The changing relationships between digital technologies, DNA and evidence

The relationship between digital technologies, DNA and evidence is changing so rapidly and profoundly that in-depth and creative analyses of the links between them are urgently needed. Digital innovations within forensic DNA analysis affect the making of DNA evidence. For example, new computer programs create identikit pictures from DNA. At the same time, DNA and evidence-based reasoning also change digital technologies, for example when DNA is used as a storage medium for digital data.

Digital DNA provides pioneering empirical insights and theorization on the reciprocal influence of digital technologies, DNA and evidence. The project defines an emerging field: the digitization of forensic biology and the influence of the biosciences on digital technologies. It provides systematic interdisciplinary studies on three sets of developments.

1. Changes in hardware. It investigates how smaller and more mobile hardware influences the production of DNA evidence, and how DNA is used as hardware in computing.
2. Changes in databases and analytic instruments. It studies how a growth in DNA databases and their algorithmic analysis influence the production of DNA evidence, and to what extent digital databases and algorithms are associated with evidence-based reasoning.
3. Changes in information per se. It discusses how the ability to alter DNA influences the production of forensic evidence, and how DNA influences the concept of digital data.

Current debates tend to focus on ethical, legal and societal aspects of forensic innovation or on the roles that big data and algorithms play in society. Digital DNA focuses on more fundamental developments: how DNA evidence changes when it is integrated with digital technologies, and the re-orientation that digital data and technologies undergo when they are integrated with biology. A unique combination of methods from the social sciences, information studies and natural sciences is used in the project.

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Task 1.b How is DNA reconfiguring hardware and what is the status of DNA computing as a scientific, evidence-based practice?

Why this question? If digital hardware influences the production of DNA evidence, the inverse development is to understand how DNA itself is used as hardware and how such hardware gains scientific status. By the 1990s scientists saw the potential of using DNA as hardware (Atlan & Koppel 1990), but actual projects have not been realized until recently. Whether the idea behind DNA as a storage medium is to keep information for future generations or to analyse and process bigger datasets, DNA is regarded as a game-changer (Goldman 2015). Others have looked into the capacity of DNA as a programming language (Molteni 2018) and data processing medium, exploiting ‘DNA’s ability to replicate to execute an exponential number of computational paths’ (Currin et al. 2017: 1). Even though the designs are more proofs of concept than beta-tested technologies, they do provide a dimension of computing that could change it altogether (Blasiak et al. 2011). The scientific status of this form of computing, however, is underdiscussed. This task addresses the way in which humans and nonhumans collaborate in DNA computing and how that shapes its status as a scientific procedure. The task also analyses the way in which DNA confronts computer scientists with challenges and how scientists from different disciplines tackle these challenges when they seek to adopt DNA’s principles for computation and get DNA computation scientific status. Exploring these issues is not just an analysis of science in practice, but a study of the way in which decision-making processes in DNA computing are enmeshed with different
scientific, financial and popular cultures (these themes are discussed e.g. on the platform https://neo.life/).

**Case study 1.b:** DNA as data storage, DNA as data processing medium and its scientific status as hardware.

**Method 1.b:** In order to get an overview of existing research in DNA computing, a web crawling method is used to create a database of relevant projects, actors and publications. On the basis of this overview, outreach to different projects and actors is organized. In order to understand how DNA, computing technologies and scientists influence each other in the development process, 40 hours of observation are conducted at DNA computing sites and labs. This understanding is complemented by discussing practical approaches to DNA computing and the challenges involved, the scientific status of DNA computing and its scientific cultures with 40 professionals in this field (qualitative, semi-structured interviews). This research is also supported by 50 hours spent visiting relevant technology fairs and related conferences (e.g. the Pacific Symposium on Biocomputing). This task will include fieldwork and interviews in the US, the UK and Norway, since each country has labs and institutions for Biocomputing.

**Task 2.b** To what extent are digital databases and algorithms associated with scientific, evidence-based knowledge production?

**Why this question?** While the growth of digital DNA databases and the rise of algorithms change the production of evidence, an equally significant development is the inverse one: the concept of evidence-based knowledge production also shapes the status of digital databases and algorithms (Rowley 2017). The relationship between data, their computation and the value of scientific evidence is anchored in the history and philosophy of science. To delve into the depths of the enduring scientific status of digital databases and algorithms, it is key to trace the diverse and intersecting histories of the scientific qualities and values that have generally been associated with the concepts of data, analytic tools and evidence. It is important to analyse whether these qualities and values have remained stable over time and across disciplines, whether they migrated through different fields of technological innovation and whether they established their own authority. Scholars in the Philosophy of Science have provided inspirational works describing the role of values in scientific processes (e.g. McMullin 1982; Sprenger & Reiss 2014). This task will analyse the values associated with data-based science (especially in relation to databases and algorithms).

**Case study 2.b:** Genealogy of scientific qualities and values attached to ‘data’, ‘analytic tools’ and ‘evidence’ especially in biology, genetics, forensics, computing and information science. In line with Foucault’s understanding of genealogy, this is a qualitative analysis of the diverse, intersecting and sometimes conflicting histories of these values. It is guided by an expansive rather than a reductive approach to these value discourses. The aim is to investigate those elements that ‘we tend to feel [are] without history’ (Foucault 1980: 139).

**Method 2.b:** In line with the project’s overarching theme, the genealogy focuses on scientific value discourses within the disciplines of biology, genetics, forensics, computing and information science. It traces scientific value discourses in three steps. First, it analyses the values that were associated with ‘data’, ‘analytic tools’ and ‘evidence’ during rise of scientific journals and the institutionalization of science that began in the 18th century (Korty 1965). Digital copies of up to 200 key texts provided by scientific and public libraries are collected and coded using a qualitative method. In the next step, these findings are compared to more recent scholarly publications that document the upsurge in digital computation. This encompasses a selection of 200 key texts that discuss the scientific qualities attached to the digital counterparts of data, analytic tools and evidence: ‘digital datasets’, ‘algorithms and software’, and ‘evidence-based’ research. Key texts are those that discuss the values and qualities of data, tools and evidence directly or that say something fundamental about their role in science. Both selections of texts will also include critical accounts. The text selection will not be based on specific countries. It will include English language texts or translations and, if ad hoc translation services are available, also texts from non-Western countries.
References


NEO.LIFE: https://neo.life/
