

Sharing Research Design, Methods and Process Information in and out of Academia

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ABSTRACT

An interview study of (N=) 16 senior researchers at a major Canadian research university shows that researchers use a broad range of means to share information about research process, methods and design to different audiences. The purpose of sharing information on these aspects of research is to enable redoing and replicating earlier studies, to preserve knowledge of how studies were conducted, to understand data, and because of the social pressure to share. Time as a barrier and distance to overcome, disciplinary and contextual variation have a major impact on sharing. In the light of the findings, a one size fits all approach is unlikely to succeed. It is critical to choose appropriate methods that help to focus on what is relevant to share in particular disciplinary contexts, and for specific audiences and goals of transparency.

KEYWORDS

Scholarly communication; research methods; process information; information practices; information genres

INTRODUCTION

In contrast to growing body of research on scholarly information sharing (Talja, 2002 cf. Pilerot, 2014) and research data sharing (Kowalczyk & Shankar, 2011; Chawinga & Zinn, 2019), there have been far fewer studies on how researchers communicate and share information about research process, methods and design. This is conspicuous considering the difficulty of achieving a high level of process transparency given different practices and expectations across disciplines (Borgman, 2012; Palmer et al., 2017; Lyon, 2016; Marsden, 2019). In parallel, a lack of comprehensive understanding of data collection and processing procedures has been identified as a major hindrance to assessing research findings, their implications, and to reuse of research data (Karasti et al., 2006; Chao, 2014; Huvila et al., 2021). As a whole there is a substantial gap between the methodological ideals of open science and actual practices (e.g., Marsden, 2019; Scheliga & Friesike, 2014 also Mirowski, 2018). This leads us to a question of how researchers think about and manage this tension.

The aim of this article is to inquire into researchers' perceptions on the relevance, barriers and enablers of sharing information about research process, methods and design. The primary focus is on forms of documentation used for communication and knowledge sharing, rather than those employed by researchers for their own purposes, although these are interconnected. We address two research questions: (RQ1) what means researchers use to share information about research process, methods and design to different audiences, and (RQ2) what factors (including barriers and enablers) influence researchers' information sharing. The study reports findings from an interview study (N=16) of senior researchers in social science and science disciplines at a major Canadian research university.

LITERATURE REVIEW

Scholarly communication and information sharing are core topics in information science research (Borgman & Furner, 2002). Methodological and process information perform important functions in scholarly communication: enabling understanding of the research, supporting knowledge claims, establishing 'scientificness' (Krämer et al., 2021) and credibility (Cotos et al., 2017), and supporting learning (Zhang et al., 2010). Methodological transparency serves as an indicator of research quality within academia (Bridges-Rhoads et al., 2015; Marsden, 2019), although effectively communicating research methods to non-academic audiences is a known challenge (Lowrey & Venkatesan, 2008). Scholarly communication practices have been critiqued for presenting idealized narratives in support of knowledge claims, which misrepresent the sometimes messy and convoluted craftwork of actual research (Frohmann, 2004; Gilbert, 1976; Knorr-Cetina, 2003; Latour & Woolgar, 1986).

Similarly to the patterns of disseminating, publishing and working with information (e.g., Bates, 2002; Becher & Trowler, 2001; Hjørland & Albrechtsen, 1995; Crane, 1972), the choice of research designs, research process and methods is linked to communities and cultures that are usually narrower and different from formal disciplines. The concept of epistemic culture refers to amalgams of arrangements and mechanisms that constitute how knowledge is produced and what is known (Knorr-Cetina, 2003); whereas, communities of practice (Lave & Wenger, 1991; Pilerot, 2015; Fry, 2006) and thought collectives (Fleck, 1935) link shared knowledge practices to community-formation and collective action. Insiders are assumed to be trained in the methods of the particular community and more reliable data and knowledge producers (Prainsack et al., 2014). Epistemic and disciplinary cultures, scholarly communities, collectives and tribes all tend to share a particular vocabulary and language and accepted ways of pursuing and creating knowledge that are crucial for the success of knowledge production (e.g., Becher & Trowler,

2001; Knorr-Cetina, 2003; Bazerman, 1988). As such, one of the rhetorical functions of sharing research process information is to anchor a study within the traditions of a given field or epistemic culture (Smagorinsky, 2008). Information sharing can play a vital role in the making of new research disciplines (Pilerot, 2014); and as disciplines evolve over time, the role and prominence of methods information may change (Strang & Siler, 2017). Notably, there is an historical trend in science publications to emphasize findings at the expense of methods information (Berkenkotter & Huckin, 1995; Harley et al., 2010) while the inverse is true for some social science fields (Strang & Siler, 2017).

Earlier research demonstrates that the practices of sharing information about different aspects of scholarship are diverse and vary depending on disciplinary characteristics (Fry, 2006), historical and cultural traditions (Chung et al., 2015), audiences (Borgman, 2012) and the aims of sharing in and out at different phases of a research project (Chung et al., 2015; Talja, 2002). Haessler and colleagues (2014) distinguish specific (i.e., often private per request sharing of non-published details e.g., information on techniques) and general sharing (e.g., presentations, working papers, web postings). Harley et al. (2010) draw distinction between sharing research in-progress and peer-reviewed archival publications. Sharing in social sciences and humanities differ from sciences both in terms of what is shared, how, and use of information genres (Talja, 2002; Bazerman, 1988). In spite of the differences in practices and means of sharing, the reported enablers, barriers and reasons for sharing are often similar: a culture of sharing or not sharing, (lack of) perceived utility and incentives to share, and the availability or lack of tools and infrastructures (e.g., Dallmeier-Tiessen et al., 2014; Kim & Stanton, 2015; Niu & Hedstrom, 2008). Besides sharing to others, scholars document and 'share' data also for themselves and within labs or research groups. In contrast to sharing for others, the documentation required for self-use can be more rudimentary and informal, and the effort for producing necessary descriptions much smaller (Niu & Hedstrom, 2008).

In contrast to the studies of sharing information on research outcomes, there are fewer on how scholars share information about their study methods, research processes and research designs. Studies of scholarly information practices account to a certain extent how researchers understand, describe and document their research processes and designs (e.g., Benardou et al., 2010; Falciani-White, 2017; Trace & Karadkar, 2017) and research on data management and reuse practices has gathered systematic evidence on researchers' process and methods related needs and documentation routines (e.g., Yan et al., 2020; Palmer et al., 2017). Lassi (2014) reports quality concerns, a lack of reward system and hesitancy to adopt a new way of working as major barriers to systematic sharing of data collection instruments. A specific method can provide competitive advantage for a research group that is unwillingly given up (Kleinman, 2003). Studies of scholarly information practices do also sometimes convey evidence of how researchers seek and obtain information on methods, processes and research design, for example, from students who participate in methods courses (Pilerot & Limberg, 2011) and by reading project descriptions (Yoon, 2014).

Awareness of the importance of sharing such information has increased especially as a prerequisite of successful (re)use of research data and replicability and reproducibility of earlier research results (Borgman, 2012; Palmer et al., 2017; Lyon, 2016; Marsden, 2019). Different methods have been proposed for documenting and communicating research processes and designs, including journals, notebooks (Ortlipp, 2008; Randles et al., 2017) and other types of textual descriptions (Lang, 2006; Yan et al., 2020; Krämer et al., 2021), data storytelling (Dykes, 2019), structured information (Palmer et al., 2017), metadata (Chao, 2014) and paradata (Huvila et al., 2021), research protocols (Mørk et al., 2004), workflow management systems, code and executable documents (Yan et al., 2020). A parallel source of insights into documentation and sharing of research designs are systematic reviews that conventionally provide overviews of research approaches used in specific research fields and broader sets of studies (Barriera-Viruet et al., 2006; Wells et al., 2015).

Methods and process related information is regularly conveyed also in patents (Silva & Vance, 2017), research publications (Chao, 2015) and increasingly in data papers (Li et al., 2020) even if these descriptions have been criticized for incompleteness and ineffectiveness. Earlier studies highlight the fact that the necessary information is often collected by comparing and piecing together multiple types of data (Niu & Hedstrom, 2008) and especially with qualitative materials, by contacting the data collectors (Yoon, 2014; Niu, 2009). A considerable proportion of sharing procedural and methodological insights is also tacit and done in practice and through other means rather than through explicit documentation (Haythornthwaite, 2004; e.g., Cambrosio & Keating, 1988; Davidović, 2009; Wendrich, 2012). These findings all point to the intricacy of sharing in and out methods and procedures. Determining the appropriate level of detail and what to include and exclude in the methods narrative are challenges in sharing this type of information (Bridges-Rhoads et al., 2015; Smagorinsky, 2008). Along the same vein, Knorr-Cetina (2003) emphasises the significance of the entire 'epistemic machinery' rather than individual tools and Fujimura (1996) the potency of 'standardised packages' of theories that are tied with a stack of methods and instruments as means of sharing new and changing older predominant procedures and practices.

METHODS AND MATERIAL

The study data was gathered through qualitative interviews (N=16) of senior researchers in social science and science disciplines at a major Canadian research university. The interviews were designed using a genre-theoretic perspective, considering research dissemination and consumption as situated acts and practices carried out through diverse genres and media formats. Individual interviews were conducted by the authors via teleconferencing; the audio only was recorded and fully transcribed. Interviews lasted between 45 to 60 minutes. Informants, including 10 women and 6 men, are listed in Table 1 with their career stage and field of research indicated.

PID	Career Stage	Field
R1	Associate Professor	Information Science
R2	Professor	Education
R3	Professor	Fishery Science
R4	Professor	Animal Welfare
R5	Professor	Biology
R6	Associate Professor	Anthropology and Linguistics
R7	Associate Professor	Linguistics
R8	Professor	Political Science
R9	Professor	Language Education and Applied Linguistics
R10	Associate Professor	Education
R11	Associate Professor	Occupational Science and Therapy
R12	Professor	Human Geography
R13	Associate Professor	Education
R14	Professor	Human Geography
R15	Associate Professor	Sociocultural Anthropology
R16	Professor	Computer Science

Table 1. Informants (N=16) interviewed

The interviews were designed to capture both the breadth of scholarly practices of sharing across disciplines and to focus attention on a common set of genres and media formats. In this study, we analyse the part of the interview data with references to sharing study design and processes of data collection and analysis. The interviews were transcribed and preliminarily coded in QDA Miner Lite to facilitate a content analysis based on the constant comparative method (Glaser & Strauss, 1967). After initial coding the analysis proceeded using close reading (DuBois, 2003) of the data and writing as an explicit method of inquiry. The reliability of the categorization was assessed three weeks after the initial thematization using negative case analysis. The data collection and analysis procedures applied in the present study mean that the themes and practices identified are not directly generalizable to a larger population but can still be expected to provide a solid enough basis for the exploratory and interpretative, rather than confirmatory, purposes of the study.

Findings

Findings are presented in six sections describing factors that influence documentation and sharing practices (audiences and temporality), means and reasons for sharing, and obstacles to and enablers of these processes.

Audiences

The interviewees indicated multiple audiences with whom they share information about research process, methods and design. The most frequently discussed audience were *other researchers* (e.g., [R3][R5][R7][R13]), often implicitly from one's own discipline or research area. These include both specialists, likely to be interested in detailed descriptions of methods, and those in adjacent research areas who might prefer a paper where methods have been moved "to the fine print" that "can read a little bit more easily" [R5]. R15 suggested that, for instance, anthropologists tend to be especially interested in research process, methods and design whereas others, for example, transdisciplinary audiences can be less keen in the topic [R15]. Besides other researchers, R5 referred to

himself as a potential audience: “clarity comes not just with a better ability to revisit your own dataset, but it also makes you more likely to see problems while you’re analyzing it”. [R5] Several interviewees described also *students* as a group that might benefit of being informed of research process, methods and design [R1-2][R13].

Potential audiences included also non-researchers, and in more general terms “people” [R7][R5][R14] or “readers” [R7] that evinces of a somewhat unspecific notion of what the audience might be. R6 mentions “Indigenous partners” as a specific relevant non-researcher audience. Considering that the interviewees referred often to non-researchers when talking about audiences, this group was, however, not considered as a major target group for information on research processes, methods or design. As R15 noted, “It depends on the audienceI mean, especially if it’s stuff for public audiences who will be interested in results but not necessarily the nitty-gritty of how you got there.”

Temporality

Time affects sharing in different senses. First, *research itself forms a long-term trajectory instead of being a series of unrelated undertakings*. Documenting a research process can be about describing specific short tasks of collecting and analysing data or a lifetime long trajectory of how one’s thinking has changed. In some disciplines the process is specific to a single study or project [R1]. In others like philosophy, understanding career-length research processes is “especially important because concepts change over time, or people change their mind, or, you know, it’s, we, we talk about people, their earlier work and their later work.” [R2].

Second, sharing is influenced by the *time between the moment when research was conducted and when the documentation is created and consulted*. Time, changing contexts and increasing difficulty to remember and understand earlier research procedures make documentation both challenging and important. Successful documentation of research methods, procedures and designs affect how replicable studies are for others [R3][R7] but also to what extent researchers can communicate their own research to themselves over time. “The problem is when you’re analyzing data, you know what that means while you’re deeply, intensively looking at it, but a month later, a year later, 5 years later, you don’t” [R5].

Third and finally, time, or the lack of it, affects *to what extent methods, procedures and research designs can be documented*. There is often limited space in publications and limited time in presentations available to devote to this kind of information, which means that researchers are required to prioritize: “[Y]ou don’t always have the time to say a lot about it, but to me, who was included, who did you actually speak with, who did you not, what language did you use, all those things are really important” [R14].

Means of sharing

The informants referred to many different means [R13] and preferences [R11] to share information research process, methods and design in the context of their everyday information practices. Simultaneously, the findings show that these means are heavily influenced by discipline. The different means mentioned in the interview record are summarised in Table 2. Of these, the methods sections of publications were most frequently mentioned, and for some this was clearly the default, e.g., R7. Nevertheless, it is significant that such a wide range of other communication devices were identified, showing a broad scatter of approaches within this group. The interviewees suggested occasionally that some were especially suited for particular audiences, such as methodology workshops and how-to videos for students. Similarly, the interviews suggest a conviction that contextual means were primarily suitable for seasoned researchers.

Besides breaking down the means according to audiences and genre, it is also possible to make rough categorisations based on more specific genre attributes (Table 2; cf. Yates & Orlikowski, 1992) of formality, purpose and level of focus. Formality represents the level of structure and convention in aspects of style and manner of dissemination, and distinguishes between casual, often in-progress or incidental sharing of methods and intentional, carefully documented and peer-reviewed means. Purpose refers to the different rhetorical intents and functions, including genres designed to instruct or explain methods and those that serve as models or templates. Level of focus reflects the varying levels of granularity and specificity in methods discussions, from those that are generic across disciplines, generic to a particular research area or approach, or specific to a particular study or project. The categorisation in Table 2 is at most indicative, as the dimensions are gradients rather than distinct to each other, but do still suggest the variance in means and modes of sharing methodological insights in and out. Further, the aim of this categorisation is not to generalise but to identify a range and variety of practices. We propose these genre characterizations as a starting point for further research, and primarily to illustrate the range of situated rhetorical actions available to scholars. As a whole, the analysis of the interview record shows that understanding a research process, method or design requires using multiple information sources and means of exchange.

Reasons for sharing

The interviewees' accounts of possible reasons to share information about research process, methods and design could be divided into five categories. The information could be useful in an instrumental sense for *redoing and replicating* earlier studies. As R3 described, “[a] good documentation should allow you to redo the analysis” [R3]. Replication is particularly significant in fields where research designs involve reuse of measures or stimuli [R7][R13]. Replication was also considered useful for teaching research methods and learning to understand methods descriptions, including what has been described and left unsaid [R7]. A related reason was the need to *extend previous work* in another context [R7][R13].

Besides instrumental uses of the information in new studies, sharing was considered important to *preserve knowledge of how a specific study was conducted*. This information could be useful for the researchers and others: “if you’re writing it so that somebody else understands it, it means that you understand it better, too” [R5]. A related reason was that it could help to *understand data* whether it was one’s own or others’. For instance, having access to original scripts used to manipulate data could be essential for properly interpreting a dataset [R5].

	Formality	Purpose	Level of focus	Mentioned by
1) Methods literature				
Methods books	Formal	Instructional	Generic, generic to research area/approach	[R11]
Methods articles	Formal	Explanatory	Generic, generic to research area/approach	[R1][R11][R13][R14]
How-to videos	Formal	Instructional	Generic, generic to research area/approach	[R10]
Handbooks	Formal	Instructional	Generic to research area/approach	[R1]
2) Methods descriptions				
Methods sections in articles and book chapters	Formal	Explanatory	Specific to a study	[R1][R3][R9][R13-14]
Exemplars	Formal	Instructional	Generic to research area/approach	[R13]
Making information available online	Formal	Explanatory	Specific to a study/ project	[R14]
Research proposals	Formal	Explanatory	Specific to a project	[R1][R4]
Theses	Formal	Explanatory	Specific to a project	[R7]
Pre-registered research protocols/workflows	Formal	Tools/templates	Specific to a study/project	[R4]
Publishing source code, scripts	Formal	Explanatory	Specific to a study/project	[R4-5]
Shared research instruments	Formal	Tools/templates	Specific to a study/project	[R14]
Following documented procedures (e.g., ARRIVE, PRISMA guidelines)	Formal	Tools/templates	Generic to research area/approach	[R4]

3) Participation				
Making comparisons to other disciplines and their practices	Informal	Instructional	Generic to research approach	[R13]
Virtual research environments (using)	Formal	Tools/templates	Generic to research area/approach	[R14]
Doing (e.g., building a database)	Informal	Tools/templates	Specific to a study/project	[R13]
Reverse engineering scripts or procedures	Informal	Tools/templates	Specific to a study/project	[R5]
4) Social exchange				
Methodology workshops, method talks, methodology seminars, series, writers' retreats	Formal	Instructional	Generic, generic to research area/approach	[R13]
Conference participation and presentations (insights into how research is done)	Formal	Explanatory	Multiple	[R13][R16]
Courses, classes	Formal	Instructional	Generic, generic to research area/approach	[R13][R6]
Webinars	Formal	Explanatory	Multiple	[R13]
Talking with experts (face to face or contacting by email)	Informal	Explanatory	Multiple	[R3][R7][R13]
Sharing by talking with stakeholders (lectures, classes, Indigenous partners)	Informal	Explanatory	Multiple	[R6]
5) Contextual information				
Complete corpus of research output	Formal	Explanatory	Specific to a study/project	[R1]
Overall research design (cf. specific descriptions)	Formal	Explanatory	Specific to a study/project	[R7]
Background information on researchers and their thinking	Informal	Explanatory	Specific to a study/project	[R2][R7]
Metatext (choice of words)	Informal	Explanatory	Generic to research area/approach	[R2]

Table 2. Means of telling, their formality, purpose (explanatory, instructional, tools/templates based), level of focus (generic, generic to research area/approach, specific to a study/project, multiple), and a reference to relevant interviewees

Finally, the interviewees referred to a *social pressure* to share information arising from concerns regarding replicability, lack of transparency and hidden bias in science [R4] or increasing interest in a method [R7]. A researcher could also feel that “the design is the core part of the methodology that you need to make transparent to the reader of your publication in order for them to have really any faith or trust in the results you’re about to report” [R7].

Barriers

The major barriers to sharing information on research process, methods and design discussed by the interviewees tended to be conceptual and social. The interviewees referred to the *difficulty to conceptualise and describe processes*. The understanding of research process and design as a shareable procedure differs between disciplines. Besides, having a description is not the same thing as mastering it: “journal articles can be replicated only when you master the method that people have used. Because there are lots of those things that cannot be stated that must be known” [R3]. Another problem is that descriptions of research processes can be difficult to distinguish from the narration of other research findings [R1].

A related conceptual barrier is the *intricacy of understanding descriptions and their undertones*. For instance, in philosophy, students do not always recognise where ideas are coming from: “part of becoming familiar with the field is developing a sort of repertoire of recognizing some core concepts” and linking them to specific theoretical and methodological ideas and procedures [R2]. Language and the use of specific words convey what people are doing.

Understanding and producing descriptions may be difficult due to the *diversity of contexts* where the procedures are executed. When the context of a study is unique enough, knowing a procedure does not suffice. For instance, in linguistic research, it can be vital to understand the specific historical and cultural conditions of the study area. [R7]. Contextual intricacies can apply also to researchers’ technical and conceptual frames of reference. Sharing procedures, scripts and code may not be particularly helpful as not everyone uses same tools [R5].

Moreover, a crucial barrier is the *difficulty to determine what is enough* to describe a procedure. You have to know “[a]s much as possible” [R3] about how the data was collected or compiled: “if you don’t know crucial things, the results are going to be nonsense” [R3]. For R3, ‘crucial’ is primarily about ruling out factors that affect the accuracy of results (e.g., non-responder bias) rather than their computable statistical precision, but admits that these priorities may differ by discipline.

The interviewees referred also to *imperfections in the genres and social conventions*. Methods sections of journal papers are often impoverished, short and lack detail to properly describe complex procedures [R1][R7][R13]. Grant applications and theses can be better in this respect [R1][R7]. Methods papers also have deficiencies and good ones can be difficult to find. Instead of consulting how-to manuals, it can be useful to read handbook literature, aggregated case studies and descriptions of proven methods and approaches [R1]. Moreover, methods and procedures are not necessarily indexed in search systems, which makes them difficult to find in comparison to research papers and results [R1]. The same fixation on findings applies also to other genres, for instance, infographics and videos that often lack descriptions of methods and procedures entirely [R1][R11].

Finally, a major underlying barrier is that the available, albeit limited, space is not used to provide descriptions as detailed as possible [R14]. Discussions of methods descriptions focus heavily on the trade-offs between openness and detail (unpacking [R1], showing our work [R6]) and opacity and readability (moving the methods to the fine print [R5]). For various reasons, the balance often shifts to the latter. Research processes are seldom communicated because there is a *lack of tradition and willingness to share in and out* (e.g., [R6][R13][R15]). “I’d say for the most part, researchers are generous and lazy. Say, ‘Yeah, here’s the stimuli, here’s the paper, figure it out’” [R7]. Procedures are also treated as trade secrets: “Research study design is, it’s difficult to ferret out. I don’t see a lot of people who communicate those ideas, in some ways, that sometimes those sorts of designs are almost, like, trade secrets. The ‘secret sauce’” [R1]. “Lots of people are reluctant to do that because they feel that their work - the analysis that they present - should be enough” [R3]. Research methods are not necessarily considered “innovative” enough to be worth sharing [R9]. Audience is also thought to be more interested in the “take-aways” [R16] than in methods [R6][R15]—even if some of the interviewees remarked that there is a growing interest in knowing more about methods and procedures [R6-7].

Enablers

The enablers to sharing research process and design described by the interviewees can be roughly categorised along practical and cultural axes. Practical measures, such as pre-registering a research protocol, can help researchers stick to a specific procedure and consequently function as a better account of the process than a post-hoc description [R4]. Using standardised (open source) software such as the statistical software R makes research more “repeatable and shareable” [R5]. There are also ways of improving and extending written descriptions, for example through inclusion of supplemental materials in publications [R5]. Referring back to one’s own previous work is another possibility to extend descriptions across individual publications even if, as [R2] notes, the double-blind peer-review makes this difficult.

Cultural factors like making the preservation and sharing of, for instance, scripts, mandatory by journals [R5] was also considered helpful. A lot depends also on the good nature of people [R5] and their personal interest in methods and methodological issues [R14]. One of the interviewees [R7] also implies that an increased awareness of the usefulness of sharing is an inducement. This applies especially to procedure-heavy projects where researchers become aware of their complexity and importance. Similarly, awareness of an interested audience, for instance, in a specific research community, spurs sharing [R15].

Even if distinguishing practical and cultural factors makes certain analytical sense, there is considerable overlap. Interviewees referred to the importance of knowing disciplinary culture and ways of thinking to understand research procedures and how they are reported. “[I]n some ways [students] get some sense of being an academic, the processes involved, that the writing is not just publishing a paper [...] that’s part of our method” [R13] It is also

important to rehearse writing to particular audiences and to consider what they already know and need to be told [R2]. A drawback of tacit cultural knowledge is that it is difficult and time-consuming to learn. One of the interviewees [R4] suggested that collaborating with librarians who can be more focused on communicating biases than people coming from a specific disciplinary community could be useful in this respect.

DISCUSSION

General observations

The analysis shows that sharing information about research process, methods and design is a complex matter. It is also widespread and diffuse to the wide range of scholarly activities covered in the present study. The interviewees considered that the major target audience besides themselves are other researchers and only to a minor extent other groups. In parallel, the interviewees described a long list of means, barriers and enablers (Table 2 cf. literature review). The breadth of practices described confirms earlier observations of the impact of disciplinary variation (e.g., Fry, 2006; Hjørland & Albrechtsen, 1995; Bulger et al., 2011), aims of sharing (Chung et al., 2015; Talja, 2002), and audiences (Borgman, 2012; Haeussler et al., 2014). Even if the analysed interview record does not lend itself to sweeping generalisations, the findings seem to align with Bates' (1996a) observation of the thorough command of the literature among humanities researchers. In the humanities and epistemically similar social sciences, information seekers emphasise a rigorous understanding of a broad epistemic and methodological approaches as the key process to communicate; whereas, in sciences, the focus is on specific procedures and techniques (e.g., protocols, scripts). For the same reason, humanities researchers' means of sharing methods, processes and design may appear 'idiosyncratic' (Hackett et al., 2017) and scientists' as lacking nuance even if their key difference is in distinct understandings of what makes a method, process and design.

Also the barriers and enablers described by the interviewees have parallels in earlier studies (e.g., Dallmeier-Tiessen et al., 2014; Kim & Stanton, 2015; Niu & Hedstrom, 2008). To a degree, in contrast to the earlier work, the present findings emphasise the significance of multiple temporalities of processes, methods and research designs and their effective sharing. This may reflect our sample of experienced senior researchers drawing upon long career trajectories and less subject to the constraints of academic reward and promotion that are prominent in shaping scholarly communication practices among early career researchers (Harley et al., 2010).

Unwillingness to reveal the recipe of one's own secret sauce is reminiscent of earlier studies that found scholars to withhold methods information (Kleinman, 2003). Even if the usefulness of specific means to share procedural information varied, as in the literature, individual interviewees found practicable a plethora of formal and informal means of sharing (Table 2). A major difference between sharing research processes, design and methods and sharing other aspects of research is the relative lack of established conventions for doing it and treating it as an essential part of the research process. Whenever an increased procedural transparency would be considered beneficial, an earnest effort to develop means and robust infrastructures seems a minimum requirement.

Bringing in researchers and sharing out information

In parallel to revealing discipline- and context-specific practices of sharing, the analysis points to a broader divide between approaches that are geared to *bringing in researchers* closer to the core of a particular—using Knorr-Cetina's (2003) term—epistemic culture, and of *sharing out information* to audiences away from the core. These approaches align broadly with mastering, craftsmanship and situated learning (Lave & Wenger, 1991; Ek & Widén-Wulff, 2008; Fujimura, 1996), and learning through informing. Even here the disciplinary variation appears significant. According to the interviewees, some disciplines are explicitly oriented towards describing, discussing and communicating methods (e.g., anthropology) or sharing code and protocols (sciences and computational fields e.g., [R4-5]); whereas, in others (e.g., philosophy) the process is embedded in written argumentation, or—implicitly—within a community where everyone is presumed to have the tacit knowledge needed to understand how research was conducted. As Strang and Siler (2017) observed, these types of variations in stance vis-à-vis sharing of methods information reflect underlying epistemological and cultural features that shape disciplinary identities and evolve over time.

Even if it would be tempting to couple specific means, modes, formality and levels of focus of sharing (Table 2) with the two approaches, the links are not straightforward. In the categorisation of means as explanatory, instructional, and tools and templates based, explanatory perhaps aligns closest to sharing out information whereas the two others are geared towards engaging researchers with particular epistemic communities. In the tool and template-based approaches, specificity of focus and use of informal means of sharing evince a deeper engagement in an epistemic culture and a shorter 'epistemic distance' (Huvila, 2020) to its core; whereas, formal means and generic focus suggest the opposite.

Sharing through bringing in researchers to an epistemic culture is clearly an effective means to overcome barriers of understanding descriptions, their undertones and contexts (e.g., [R2-3][R7]), lack of trust, and imperfections in scholarly genres (e.g., [R1][R7][R13]). At the same time, it risks erecting epistemic monopolies (Knorr-Cetina,

2003) that exclude other audiences, and hinder the emergence of explicit means and genres of sharing and bridging understanding between epistemic cultures. Further it is time-consuming to educate a researcher in an epistemic culture and can result in a high degree of uncertainty among students and junior scholars (Bridges-Rhoads et al., 2015); and, as research fields are not static entities (Crane, 1972), staying within an epistemic culture requires continuous effort.

Sharing out through standardised information has advantages and disadvantages. At its best, it is open to wider audiences and could help in communicating procedures to non-researchers and to students and interdisciplinary communities generally underserved by discipline-specific documentation (Bates, 1996b). Problems arise from the difficulty of conceptualising and describing processes and conveying their essential aspects (e.g., [R2-3][R5][R7]). Here, time unfolds as a key factor. The on-going thinking about theory and data that takes place over the course of the sometimes shorter and sometimes career-length research processes make them difficult to capture in current forms of publication ([R1-2] also in Bridges-Rhoads et al., 2015). The varying willingness across disciplines to publish in-progress work and share ‘methodological data’—notes, records, iterations and drafts that can help to reconstruct process (Bridges-Rhoads et al., 2015)—rather than only final archival outputs, means that different amounts of documentation of this thinking can be available. Creating exhaustive documentation is time-consuming and difficult to motivate especially for public audiences and when its utility remains vague (Lowrey & Venkatesan, 2008). The tendencies to interpret and bend standards when creating and using information, which reduces the universal understandability of standardised information, are also well-documented (e.g., Berg, 1997; Latour & Woolgar, 1986). Moreover, as standards do not document reality, but rather shape it and create new orders as a result of their failure to meet it, the shared information remains an imperfect representation of what happened (Mol & Berg, 1998; Star & Lampland, 2009). In this respect, the suggestion of one of the interviewees [R4] to promote the use of pre-registered research protocols makes sense. Instead of trying to share information on methods, processes and research designs through descriptions of what was supposedly done, introducing and sharing a standardised ‘new order’ (Berg & Mol, 1998) can be expected to lead to higher conformity between descriptions and actual doings. Protocols and workflows have the advantage of representing science as a process rather than as a body of facts and findings. Further, this approach could support more open, collaborative and community-based approaches, as protocols could be jointly developed with community-partners. The apparent downside of following pre-established protocols is, as Mørk and colleagues (2004) note, that it can limit more spontaneous collaborations and innovation and reproduce old divisions of labour. Another option could be to make greater use of narrative modes of communication for external audiences, that “tell stories” of research in understandable and sufficiently contextualized forms. The use and usefulness of narratives is increasingly being recognised (Sampson & Atkinson, 2011; Arya & Maul, 2012). This assumes that the goal for some—or most, as suggested by Harré (1994)—audiences is actually to build trust and to represent research more faithfully as a process rather than for full transparency or reproducibility. Setting such goals for sharing out research would seem to be particularly relevant and important for community-based research and in meeting ethical commitments of research involving human subjects (Doucet & Mauthner, 2012). The analysed interview record contains data to suggest that of the newer forms of communication, podcasts are valued because they are less condensed and less results-focused.

As a whole, the results point to the need to account for variable practices within disciplines and epistemic cultures regarding methods and process information when devising mechanisms and policies in support of methodological transparency. One size fits all approaches may conflict with deeply held, even unquestioned assumptions about how knowledge claims are constructed and justified. The documentation, descriptions and means of sharing might be meticulous and comprehensive but not necessarily informative for everyone. In this respect, the findings point to a parallel need to account for the conceptual barriers in sharing of methods information. Researchers face an ongoing challenge to determine appropriate means and scale for representing the research process. Tensions exist as initiatives for open science and data sharing push towards maximal documentation and processual transparency, while in some fields and high profile venues (e.g., Nature) and especially for external audiences, methods information is marginalised in favour of highlighting findings. One approach may be a greater focus on what Bridges-Rhoads (2015) term “methodological data” and diverse forms of in-progress documentation and sharing practices. Another is increased sharing of tools—although this has its own challenges, as tools, scripts, protocols require their own layers of documents and context.

CONCLUSIONS

Our study shows that researchers use a broad range of means to share information about research process, methods and design to different audiences to enable redoing and replicating earlier studies, to preserve knowledge of how studies were conducted, to understand data, and because of the social pressure to share. Time—both as a finite resource when describing processes and as a distance to overcome between the moment when research was done and when the information is needed—is a key factor that affects sharing. Means of sharing vary across several dimensions, including formality, purpose and level of focus, which results in a broad palette of genred approaches

and enables their fit-to-purpose selection, which is, nevertheless, strongly shaped by disciplinary cultures. Major barriers relate to the lack of tradition, perceived relevance and conventions to share, the complexity, diversity and fluidity of research processes, and the difficulty of capturing pertinent aspects of methods using the available means. In response to the barriers, multiple cultural and technical factors that can function as enablers to sharing are identified, including the use of established protocols and more binding requirements.

Further, the analysis highlights the disciplinary and contextual variation in sharing practices. Partly, sharing is geared towards reducing the epistemic distance of researchers from epistemic cultures i.e., mastering how research is done in particular disciplinary contexts, and partly, by sharing out information to audiences away from those cultures. Both approaches have their strengths and in general, the findings suggest that it is hardly possible or even relevant to pursue a one size fits all approach in sharing information about research process, methods and design. Rather, it seems necessary to choose appropriate methods that help to focus on what is relevant to share in particular disciplinary contexts, and for specific audiences and goals of transparency. This research was exploratory and interpretivist and drew upon a limited sample of highly experienced researchers from one major university, and primarily from the social and applied sciences. It opens up a number of areas for further and deeper inquiry within and across disciplines, given the relative lack of prior research focused on the communication of this type of scholarly information.

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