ranked search, this may stem from its unique approach of processing Boolean queries.

5. Summary

For the reflection of the operation aspect for information seeking behaviour I adopted the Ellis model as shown in *figure (2)*. Starting with the analysis of the topic, I developed initial queries using PMEST method, regarding health impacts of noise pollution. In the browsing phase, I reviewed texts, images and videos provided by the search systems. During chaining, I checked search results links and check the reference of a search, in addition to this I checked document citations. I then moved onto differentiating, prioritizing search results that focused solely on the narrative; health effects of noise pollution, excluding other forms of pollution or non-health related effects. In the extracting phase, I gathered relevant results, and verified the accuracy and reliability of the information, by cross checking results with peer reviewed and authentic sources where possible. Finally, I assessed whether I had sufficient information to fulfil my need, if this was not the case the information seeking process would restart.

Overall, among all the search services evaluated, Bing Web Search performed the best for my topic. Social Searcher, Google ranked and Startpage Boolean all performed well attaining relatively high precision. These services demonstrated the ability to retrieve relevant information related to the health effects of noise pollution, with minimal instances of spam or duplicate documents. In contrast, the worst performing search service was a Boolean query search on Bing, where half the documents were unretrievable, this may be possible due Bing finding the query used unfavourable. This insight highlights the importance of search service selecting to obtain accurate and reliable search results.

Ranking searches generally outperformed Boolean searches in terms of precision and EAP. This is expected, considering the popularity of ranked searches. Ranked searches are more user friendly and provide results based upon relevance whereas Boolean searches are more complex and focus on keyword relevance, in many instances key word may not always direct to the necessary search, this was evident when I applied my searching strategies. When assessing the different search system interfaces, web searches performed the best holistically. This is due to the abundance of textual information available on the web. multimedia searches performed the worst collectively, this may be down to the nature of the topic, which is primarily discussed in textual form rather than through images or videos.

For future work, expanding the scope of searches and using multiple queries on a larger variety of search systems for different search types would enhance the study. The evaluation process for this topic provided valuable insights into the strengths and limitations of various search services.

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Appendix

Search Service	Query Type	P@5	P@10	EAP	RT-Dup	LB	NT	SPAM
Google Web Search	Boolean (2Dsearch)	0.80	0.80	0.70	0.00	0.00	0.00	0.00
	Ranking	1.00	0.80	0.73	0.00	0.00	0.00	0.00
Bing Web Search	Boolean (2Dsearch)	0.4	0.2	0.2	0	0	5	0
	Ranking	1	0.9	0.89	0	0	0	0
Google Images	Ranking	0.8	0.7	0.58	0	0	0	2
Bing Images	Ranking	0.6	0.6	0.33	0	0	0	0
YouTube	Ranking	0.6	0.4	0.23	0	0	0	0
Bing Video	Ranking	0.4	0.4	0.26	0	0	0	0
ProQuest Dialog	Boolean	0.4	0.5	0.28	0	0	0	0
Social Searcher	Ranking	1	0.8	0.76	0	0	0	0
Startpage	Boolean	1	0.8	0.8	0	0	0	0
	Ranking	1	0.6	0.56	0	1	0	0
Google Scholar (other)	Ranking	0.6	0.7	0.47	0	0	0	0

Figure (1): Table showing consolidated search queries evaluation results.
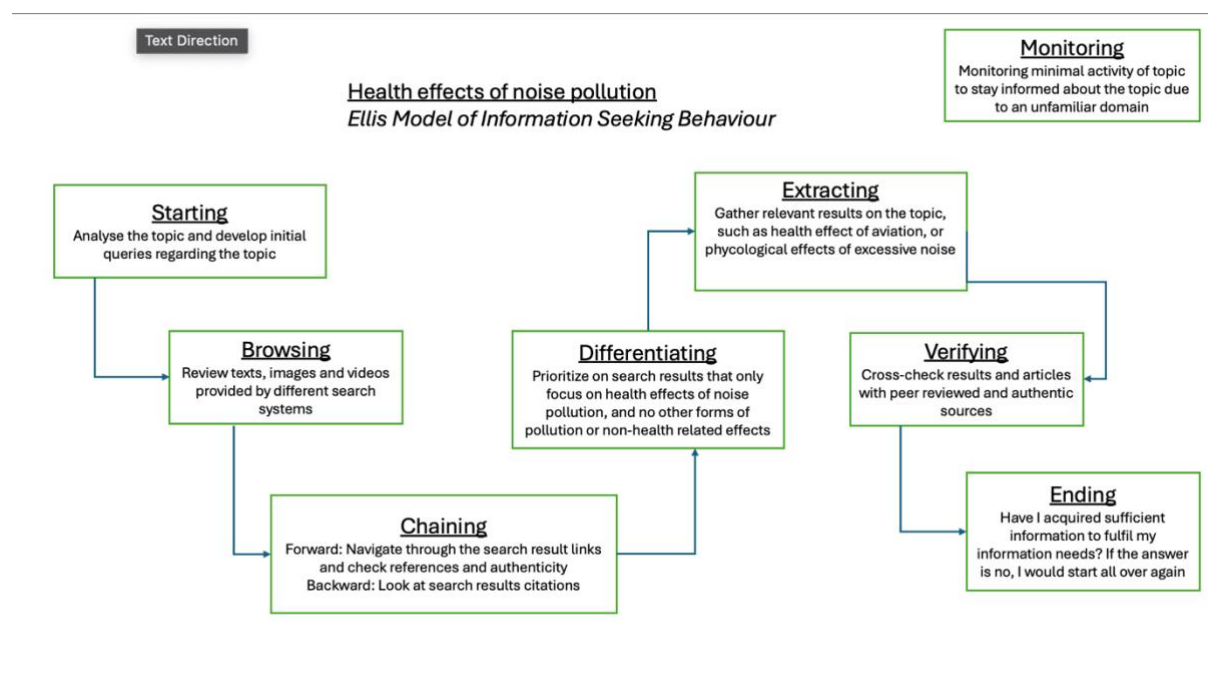

Figure (2): Flowchart diagram showing operational analysis using Ellis's model for information seeking behaviour.