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BIOETHICS AND PHILOSOPHY OF MEDICINE – A COMPUTATIONAL HISTORY OF THE FIELD

The standard way practitioners of an academic discipline reflect upon the history and impact of their field is through „close reading" of selected texts, which is often mediated by their personal experience and academic interests. This approach is visible in the classical books about the history of bioethics (Jonsen 2003) or important articles that try to identify „the hottest topics" during the development of the field. Here is a typical statement identifying trends in bioethics based on such an approach: „Over the course of the history of bioethics, certain topics have moved in and out of fashion: in the 1970s it was euthanasia and abortion, in the 1980s genetics, in the 1990s stem cells and reproductive technologies, and in the 2000s, enhancement and data/tissue storage" (Dawson 2010).

The approach we adopt in our new project takes seriously the epistemological question of how one can justify the belief that, for example, the issue of „enhancement" dominated the debates of the 2000s. We employ a method characteristic for a distant reading: topic modeling – a computational text-mining technique aimed at discovering hidden thematic compositions in large collections of documents. An 'unsupervised' algorithm we used (latent Dirichlet allocation – LDA) identifies 'topics,' that is, sets of words that tend to be used together across documents in the corpus, and is able to provide the exact proportions in which different topics discovered by the model contribute to each document in the corpus. In our paper forthcoming in Bioethics, we used this method to analyze over 19,000 texts published since 1971 in seven English-language leading journals in bioethics and philosophy of medicine: *American Journal of Bioethics*; *Bioethics; Hasting Center Reports*; *Journal of Medical Ethics*; *Journal of Medicine and Philosophy*; *Medicine, Health Care and Philosophy*; *Theoretical Medicine and Bioethics* (Bystranowski, Dranseika & Żuradzki 2022a).

Our aim was not to replace close reading, so typical for the humanities, but rather to present an instrument useful for researchers that may support human interpretive work. As we observe, some topics are correlated, in the sense of being more frequently present together in the same texts. This simple observation allowed us to identify communities of related topics that tend to be expressed in the same texts. This way, we were able to draw

a novel, fine-grained yet interesting map of bioethics and philosophy of medicine that readers should inspect in full on their own (Figure 1) together with other materials at our website. By providing extensive online supplements, we not only invite readers to engage in their own interpretations of the present topic model but also to utilize the model in a variety of ways, from more focused historical analyses to teaching.

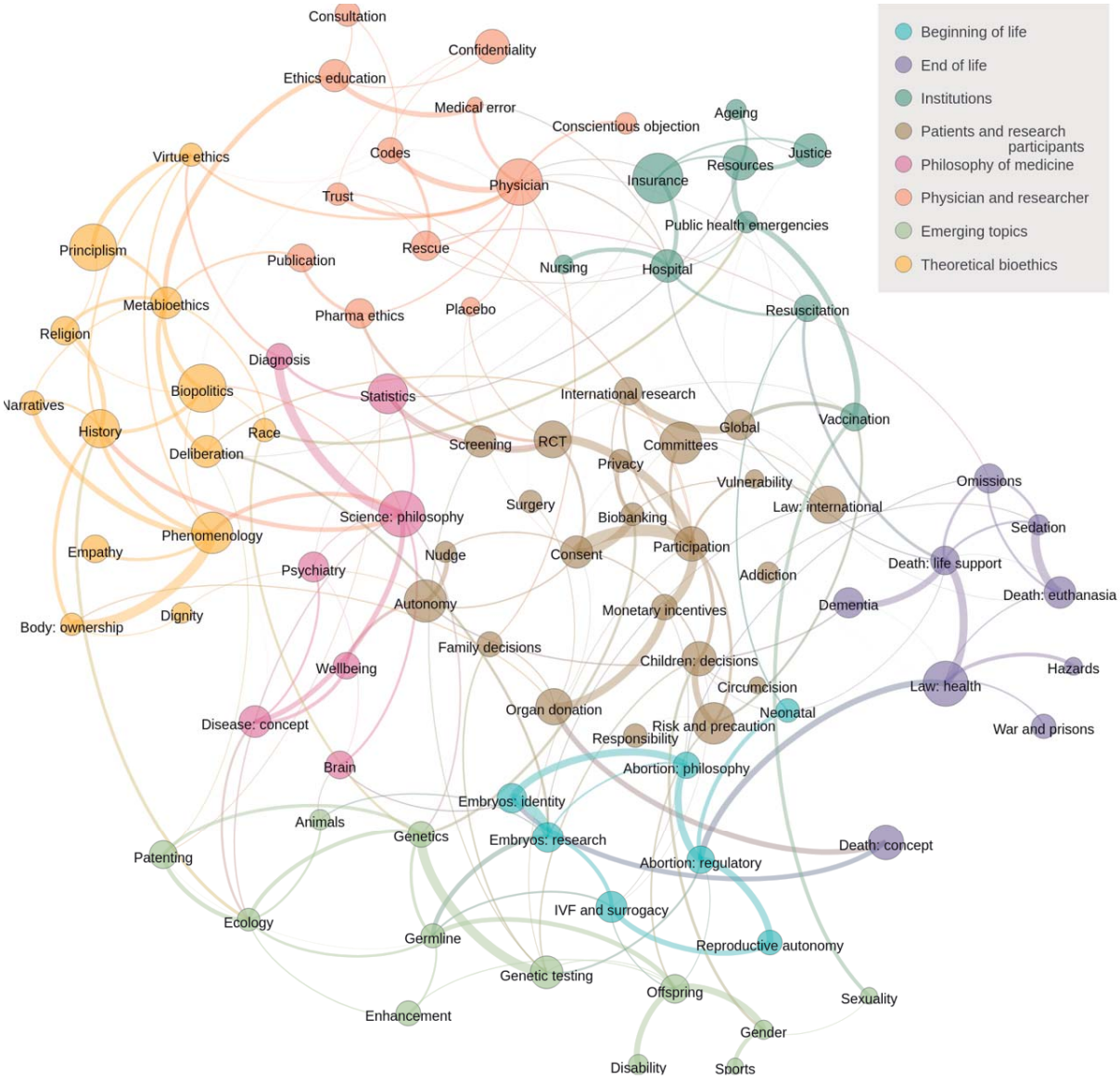

Figure 1. 91 content-based topics grouped into 8 clusters. Node size reflects a topic's prominence in the corpus, edge size reflects Pearson's correlation coefficient for a given pair of topics (only correlation coefficients above .05 are included in the graph).

The method may be helpful in interpreting the thematic structure of the entire field, the relations between different themes, the patterns of researchers' interests, and the evolution of such interests over time. Thus, for example, we are able to analyze the themes that „have moved in and out of fashion" in bioethics and philosophy of medicine more precisely and rigorously than with the help of standard „close reading" methods.

Here are some examples of interpretations one can draw from our study. Our analyses show which topics in bioethics and philosophy of medicine were the most popular over the last 45 years in seven analyzed journals (the first four content-based topics: *Health insurance*; *Health law*; *Physician's role*; *Research ethics committees*). One may interpret that their popularity reflects research interests relevant for the US healthcare system. For example, all of the top-10 papers characteristic for *Insurance* (see top-10 documents per topics) discuss Medicaid, US health reforms at different levels (federal and state), the healthcare programs of American presidential candidates, rising healthcare costs in the US, etc.

In turn, our diachronic analyses suggest changing patterns in research interests and reveal which themes have attracted or lost the attention of scholars over time. On the one hand, if we focus on the popularity of particular themes in the early days of the field (1976-85) in comparison with the most recent ten years in our corpus (2011-20), the biggest winners in terms of relative growth are themes represented by the topics we called: *(Moral) Enhancement*, *Public health emergencies*, *Circumcision and genital mutilation* (whereas the most significant losers are: *Medical Confidentiality*, *Historical topics in medicine and philosophy of medicine (History)*, *Medicine and general philosophy of science (Science: philosophy)*).

The main winner (in terms of relative growth) can be easily interpreted. In particular, considering that *(Moral) Enhancement* correlates with *Germline modification and gene therapy*, and *Genetics: concepts and research*, one can observe a broader trend of interest in different ethical, regulatory, and theoretical questions about heritable genome editing. The topic *Germline modification and gene therapy* is also among the recent top peaks. Still, it is also perfectly understandable if one considers the recent explosion of interest in the CRISPR/Cas9 method and the He Jiankui scandal. So, the above comment by Dawson (2010) about the popularity of enhancement topics did not describe the state of the art in the early 2000s, as much as it accurately predicted the main trend in 2010s.

The diachronic analysis of topic prominence allowed us to identify the most pronounced topic peaks, understood as the highest sudden increases of topic prominence (in a given 5-year period, as compared to the previous two periods), as well as to speculate on the causes for such drastic shifts in the object of bioethicists' attention. For example, the two peaks we observed for the topic *Stem cells and embryo research* (in periods 1991-95 and 2001-05, see Figure 2) may be straightforwardly interpreted as reactions to scientific discoveries and breakthroughs. The later, more visible peak represents an apparent reaction to the discovery in 1997 and 1998 of methods for deriving and culturing human embryonic stem cells indefinitely and methods for the cloning of adult mammals using nuclear replacement techniques. Many papers most associated with the topic *Stem cells and embryo research* published in that period (see top-30 documents per peaks) cite the influential article by Thomson et al. (1998), while others also discuss the regulations or guidelines that followed these discoveries. The earlier peak of the same topic is a reaction to some advances in reproductive technology, particularly in vitro fertilization (1978), and then cryopreservation (1984) that have made early human embryo experimentation possible.

Our topic model can be used for further analyses, for example, to investigate the impact of other fields on bioethics / philosophy of medicine or relations between bioethics / philosophy of medicine with other fields. Let us illustrate this briefly with some examples. The beginning of institutionalized bioethics and philosophy of medicine corresponds with the rapid changes in moral and political philosophy between about 1968 and 1975, as documented by other topic modeling studies (Weatherson, 2022). The works of key philosophers

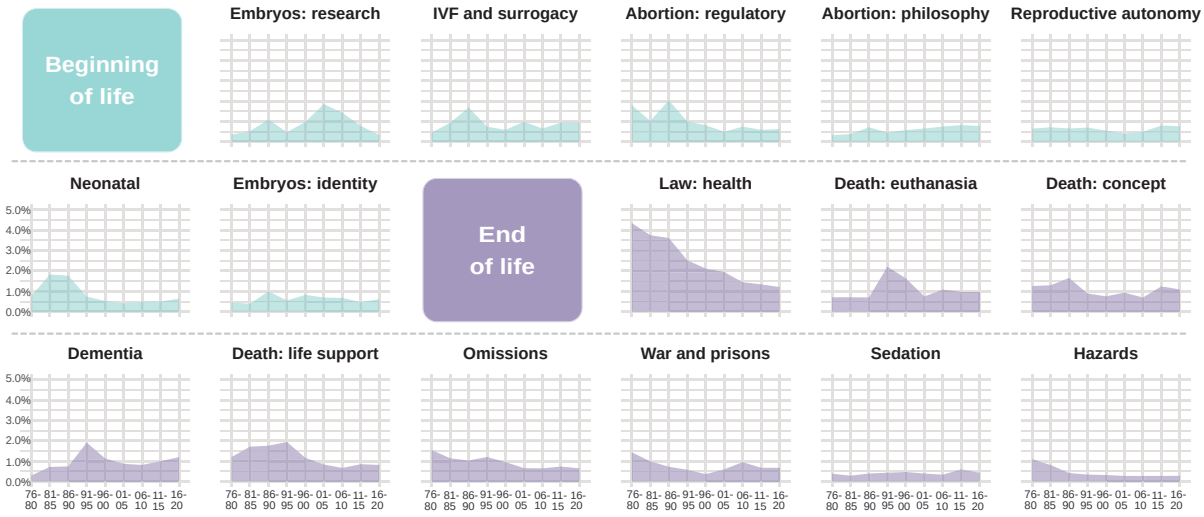

Figure 2: The mean prevalence of topics in two clusters (BEGINNING OF LIFE and END OF LIFE) across 5-year periods from 1976 to 2020. Topics within each cluster are ordered by their overall prominence in the corpus

relevant to these changes (Frankfurt, Thomson, Rawls, Singer, and Foot) are also critical for bioethics. In a recent commentary paper, Blumenthal-Barby and colleagues (2022) assumed that, compared to the early days of bioethics, the role of philosophy is now diminished across the field. However, based on our topic-modeling study and drawing from citation analyses, in our new commentary paper (Bystranowski, Dranseika & Żuradzki 2022b), we argue that the picture is far more nuanced. First, the proportion of citations to philosophy in the leading bioethics journals has remained very stable over the last decades. Second, there is no sign of decline in the relative prominence of 'philosophical' topics (identified by measuring correlations between topics' prominence in a text and the proportion of citations from such a text to philosophy journals) in the leading bioethics journals. While some par excellence philosophical topics popular at the dawn of bioethics (such as Doctrine of double effect and act/omission distinction (Omissions)) have indeed been waning in all corpus (but not in its bioethics subset), the presence of others has been surprisingly stable in the last 50 years: (e.g., Abortion: philosophical issues).

Thus, a macro-level analysis based on citation data is a natural extension of our previous studies. In our ongoing study (with Mahdi Khelfaoui), we conduct a quantitative analysis of citation flows from and to bioethics and philosophy of medicine papers published in leading journals representing the discipline. In particular, by providing an analysis of the visibility of bioethics and philosophy of medicine in other disciplines (and other disciplines in bioethics and philosophy of medicine), we plan to contribute to the debate on the influence of bioethics and philosophy of medicine on the biosciences, health studies, and social sciences and humanities (SSH). We believe that our quantitative studies will help us understand changes in science institutions and production as well as medical practice since establishing research ethics committees (RECs) in the 1970s with the institutional review boards (IRBs); through the development of ethics consultation in the 2000s; to the recent developments stemming from evidence-based medicine movement in the 2010s.

Acknowledgments

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