Data cultures:
a scoping literature review

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Introduction. This paper reports the outcomes from a literature review of the concept of data cultures as the first step in extending the body of knowledge relating to information culture in the information science domain and raising awareness of the need for further research.

Method. A scoping literature review was conducted of English language peer reviewed publications indexed in SCOPUS as well as specialist information and computer science databases.

Results. There is a rich and growing body of research concerned with the concept of data cultures, spread across a wide range of disciplines but without any evidence of a universally adopted shared definition or understanding. Information science expertise does not appear to be widely recognised as providing any essential insight into this problem space.

Conclusion. The knowledge and understanding of information cultures gained from information science research does not seem to be being applied to data dominated environments. Expertise relating to information behaviour, digital literacies, information management, digital sustainability and preservation are unique and essential perspectives to understand issues relating to data cultures.

Introduction

For almost thirty years, there has been significant international interest in understanding the concept of information culture within the information science domain. More recently, as all aspects of life and work become increasingly data-driven, attention is turning to extending that understanding into the ways in which

people's values, attitudes, and behaviour influence the creation, storage, and sharing of data. As a first step in raising awareness of the need to investigate this problem area from the perspective of information science, we conducted a scoping literature review to find how the concept of data cultures is understood, and which disciplines have contributed research to this area.

The paper presents the outcomes from that literature review, highlighting the range of disciplines undertaking research in this area and identifying research foci and gaps in current research activities. Of notable concern is the absence of information science perspectives in much of the literature. The paper begins by providing an overview of information culture research, then outlines the case for considering data culture. It then explains the method followed to undertake the literature review and to analyse the selected papers. Findings show the range of definitions of data cultures, the diversity of disciplines conducting research and the different foci investigated by researchers. The discussion section considers the gaps identified as well as the need for input from the information science community, invoking Andrew Abbott's theories relating to the development of professions and the application of ecological theory to university endeavours (Abbott, 1987; 2005). The conclusion indicates the next steps for our research agenda.

Information culture research

Cultural influences on the ways in which information is managed, accessed and used in organizations has been the subject of study by researchers for several decades (see, for instance, Brown and Starkey, 1994; Curry and Moore, 2003; Davenport et al., 1992; Davenport and Prusak, 1997; Jarvenpaa and Staples, 2000, 2001). The concept was first defined by Mariam Ginman (1993) to describe organizations with a management style responsive to information from the external environment and open to change and innovation. Subsequently, research explored relationships between information culture and information behaviour in organizations (Widén-Wulff, 2000; Widén-Wulff et al., 2008; Widén-Wulff and Ginman, 2004; Widén and Hansen, 2012; Widén and Karim, 2018), and between information culture and information use (Choo et al., 2008). In the archival science domain, research has focused on the essential need to take information culture into account to achieve recordkeeping objectives, resulting in the inclusion of the concept as one of the three dimensions in the reinvention of records management for the digital age (Upward et al., 2018).

We suggest that it is time for data culture to receive a similar level of attention. Notwithstanding the clear differentiation of the concepts of data and information

(and indeed knowledge) (Wilson, 2002), there are obvious interrelationships and dependencies between them. Returning to Ginman's (1993) initial hypothesis about the links between an information culture and management's openness to change and innovation, in today's digital environment it would be impossible to consider organizational change and innovation without taking data into account. The twenty-first century has witnessed a massive increase in the volume, variety, and velocity of data (the "big data" phenomenon (Laney, 2001)) and organizations are using data in novel ways with the aim of generating new insights and sources of value (Frizzo-Barker et al., 2016). With cloud computing providing an affordable, scalable infrastructure for storing, parallel processing and analysis of huge data sets it is now possible for many organizations to access more advanced capabilities and work with larger volumes of data than before (Hashem et al., 2015). The Society for Information Management's annual survey of information technology executives has identified data management and analytics as the third most important organizational information technology issue for 2019 and 2020 (Kappelman et al., 2021, p.75). However, with this significant disruptive shift in the strategic role of data, organizations are struggling to integrate big data into their organizational cultures (Frizzo-Barker et al., 2016). Given this situation, it is entirely possible that attitudes and values relating to organizational information and its use do not neatly align with attitudes and values regarding data and its use. For these reasons it is timely to consider data culture in its own right.

We set out to discover whether the concept of data culture had been previously articulated, (and if so, how), as well as to find out which disciplines were most actively researching in this area. Our starting point was to conceptualise data cultures as the contexts in which data are created, collected, managed, accessed, used and re-used. Furthermore, we considered that data cultures reflect and are influenced by people's values, attitudes, and behaviour. These influences may be implicit or explicit, deliberate or inadvertent, transparent or covert. There may be little understanding of these values, attitudes, and behaviour which may be in conflict with those of dominant cultures, and consequently these values may not be recognized or facilitated by technological design. Our conceptualisation complements and extends understandings of information culture to explicitly acknowledge the attitudes and values that influence the management and use of data as distinct from information (which one can argue has been somewhat privileged in organizations' curatorial endeavours, as reflected in its superior status in the DIKW (data, information, knowledge, wisdom) pyramid).

Method

A scoping literature review was undertaken in March 2022. A scoping literature review provides the means to rapidly provide an initial view of a specific topic (Arksey and O'Malley, 2005) and is generally defined compared to other types of literature review (Paré et al, 2015). Scoping reviews aim to provide an initial indication of the extent, range and nature of the existing literature on a particular topic. They can help identify research gaps and gauge the value of undertaking a larger systematic review (Paré et al., 2015) We decided to undertake a scoping literature review because our topic was relatively broad, likely to have diverse study designs, and we were not aiming to answer very specific research questions (Arksey and O'Malley, 2005, p. 20). By way of contrast, systematic reviews are much more precisely focused, undertaken "to confirm or refute whether or not current practice is based on relevant evidence, to establish the quality of that evidence, and to address any uncertainty or variation in practice that may be occurring" (Munn et al., 2018) and thus are not appropriate for a preliminary exploration of the literature.

We restricted our search to full text publications in English (in accordance with the language competencies of the authors), with abstracts, and appearing in peer-reviewed outlets. Since we did not want to limit our search to a single disciplinary perspective, we used SCOPUS as the initial source. Although Google Scholar is cited as being the most comprehensive source for research literature (Martín-Martín et al. 2021) its limited search functionalities would have entailed much manual effort to eliminate duplicates and restrict coverage to peer-reviewed publications; furthermore its quality and reliability have been called into question (Halevi et al., 2017). The coverage of SCOPUS and Web of Science are similar (Martín-Martín et al., 2021), but SCOPUS was selected due to institutional availability. We conducted additional searches in three specialist databases: the Association for Information Systems (AIS) Electronic Library (AIS eLibrary), the Association for Computing Machinery Digital Library (ACM DL), and the Association for Information Science and Technology (ASISandT) Digital Library. These three databases were selected because of their close disciplinary alignment with information science.

The search strategy was identical for all four databases: a single search term was used ("data culture" or "data cultures") with the limitation that the phrase had to appear in the title, keywords, and/or abstract. This purposively limited findings to only those publications that specifically addressed the concept of data culture/s, and thus our findings do not include publications addressing other relevant aspects such as data fluency, data literacy, data sharing and data reuse, if they did not explicitly refer to data culture.

Most hits (146) were obtained from the SCOPUS search, but on reviewing the abstracts it was found that the search results had included retrieval of the words 'data' and 'culture(s)' separated by punctuation (full stop, comma and semi-colon). These papers were removed as they mostly referred to in vitro studies discussing data about specimen cultures, with the remainder complete non-sequiturs, i.e., the juxtaposition of the two words was not meaningful or did not refer to the concept under investigation. In addition, a further five citations referred to books and these were also eliminated as they were not available in their entirety online, although any individual chapters available in full text were retained. The total number of publications retained was seventy-eight.

Searches of the three specialist databases retrieved far fewer papers, with most already identified from the initial SCOPUS search. Duplicates, and publications without full text (poster, panel presentation, keynote) were removed, resulting in just two more added to the total. Results are summarised in Table 1.

Database	Initial number of papers retrieved	Final number of relevant, unique papers with full text online
SCOPUS	146	78
AIS eLibrary	5	2
ACM Digital Library	3	0
Asist Digital Library	0	0
Total		80

Table 1: Database search results showing number of relevant publications identified

In summary, a total of eighty full text papers (detailed in the Appendix) were identified as relevant and meeting all selection criteria. Analysis necessitated more in-depth engagement with each paper, involving both full-text word search as well as the use of author metadata to categorise papers by discipline. The specific steps undertaken to identify definitions and determine the disciplinary category and level of research are provided at the start of the relevant findings section below. The initial analysis for each of these activities was carried out by the first author, with all decisions checked and confirmed by other team members. Any uncertainties were discussed and resolved by the whole team.

Findings

The earliest relevant paper identified was published in 2004, with the subsequent trajectory of publications gradually increasing with twenty-one papers appearing in 2021 (see Appendix for the final dataset of publications). Findings relating to definitions, the range of disciplines active in this area, and the cultural levels or strata being studied are reported in turn.

Definitions

A word search of the full text of each paper identified any specific definitions used by authors. Most of the papers analysed did not in fact include an explicit definition of data culture or data cultures. However, it was evident from the definitions provided, and from the diversity of research design, that there is no unified or shared understanding of the concept. This is in keeping with earlier research into information cultures, where two quite different perspectives could be identified: the first interpreting information culture as 'a culture of information,' one that is conducive to effective information management and successful business, with the other acknowledging the universal and ubiquitous nature of information culture (Oliver and Foscarini, 2020). The definitions of data culture reported below provide examples used by researchers investigating diverse contexts.

Data culture in society

Considering societal data culture, a very precise and quite narrow definition is provided by Aragona and Zindato reflecting a culture of data perspective: '*Data culture refers to the connection between the moment when data are constructed and the moment when they are used to produce knowledge in a specific domain*' (Aragona and Zindato, 2016). In other words, this definition assumes that a data culture only exists if data is actually being used.

In contrast, a multidimensional conceptualisation for societal data cultures is proposed by Albury and colleagues in a study of mobile dating apps. They explain: '*The term "data cultures" is intended to be generative and dynamic... to tease out the complexity of data within digitally mediated dating and hookup cultures, and to move beyond simplistic "top-down, bottom-up" understandings of data power*' (Albury et al., 2017, p. 2). They usefully identify four conceptualisations of data cultures (p. 3):

1. Cultures of production — '*the institutionalized routines, habits and knowledge practices of the app publishers with respect to data in dating apps*', and most importantly suggest that many of these cultures will reflect the extremely individualistic Silicon Valley ideologies.

2. Cultures of cultivation — or the ways in which data are cultivated, as opposed to mined – '*in dating and hook-up apps various forms of data are created, cleaned, ordered, harvested, and cross-fertilised – by multiple and distributed but connected actors, including corporations, governments, developers, advertisers and users*'. 3. Cultures of datafication — or the commodification of culture '*via the algorithmic logics of digital media like mobile dating and hook-up apps*'.

4. Cultures of use — '*how data structures and processes are encountered, experienced, exploited and resisted by users who encounter them in the practice of everyday life, and how vernacular norms and practices for data ethics and safety are being managed and contested within user communities.*'

Data culture by sector and domain

The plurality and diversity of data cultures is also pointed out in the context of the public sector by Falk (2021) who refers to the dialectical nature of the developing and existing data cultures concluding that,

'data-cultures have emerged within the modern-day government, both on national and local levels. These cultures are constituted by the socio-material conditions and practices of digital tools and services that generated and accumulated user- and meta-data through a multitude of digital interactions throughout the public sector's digital dispositif'. (Falk, 2021, p.38)

A much earlier consideration of data cultures in the life sciences also emphasised the need to take into account existing and desired norms:

'The phrase "data culture" refers to the explicit and implicit data practices and expectations that determine the destiny of data. It relates to the social conventions of acquisition, curation, preservation, sharing, and reuse of data. If the goal is to make data digital, standardized and openly accessible in a reusable format, then current data cultures provide starting points to determine the changes that will be needed before that vision can be realized'. (Thessen and Patterson, 2011)

This is a more inclusive definition because it considers the practices involved in all stages of the data cycle and allows for the kind of anti-data-use culture not recognised by the culture of data view mentioned above.

Another attempt at teasing out the complexities of data cultures is provided in the context of higher education institutions, where two distinct data cultures are distinguished on the basis of their purpose; i.e., using data for learning or using it for accountability (Hora, 2017). The former is linked with the level of desire to engage in self-regulated learning, while the latter is associated with bureaucratic compliance. This study draws attention to distinctive data cultures and micro-cultures operating at the level of faculty and individuals, based around practice, and how these may delimit the potential of data use in practice.

A much simpler understanding of the data cultures concept that does not acknowledge the diversities of infrastructural capacities in high, middle, and low income environments is invoked in the World Health Organization's call for each country to promote a national data-driven culture to empower citizens in the fight against COVID-19 (Azzopardi-Muscat et al., 2021). This is an example of a normative definition, an attempt to adopt a rational evidence-based approach as a shared and accepted cultural method of decision-making.

Data culture/s in organizations

Research in organizational settings provides definitions that range from the very simplistic to those acknowledging their complexities. For example, from '*Data culture – the culture that decisions are made objectively and based on analysis of available data and evidence*' (Wong, et al., 2018, p. 187) to '*a situated, collective expression which encompasses professional identities, policies and specific practices relating to data, as part of an institutional culture*' (Raffaghelli et al., 2020).

Disciplines researching data cultures

We relied on the information about authors provided by publishers to understand which disciplines have undertaken research into data cultures. We checked the affiliation provided for each lead author, and where there was any lack of clarity about discipline we searched further for online biographical information. This enabled us to assign a specific discipline to each paper. We then allocated the named

discipline to one of two broad groups: Humanities, Arts and Social Sciences (HASS). or Science, Technology, Engineering and Mathematics (STEM)

The disciplines represented in our population were diverse and it was not possible to single out any major area where data cultures have not been addressed by research. The common theme running through all publications, regardless of discipline, was recognition of the significance of data cultures in extremely diverse research contexts. The majority of papers in our dataset (55 or 68.8%) reported research conducted in HASS disciplines, in education, sociology, communication studies, business and management, political science, information systems, information science, humanities, and philosophy. Given our inclusion of the word culture in our search strategy this might not be entirely unexpected, but our dataset indicated that STEM researchers also regard data cultures as being important.

The STEM disciplines represented in our population were from healthcare, the geosciences, life sciences, computer science, and mathematics. Of particular relevance to the information science community are three related disciplinary areas which bridge HASS and STEM groupings: information science, information systems and computer science. In total, there were 20 publications representing this disciplinary cluster, just 22.50% of the overall population. This small set of papers consisted mainly of contributions from computer science (10) and information systems (6) with just four that clearly represented information science research.
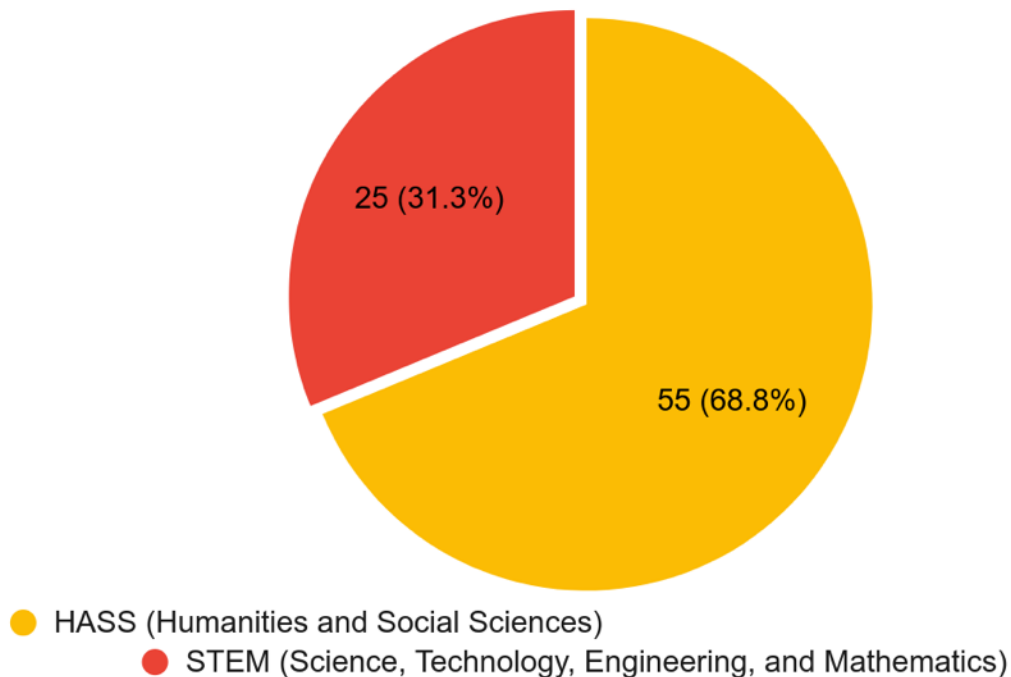

Figure 1: HASS and STEM categorisation of publications

Research levels

The literature in our dataset collectively showed a continuum of perspectives on data cultures ranging from the whole of society through industry, occupation and/or nation, to organizational and individual level. In order to gain more precise insight into the context of concern we applied an adaptation of the heuristic developed by Poirier and Costelloe-Kuehn (2019). Their heuristic was inspired by cultural anthropology discourse which argued for the use of strata or levels to guide cultural analysis (Fortun, 2009). The data cultures heuristic defines seven levels, namely meta, macro, meso, micro, techno, data and nano, to provide '*a template for ... examining data cultures within the context of a particular discipline, institution, geography or project.*' (Poirier and Costelloe-Kuehn, 2019, p.3).

We applied this heuristic to provide a view across the entire dataset of research projects. So, although the research reported in individual papers may have addressed multiple levels, we assigned each publication to a single level which appeared to best represent the primary focus of interest.

The first step in the process was to allocate each paper to a specific level based on the abstract. Papers were then grouped by level in order to evaluate consistency in decision making and classification, where there was any uncertainty about the most appropriate level the paper's introduction and conclusion were also reviewed and the classification confirmed or changed as necessary. The definition and scope for each level is based on that of Poirier and Costelloe-Kuehn (2019, pp. 4-5), but amended to extend applicability beyond scientific research communities and to reflect the characteristics of the research reported in our dataset. The overall distribution of papers by level is shown in Figure 2. A brief description of each level is provided below, referring to the specific papers identified by the sequential item numbers assigned in the Appendix.
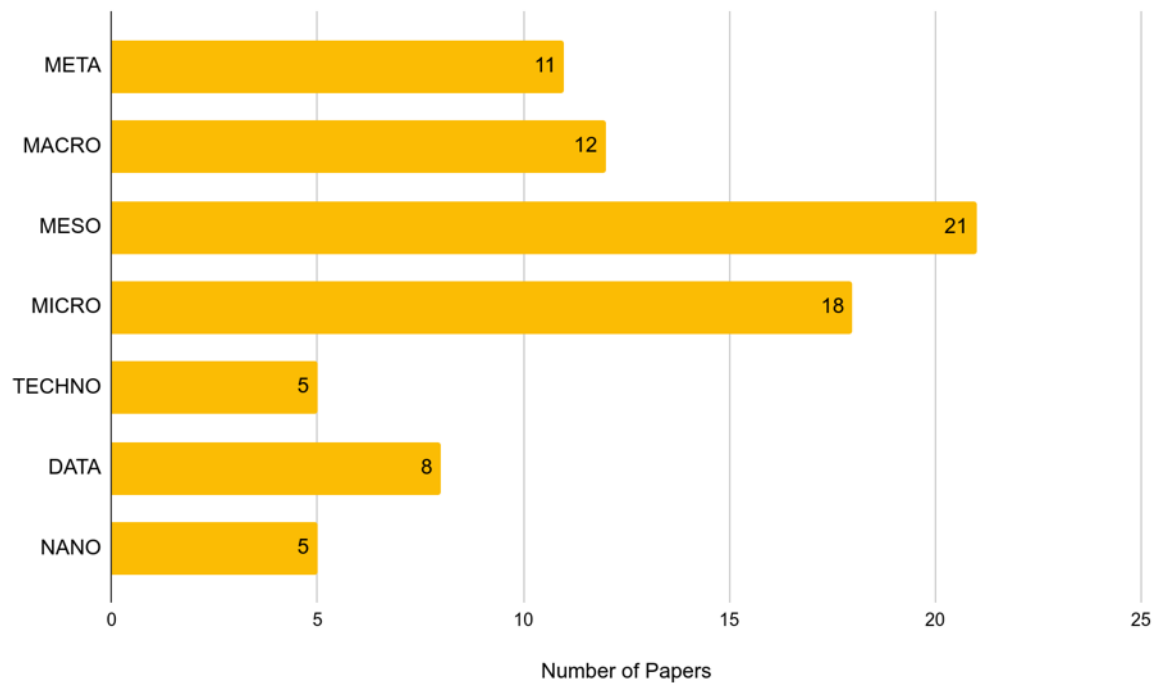
Figure 2: Distribution of papers according to primary level of focus

Level 1: Meta. High-level discourses including philosophical debate. Papers in this category included those focused on a specific context (papers 21, 68) but were mostly much more wide ranging, not limited to a particular place or discipline (for instance, papers 7, 8, 18, 29, 32, 56 (see Appendix)).

Level 2: Macro. The financial and legal structures influencing data cultures, for instance those supporting data sharing initiatives or restricting access to organizational boundaries. The papers which appeared to most strongly represent this level included those considering data cultures from a regional perspective (papers 9, 10, 30, 65, 76) as well as those specifically focused on legal aspects (papers 22, 24, 77).

Level 3: Meso. Organizational level activities, including collaborative networks. The largest percentage of papers were classified at this level. This set of 21 papers included considerations of disciplinary networks (papers 19, 55) organizations in general (papers 28, 58, 78), specific types of organization (papers 41, 43, 47, 54, 64) and individual organizations (papers 17, 51).

Level 4: Micro. The practices and customs of individuals working with and using data. This includes consideration of competency building through training and education. Papers classified at this level represented the second largest cluster, with some very

closely aligned to level 3 papers. These were the studies of data practices and competencies of people working in organizational settings (papers 1, 2, 6, 50, 61, 70, 75), but also papers considering competencies from a broader, societal view (papers 14, 45, 46, 63, 74). Another group focused on educational needs (papers 25, 33, 35, 42, 62, 69).

Level 5: Techno. The technologies acting as barriers or enablers in data cultures, including standards. This small cluster of papers was restricted to those specifically focused on technological systems (papers 3, 16, 37, 71, 72) but they are closely aligned with the level 6 papers.

Level 6: Data. Concerned with data types, data architectures and configurations. The papers classified at this level were those with a predominant focus on data architectures, in disciplinary areas (papers 23, 36, 53, 73) or in specific settings (papers 39, 60).

Level 7: Nano. Values and motivations of individuals in relation to data use and data sharing. Another very small cluster of papers, three of which were concerned with data cultures in education (papers (4, 31) and higher education (paper 38)). The remaining two addressed a much broader view of values relating to data in society (papers 57, 66).

Discussion

The insight gained from analysing the literature according to level is useful from two perspectives. The first is in terms of identifying areas where future research can be targeted. One gap noted is in relation to cultural perspectives, with relatively few papers classified at the nano level, i.e., those primarily concerned with individuals' beliefs and values. Indigenous data sovereignty issues were entirely absent. Further exploration of the SCOPUS database confirmed that the combination of data culture and Indigenous populations was invisible. To gain an understanding how Indigenous data was represented in the database, a search was conducted using these terms (thus dropping 'culture/s'), resulting in a total of fifty-eight records. These records were then analysed to identify the context that was being applied when discussing data. Common references were made to data sovereignty, Indigenous data sovereignty, Indigenous knowledge, Data governance, Indigenous data governance, and Indigenous rights. A separate synthesis of this literature would seem sensible as there are differences in the way culture applies to data in an Indigenous context and this needs to be explored in greater depth.

The second perspective is the demonstration of where most problems are perceived. Most papers analysed reflected the primary focus at meso (organizational) and micro (practices and customs) levels. A consistent theme in these papers related to digital and data literacies, and the need for skills development. This is an area central to information science, so presents a very clear opportunity to make the case for the essential need to include information science expertise in research project teams.

Our scoping review identified a rich and growing body of research concerned with the concept of data cultures, spread across a wide range of disciplines. Of concern from the perspective of information science researchers is the indication that although we are active in this area, our expertise does not appear to be widely recognised as providing any essential insight into this problem space.

We did not find any evidence of a universally adopted shared definition or understanding of the concept of data cultures. The definition with most potential to help focus future research is the multi-dimensional conceptualisation provided by Albury and colleagues (2017). Although their usage is focused on a very specific area, the four perspectives identified could be used as the basis of a framework for application in diverse settings. The theories of sociologist Andrew Abbott provide insight into the challenges faced by the information science community to demonstrate relevance to this problem area. His major work identified a competition for jurisdiction between established and emerging professions, competing for ownership of specific problem areas (Abbott, 1987). Applying this theory to academic disciplines suggests that the more closely related the disciplines are, the more resistance there is likely to be to collaborative research. If one discipline considers itself to own a particular problem space, it may be very difficult to perceive any value in working together with those in a closely related discipline, and collaboration is regarded as relinquishing territory.

Subsequently Abbott (2005) articulated an analogy of linked ecologies as a way of analysing social relationships between disciplines and professions. One basis for this proposition is the emergence of academic disciplines from practice environments and eventual decoupling. An example he provides traces the evolution of computer science from practice demands for programming and systems analysis expertise to a strong and distinct discipline with academics largely divorced from practice skills (p. 266). This proposition suggests further challenges for information science researchers. If researchers are perceived largely in terms of practice origins (for example, librarians or archivists) and those occupations are not regarded as essential to address issues, they are unlikely to be considered relevant to investigations of data cultures.

Information science researchers are undoubtedly engaged in research relevant to data cultures (see for instance the work of Frank et al., 2015; Trace and Zhang, 2021; Yoon and Kim, 2017), but unless their publications referred explicitly to the concept they were not identified in our scoping literature review. The disciplinary tensions and ambiguities suggested by Abbott's theories should motivate more attention being paid to using terminology that will assist in making information science research discoverable across disciplinary silos.

Conclusion

A common definition of data cultures is not shared by authors, and there is no one discipline that dominates the discourse. Analysis of the definitions identified from the literature point to the conclusion that data cultures are the social, technical, and cultural characteristics, values and practices that influence/determine the nature of data production, generation, acquisition, cultivation, use, curation, preservation, sharing, and reuse by individuals, organizations, governments, and societies. They may co-exist and compete at multiple levels and are dynamic and normative in nature.

The knowledge and understanding of information cultures gained from information science research does not seem to be being applied to data dominated environments, or if that is happening, without explicit acknowledgement of data which means there is a risk of relevant research being missed by other disciplines. This paper contributes to raising awareness of the research underway in a range of disciplines into an area which could be considered core to information science expertise. Expertise relating to information behaviour, digital literacies, information management, digital sustainability, and preservation are unique and essential perspectives to understand issues relating to data cultures and to achieve research objectives. One clear gap that has emerged from the literature reviewed in this scoping study relates to the consideration of indigenous perspectives in data cultures. Accordingly, our next steps in building this research agenda will be to undertake a separate literature review of indigenous data, and subsequently focus on the operationalisation of indigenous data sovereignty principles (Sporle, et al. 2021). This context will be characterised by the juxtaposition of distinct data cultures and provide a rich setting to investigate completing influences and motivations. All research addressing data cultures has the potential for transformative impact, and use of the data cultures heuristic developed by Poirier and Costelloe-Kuehn (2019) can assist in developing appropriate research questions for specific contexts.

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Note: A link from the title, or from "Internet Archive", is to an open access document. A link from the DOI is to the publisher's page for the document.

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