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Lang Prize Reflective Essay

When I joined Dr. Carey's Hibernation Writing Project, I was assigned the topic "Human torpor: Historical, accidental, and medical." I started the research process under the false pretense that I could simply skip over the background-gathering phase since I already had a topic. While I have written research papers in the past, none have been quite as robust as this project, and it turned into an extremely rewarding learning experience, but I soon realized how important background information is to understand what terms to use and how to piece them together for effective searching. Suffice it to say, my search strategies evolved continuously throughout this project as I gained more skills and a deeper understanding of the search tools I am privileged to have at my disposal as a UC Davis student.

In the beginning, I pulled key words directly from the assigned topic and searched for them in Google Scholar to start collecting some broader sources to get a handle on my topic. I chose Google Scholar for this stage of research because it hosts one of the broadest academic libraries of any academic search engine, and, honestly, because I was already comfortable with it and still learning what else is out there. These initial search terms were quite broad and included "human torpor," "medical torpor," and "accidental torpor." While human torpor yielded quite a few results, I lacked the affiliated vocabulary to sort through which were actually relevant or frankly make sense of the article at all. Additionally, I was not so lucky with the latter two, which required different search strategies as I learned more appropriate terminology. Here marks my first research strategy evolution: Instead of trying to filter through medical, accidental, or historical torpor, I started focusing on the biology behind torpor in naturally hibernating animals. From there, I learned more about which specific mechanisms occur and

developed a list of chemicals and pathways to search in the context of human torpor. The most significant finding from this new approach was the concept of "induced" or "synthetic torpor," which I found extremely interesting and knew would be an important scaffolding for medical torpor.

I also had to evolve my perception of what constitutes a "good" source. I was under the assumption that only peer-reviewed, scholarly articles were acceptable sources for a research paper, but I was at a loss for the "accidents" part of the topic as well as the mythologies part of torpor history. Besides a handful of brief references to the St. Louis accident in articles I found relating to torpor biology, Google Scholar was quite sparse in these areas overall, and I wanted to find more direct evidence from news stories published closer to the time of the accident. To overcome this challenge, I opened myself up to the concept of using Google as a general browser, and I was able to find news articles regarding the accidental torpor incidents as well as Wikipedia pages and blogposts as a starting point for the stories and mythologies. I followed the reference links on Wikipedia and the blog pages to find more reliable, scholarly works, some of which I used in the paper. If I could not find scholarly works, I emphasized ".edu" sources over ".com" or ".net" to maintain as much credibility as possible. I also familiarized myself with the UC Davis Library, which has a wonderful mix of academic, creative, and journalistic literature from quality sources. In hindsight, I wish I would have started with the library and saved myself the time of searching between both general Google and Google Scholar, so I will certainly do so when conducting future research.

With my relevant vocabulary, background knowledge, and paper outline greatly developed after the broader Google Scholar, general Google, and UC Davis Library search, it was time to move onto more advanced libraries and databases to provide

greater depth and evidence to the content of the paper. Throughout this process, and learning from other, smaller-scale research papers I wrote for other classes, I became more familiar with publishers and databases like PubMed, JSTOR, and Annual Reviews. Understanding the advanced search functions, such as "AND," "OR," or "NOT" functions to specify and filter search terms and the "fields" drop-down menu that often includes "Author," "Publisher," "Journal," "Date," etc. to narrow the search further or find related articles from good authors or publishers was groundbreaking.

PubMed and Annual Reviews proved exceptionally helpful for the scientific aspects of this research. Searching "synthetic torpor" or "torpor induction" or "'torpor induction' AND 'human'," as one example, yielded a much narrower but still rich pool of sources to continue to develop the paper's narrative and find top-tier sources to corroborate or negate evidence I had found during the more general search. It was rewarding to see some of the sources I had previously collected from Google Scholar or the UC Davis Library show up as results for these searches as well. I primarily used JSTOR to find new or more credible sources related to the stories and mythologies now that I knew search terms such as "sleeper awakes" or "suspended animation" or even "'Sleeping Beauty' + [global region]." I ultimately replaced several of my initial sources from blogposts or vague educational websites with these reliable, rich sources from JSTOR and expanded the global scope.

As I researched, I developed new strategies to filter through search results more accurately and efficiently, and this changed as my coherency with the topic improved. Initially, I found it easier to sift through articles by title and outline then skim the introduction and conclusion. Abstracts were too dense and technical as I was still building my affiliated vocabulary, and I mainly read the abstracts for practice in understanding the appropriate language and adding to my list of future key words. As I

got deeper into the process and my vocabulary grew, I could use abstracts more effectively. Here, I looked at the title first, then abstract. Then, if the paper appeared to be reasonably relevant to the research topic at this point, I read the introduction and conclusions of the paper and skimmed sections that seemed to match the information I was looking for. This process became exceedingly efficient, and I am glad to say that I was using citation management software, Zotero, to organize and keep track of sources as I saved them.

One other challenge I faced during this research relates to the novelty of human torpor. While I emphasized using peer-reviewed sources primarily from credible databases and journals for the scientific studies, it was difficult to find corroborating sources or simply sources that fit all the above criteria to start with. Even though the many stories and mythologies I collected throughout the process demonstrate how long humans have had an interest in this topic, human hibernation only appeared in fiction until very recent scientific technology bolstered interest and funding in the field. Thus, even though research in this field is rapidly growing and has been for primarily the past decade, there has not been enough time for replication studies of many synthetic torpor methods. There also has not been any related human trials yet, which I searched for directly in the National Institute of Health clinical trials database, save for the ongoing clinical trial using hypothermic conditions for emergency preservation and resuscitation (EPR) that I reference in the paper.

While writing the paper, the goal was to keep the most credible and recent studies, particularly from the last 5-10 years. There were some cases—such as news articles where I prioritized more direct evidence over a recent date, mythology reviews where the history and story summary would not change between the 1980s to now, or studies with strong experimental designs and evidence that were published a few years

outside of the date—where I made exceptions. Likely the most glaring of these "exceptions" was the 1950's study on hibernation effects on cancer, so I want to address this directly. After finding this article, I looked for contemporary study replications or any sources that may corroborate these findings; however, this search was unsuccessful. It is possible that modern replications of the study exist, but my search strategies may not have included the correct key words, or they are not available through the search engines and databases I was using. It is also possible that there have not been and replicas since studying the effects of hibernation on cancer is quite niche and does not have a place in human medicine yet. Additionally, ethics has become a greater concern since the time of the study's publication, so modern replications may have been blocked by institutional review boards since giving mice cancer and subsequently subjecting them to freezing temperatures without a reasonable motivation until human torpor research develops may raise questions about ethics and animal cruelty.

My goal for this paper was to synthesize research on historical, mythological, real-life, and theoretical human torpor. I sought to create a piece that explains the relevant biological methods of natural torpor and hibernation, how they can be manipulated to induce torpor in humans or other non-hibernating animals, and what medical benefits this may hold for us in the future. I included real-life, or accidental, accounts of humans entering torpor-like states to suggest that humans have preserved some of the torpor mechanisms from our ancestors and will successfully enter torpor with the right synthetic induction methods. I additionally host discussion on torpor in media and mythology to offer context to the scope of interest and to explain why institutions continuously fund research that has not appeared possible until only the past few years, and which still has a long course of animal models and clinical trials ahead. There are many literature reviews available that discuss the accidental and theoretical incidents of human torpor in tandem with natural torpor biology, but they

miss out on the exploration of why humans are drawn so inexplicably to this field, and I believe that describing humanity's long fascination with hibernation fills this research gap.