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Editorial: What Does Openness Conceal?

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It is our pleasure to share some recent news from the journal regarding open access and evaluation indicators. S&TS is now listed in the Directory of Open Access Journals (DOAJ) and has an impact factor from Clarivate Analytics. As the relevance of open knowledge is more pertinent than ever, a few reflections about these developments are in order. I organise the thoughts by extending Marilyn Strathern's (2000) question what does visibility conceal.

Open access beyond technical concerns

Open access is often discussed as a positive value aimed at enabling availability of knowledge to everyone everywhere, thus expanding the reach of that knowledge. Unquestioned as a value, the implementation of open access, then, becomes simply as a technical matter for journals, publishers and sponsors to consider. S&TS and its sponsors European Association for the Study of Science and Technology and Finnish Society for Science and Technology Studies have over the past years deliberated the costs of open access following loss of income via library subscriptions and member-benefits to the sponsoring scholarly societies. In such discussions, the value of openness was deemed as more important than the financial gains made and the community of STS scholars broader than the paying members (Sariola 2017).

Publishing open access has generated different kinds of financial mechanisms to fund open access. Science & Technology Studies journal has been fully open access since 2017; the journal is open access not only by the definition that it is openly available, but it is also free to publish in - we don't charge article processing charges (APCs). S&TS is among the few journals in the field of STS that does not follow either the pay-to-read or pay-to-publish model. The 'pay-to-publish' model, Marcel Knöchelmann (2021) argues in this issue, has mainly benefited corporate journals who by having parallel publication of open access papers made available by charging APC, *and* charge library subscriptions, effectively have their cake and eat it. The shift, then, has not radically altered the unjust and financially divisive publication structures of academic knowledge ecologies as pay-to-publish leaves many unable to pay for what can be exorbitantly high APCs.

Open access is, then, much more than a technical concern - it makes visible the political economies of publication ecologies, upheld by the various actors in the field, and their agendas.

Open vs. proprietary science

The present moment in the COVID-19 pandemic makes open science all the more important. The vaccine sold by AstraZeneca was originally produced by Oxford-based researchers. Various news sources have reported that the vaccine was originally intended to be openly available but that Bill Gates persuaded the developers to sell the license exclusively to AstraZeneca who now sell it to various countries under confidential, non-public, and proprietary contracts (Zaitchik, 2021).

The rationale for why Gates would turn a public good commercial can only be speculated. Tim Schwab (2021) in The Nation hints that Gates has direct financial motivations and holdings in vaccine companies. Another interpretation of why Gates might facilitate handing over exclusive license to a private company concerns open science. Linsey McGoey's (2015) book on Bill and Melinda Gates Foundation is instructive in highlighting how philanthropic funders like Gates have reorganized the health and development sector towards a philantrocapitalist logic based on exclusive intellectual property rights. There is no such thing as a free gift, McGoey's book is aptly titled, that is pointing to the underlying market logic in how medical research is owned and organised. Open science models might potentially change the modus operandi of drug and pharmaceutical development and bring to question the present interlinkages of exclusive science and corporate investment, and as such, have profound impacts on how innovation political economies are organized. While there is much more to be said about open science and intellectual property rights, the example begins to shed light on the forces put on academic knowledge and reduction of the space for intellectual commons.

Open access policy Plan S and its limits

From January 2021, open access policy called Plan S was enforced in Europe. Plan S mandates that all funded research ought to be published open access. On its website, it states as its vision that "With effect from 2021, all scholarly publications on the results from research funded by public or private grants provided by national, regional and international research councils and funding bodies, must be published in Open Access Journals, on Open Access Platforms, or made immediately available through Open Access Repositories without embargo."i Plan S manifests in ten key principles that underscore, among others, that authors and institutions retain copyright; in case there are open access costs, they need to be fully transparent and that authors should not be the ones paying but institutions; that hybrid models of publication (some content being open and some by subscription) are not accepted; and that funders when assessing research outputs should value the intrinsic merit of the work and not consider the publication channel, its impact factor (or other journal metrics), or the publisher.

At the end of 2020, the Science & Technology Studies journal was listed in the Directory of Open Access Journals, that is a platform to which journals are accepted following a validation and evaluation process. The aim of DOAJ is to flag high quality and ethical publication practices and distinguish predatory journals from academic venues. Journals listed in DOAJ are also Plan S compliant.

While Plan S makes laudable attempts to undo corporate publishing structures and inequitable access restrictions, it has been criticised for failing to address the hierarchy of journals, and what Vann (2017) and Fochler de Rijcke call 'indicator game' (2017) .

During the transition period to Plan S, some scholars saw the change as a threat to their careers as they felt that with the expectation of publishing open access, they would not be able to submit their work to the most prestigious journals in their field (as they were not open access). The comment signals a publication hierarchy that open access does not (yet) resolve. Knöchelmann (2021) argues that open access does not go far enough in decolonizing knowledge and questioning knowledge hierarchies according to which accessibility was never the grounds for choosing a journal as a publication venue but rather the perceived rank that associates journals with prestige, authority, quality, and merit. Angela Okune, Sulaiman Adebowale, Eve Gray, Angela Mumo and Ruth Oniang'o (2021) in conversation with publishers based in Africa caution that Plan S has the risk of setting standards from above that are too narrow in their terms, constraining what kinds of publication types count as publishable, and what counts as quality peer review and scientific credulity, and thus end up upholding elitist knowledge structures. They poignantly ask: How can funders or other international organizations reduce the competitive friction of individualized 'success' and instead encourage more creative, egalitarian, and innovative models of partnership around scholarly publishing?

Closing words

Science and Technology Studies as a discipline and form of inquiry has a pertinent vantage point to analyse structures of knowledge and the implications of how the structures shape our intellectual endeavours. Thinking about what open access conceals presents an opportunity to think about the interlinkages of evaluations of individuals and institutions based on bibliometric ranking, what sorts of knowledge ecologies are created by these, by and for whom, and who benefits from the commercial structures of publishing ecologies. As knowledge structures are made and remade, they also present opportunities to rethink modes of practices and evaluate what they are doing for the scholarly community of STS. While at S&TS we recognise that it is still crucial to many to see their work published in impact-factored journals, it is important that publication venues are considered beyond the merit warranted to the authors' careers, and to see them as representing particular values as institutions. Who are they for and what sort of agendas and logics define them? How are journals situated in the broader ecology of academic structures, careers, and collectives? What are the alternatives for crude evaluations and how can journals be part of that in ways that do not replicate various power hierarchies? S&TS would like to continue to offer a publication venue that critically examines structures of science and knowledge and the technologies that enable and produce them, including its own.

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The Pragmatic Turn in Clinical Research: in Search for the Real World

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Abstract

How does knowledge obtained in clinical trials apply to the actual treatment of patients? This question has recently acquired a new significance amidst complaints about the limited ability of trial results to improve clinical practice. Pragmatic clinical trials have been advocated to address this problem. In this article, I trace the emergence of the pragmatic turn in clinical research, starting from the first mention of 'pragmatic trial' in 1967, and analyse the changes to how such trials have been conceived. I argue that contemporary version of pragmatism in clinical trials risks missing the mark by focusing exclusively on establishing similarity between the trial and the clinic for the purpose of greater generalizability. This focus eclipses the move for carefully aligning medical experimentation with conditions, needs and concerns in the clinic aimed at greater usefulness.

Keywords: clinical trials, pragmatic trials, RCT, real-world evidence, statistics

"Although randomized clinical trials provide essential, high-quality evidence about the benefits and harms of medical interventions, many such trials have limited relevance to clinical practice" James H. Ware and Mary Beth Hamel (2011: 1658) wrote in one of the 2011 issues of The New England Journal of Medicine. With this opening line, Ware and Hamel, a biostatistician and a clinical scientist, joined the increasingly prominent conversation within the health research community about the relations between the tightly controlled experimental apparatus of clinical trials and the messy realities of clinical practice.

Concerns about how knowledge obtained in clinical trials applies to the treatment of patients have accompanied the very rise of the randomised controlled trial (RCT), which has been the key method of evaluating medical interventions since the 1960s, particularly pharmaceuticals (Bothwell et al., 2016; Cartwright, 2007; Moreira and Will, 2016; Timmermans and Berg, 2003). Yet, in the last two decades, these concerns became ubiquitous. Simultaneously, an explosion of interest in pragmatic trials took place, stimulated by the promise of this approach to designing and running RCTs to improve relevance of clinical trials to clinical practice. Proponents of pragmatic trials nowadays envision such improvement as an outcome of undertaking trials under the so-called 'real-world conditions' (Dodd et al., 2016;

Zwarenstein and Treweek, 2009). An ostensibly paradoxical move takes place, whereby the more capable the experimental clinical trial machinery is at excluding interfering factors and suppressing seemingly irrelevant details to produce reliable universal knowledge, the less useful for clinical practice the results appear to be.

In this paper, I trace the emergence and implications of the pragmatic turn in assessing new pharmaceutical treatments. Such focus makes visible the changing ways in which the relevance of clinical research is conceived and established and points to some crucial differences between efforts to produce generalizable knowledge and efforts to produce useful knowledge.

Analytical perspectives: purification and contextualisation

RCTs rely on random assignment of study participants to groups. There can be one or more intervention groups where participants receive a new treatment and a control group where participants receive existing treatment or, sometimes, placebo. Outcomes are compared across groups and to ensure fair comparison, blinding is often employed so that participants and investigators are not aware who is assigned to which group. Randomization, the use of control groups, and blinding form the methodological backbone of the RCT, held in high esteem for its ability to keep bias at check and to make cause-effect relationships between treatment and outcome more palpable. But adhering to this triad is not enough for the RCTs to deliver on their promise of reliable results. To minimize interferences that may obscure the cause and effect relations, traditionally RCTs have been characterized by the narrow precision of tested interventions, the tight control of the conditions under which these interventions are administered, and the highly scripted experimental procedures (Calvert et al., 2011; Tunis et al., 2003). These characteristics are meant to perform what can be called purification to borrow from Latour (1993), that is to keep the noise of the daily world outside the confines of the medical experiment, thus clearly and reliably distilling the experimental intervention's true effects. Therefore, traditional RCTs rely on establishing purified experimental environment capable of isolating a number of critical variables to produce knowledge of causal relations held to be universally valid (Rosengarten and Savransky, 2019). Ironically, these same characteristics have given reasons for concern about the relevance of RCTs to clinical practice, where as some worry contextual dynamics kept at bay in a trial laboratory may reshape the expected results (Bower, 2003; Brass, 2010).

Criticism of traditional RCTs by contemporary advocates of pragmatic clinical trials centres on the difference between the purified experimental environment of RCTs and the diversity and contingency of clinical practice. According to critics, the very specificity of RCTs, which distinguishes them from clinical practice, while supposedly optimal for producing robust evidence, leads to "limited applicability of many trial results beyond the artificial, 'laboratory' environment of the trial" (Treweek and Zwarenstein, 2009). Those advocating the wider use of pragmatic trials as a remedy for this applicability problem argue that the little resemblance between the trial laboratory and real-life clinical practice affects relevance of RCTs in two ways. First, questions to be answered during a trial often have little to do with questions faced daily by patients, physicians and policymakers (Zuidgeest et al., 2017). Second, answers to the questions eventually asked may still fail to hold when transported from the secluded experimental site to the clinic with patients, physicians, routines and technologies which are unlike those in an RCT. What pragmatic trials are expected to do is to 'show the real-world effectiveness of the intervention' (Ford and Norrie, 2016), i.e. what an intervention can do for actual patients under far-from-ideal circumstances. In short, the medical research community has recently become vocally concerned with the apparent weakness of the connection between the knowledge produced in clinical trials and the contexts where this knowledge is meant to be applied. We can understand this as a concern with weak contextualization of trial-produced knowledge and a call to complement the strive for rigour and reliability through purification with the strive for applicability through contextualization.

These concerns contrast with critical social science scholarship which has long highlighted the already contextually engaged nature of clinical

research. The picture of the RCT as insulated from the clinic and the world outside a trial is challenged by the Science and Technology Studies (STS) scholars. First, analyses of trial conduct in diverse locations highlight how the apparently standardised neatness and stable orderliness of an RCT are enabled by modifications, creative acts and negotiations performed by those doing the work that goes into successful accomplishment of a trial (Simpson and Sariola, 2012; Zvonareva et al., 2017). Second, STS works suggest that in designing their RCTs, especially in public health and health services research, trialists do modify the pure world of the experiment by selectively incorporating elements of the outside world, for instance, by coordinating delivery of an experimental intervention with existing organisational routines in the test sites (Will, 2007). This dual concern with purification and contextualisation at the same time serves to ensure interest and buy-in from those collectives whose cooperation is necessary for a trial to proceed and for its results to reach clinical practice. Third, scholars argue that clinical trials affect clinical practice not just through dissemination of findings after research completion, as is typically assumed. The very practice of research itself alters the operation of the healthcare organisations where trials are conducted, already during the preparation and running of medical experiments (Petty and Heimer, 2011). For instance, infrastructure gets built and renovated for trials, the relationships within a clinic change, and tests, drugs and other artefacts are shipped in.

STS research makes it clear that the picture of the traditional RCT as fully disconnected from clinical practice does not do justice to the complexity of the interactions involved. Trialists' actual practices do involve purification to ensure methodological adequacy and contextualisation for the sake of making trials relevant for those who conduct them and may use their results. However, contextualisation has not been an explicit consideration within the trials field itself until recently. The difficulty of direct transfer of evidence from RCTs to the clinic, while acknowledged, has been cast predominantly as the issue of practice being inferior to the RCT because of difference in resources and skill or as the issue of the implementation gap where practice is lagging behind the results of trials (Dopson et al., 2003; Sanders and Haines, 2006). Efforts to address this difficulty, therefore, have focused on improving clinical practice by informing and technologically equipping it. But when proponents of pragmatic trials now state that "real-world evidence is needed" (Zuidgeest et al., 2017: 7), they appear to approach the problem of applicability from a different angle by criticising precisely the secondary importance given to contextualisation in the process of knowledge production. What is new and significant here is an emerging turn within the health research field itself towards explicitly reconsidering the connection between clinical experimentation and clinical practice in order to reform the RCT itself accordingly.

This development appears to be in line with the wider shifts towards greater contextualisation in contemporary knowledge production, which Nowotny, Scott and Gibbons (2001) described. Contextualisation, for these authors, involves the growing role that society and its diverse concerns play in science, but also a "shift within science from the search for 'truth' to the more pragmatic aim of providing a provisional understanding of the empirical world that 'works'" (Gibbons, 1999: 82). In their analysis, the authors mention medical research as one of the fields marked by strong contextualisation. However, according to pragmatic trial enthusiasts, such shift towards greater sensitivity to the needs of clinical practice and greater focus on the usefulness of results is not yet an accomplishment, but rather a task at hand.

In this paper, I investigate the new kind of balance pragmatic trials attempt to strike between what is considered a health intervention and what is considered its context and how exactly the relationship between an experiment and the real world is being reshuffled. Aiming to produce real-world evidence, pragmatic trials seek to reshape the classic RCT methodology, but which elements of this methodology are open for change and which are non-negotiable? If pragmatic trial departs from conceiving the RCT as a sterile and controlled laboratory, what then accords its epistemic robustness? And, most importantly, how promise of greater contextualization is

being fulfilled? To answer these questions, I first delve into the origins of the notion of pragmatism in relation to clinical trials. I analyse how the pragmatic attitude in clinical trials was conceived in the very first article on this topic published in 1967 and why this publication attracted significant attention from the medical research community only some 30 years later. Further, I follow the explosion of interest in pragmatic trials at the end of 1990s and focus on the ways in which pragmatism has been reinterpreted and on the strategies used to stabilise its contemporary version. In the concluding section, I discuss the implications of this pragmatic turn and argue that contemporary version of pragmatic trials risks missing the mark by allowing the focus on establishing similarity between the trial and the clinic environments for the purpose of greater generalizability to eclipse the move for carefully aligning medical experimentation with conditions, needs and concerns in the clinic for greater usefulness.

What problem are we solving?

Pragmatic trials were first distinguished by two French statisticians, Daniel Schwartz and Joseph Lellouch. They articulated their views in the 1967 article 'Explanatory and pragmatic attitudes in clinical trials'. Trials, Schwartz and Lellouch stated, may be aimed at solving two radically different types of problems. Trials conceived and implemented without clear recognition of what type of problem they aim to solve end up yielding inadequate and even ethically indefensible results.

Let us take a look at one of the examples Schwartz and Lellouch (1967) provided to explain their point. Imagine that trialists would like to compare two anti-cancer treatments, one being radiotherapy alone and another being the same radiotherapy but preceded by a novel drug. This drug may sensitise patients to the effects of radiotherapy and is to be administered over a 30-day period. Stating simply that the trial aims to compare the two treatments, as is often done, is misleading. Instead of this single general formulation, Schwartz and Lellouch offer to select one of two different approaches to designing the trial.

One approach would centre on the question *Does the drug have a sensitising effect?* To answer this question, investigators would split trial participants into two groups: 'drug + radiotherapy' group and 'radiotherapy alone' group. The drug + radiotherapy group begins receiving their intervention right away, that is, they undergo 30 days of taking the drug and then radiotherapy. Simultaneously, the radiotherapy alone group undergoes a 30-day blank period, so that at the end of this period radiotherapy is administered at the same time to both groups. This approach allows to entirely equalize the conditions of administering treatments, so that the two groups differ only in the presence or absence of the drug. This is what Schwartz and Lellouch called *explanatory* trial. In this case, the treatment studied is the drug; investigators are able to distil the effects of this key component, and aim at *understanding*. But what would the presence or absence of a drug's sensitising effect mean for treating actual patients? The explanatory version of this trial would produce practical implications only if the drug + radiotherapy intervention turned out to be no better than radiotherapy alone after a delay. In this case, there is no reason to use the drug prior to radiotherapy in clinical practice, since the combined treatment would be no better than immediate radiotherapy without delay. However, if drug + radiotherapy turned out to be better than radiotherapy alone, investigators would end up in a situation where the drug, despite being proven efficacious, "may be of no practical interest since it has only been compared with radiotherapy inefficiently administered" (Schwartz and Lellouch, 1967: 639).

Schwartz and Lellouch then described another approach to designing this same trial, which they termed *pragmatic*. The pragmatic trial is aimed at *decision* and would seek to answer the question *Which of the two treatments should we prefer?* In this case, the radiotherapy alone group would receive radiotherapy at once, without the 30-day blank period, at what is likely to be the optimal time for the radiation treatment to benefit patients. Instead of comparing the presence of a drug with its absence under equalised conditions, this approach allows for comparison between two modes of therapy provided under conditions optimised for each therapy to work in terms of timing, dosage, mode of administration, auxiliary care, etc. Where an explanatory trial provides

information on the effects of the key component, a pragmatic trial compares two complex treatments as wholes under the conditions in which these treatments are likely to be applied in practice. The former entails stripping the tested treatments of the context of their administration and equalising conditions of their provision, while the latter entails separately defining each of the tested treatments in a contextualised way to include their presumed optimal usage conditions in practice.

Schwartz and Lellouch went on to stress that while treatments compared in a pragmatic trial are much more broadly and flexibly defined than in an explanatory trial, this does not constitute a violation of the essential experimental procedures:

> The basic principle that two treatments must be compared in two groups which are in every other respect comparable is in no way contradicted by optimisation of the contextual factors. Instead, these factors become themselves part of the therapies to be compared and are thus distinguished from non-contextual factors for which comparability must be assumed. It is characteristic of the pragmatic approach that the treatments are flexibly defined and "absorb" into themselves the contexts in which they are administered. (Schwartz and Lellouch, 1967: 638)

Thus, the distinction is drawn differently between an experimental intervention and its context in explanatory and pragmatic trials with the latter being much more contextualised. In Schwartz and Lellouch's terms, contextualisation refers to considering tested treatments in a broad sense, together with the particularities and conditions of their administration in clinical practice. Yet, contextualisation necessarily proceeds within the experimental framework. To produce reliable answers, a trial has to be controlled, meaning it must involve comparison between reasonably similar experimental and control groups.

Apart from contextualising treatments to compare them under optimal rather than equalised conditions, Schwartz and Lellouch suggested that pragmatic and explanatory trials differ in several other respects. First, the difference lies in how patients are included. For any given trial, suitable patients are selected from the class of all comers by means of inclusion and exclusion criteria. Within the explanatory approach, patients deemed suitable for a trial are strictly selected and made as homogenous as possible. Furthermore, some patients may discontinue participation during the trial because of side effects, changes in their schedules, unpleasant trial procedures, quarrels with personnel or other reasons. In an explanatory trial, the class of suitable patients is redefined *a posteriori* to exclude withdrawals. Under the pragmatic approach, trial participants are more heterogenous and selection is not taken too far so as to stay close to the class of all comers. Withdrawals are not excluded from the analysis, as the treatments under comparison are flexibly defined to absorb discontinued participation as well. Comparing the two approaches, Schwartz and Lellouch summarised:

> [w]ith the explanatory approach, we compare strictly defined treatments on a relatively arbitrary class of patients; with the pragmatic approach, loosely defined treatments are compared on patients drawn from a predetermined class. viz. those to which the conclusions of the trial are to be extrapolated. We may say that in the first case the class of patient is defined to fit the predetermined treatments, while in the second the treatments are defined to fit the predetermined class of patients. (Schwartz and Lellouch, 1967: 643)

Second, the difference between explanatory and pragmatic trials lies in whether laboratory or normal conditions are adhered to. The first way implies more rigorous and intense procedures which could be performed only in the course of a trial (laboratory conditions). The second way adheres to conventions of the current clinical practice (normal conditions). Here, Schwartz and Lellouch view the clinic as an imperfect version of the laboratory, with the distinction between normal and laboratory conditions depending on the level of clinical practice and being able to vanish if this level were to rise. The distinction between normal and laboratory conditions is of the spectrum type in contrast with the optimal and equalised conditions of testing interventions, which

Schwartz and Lellouch viewed as "totally opposed concepts" (Schwartz and Lellouch, 1967: 639).

The third difference between explanatory and pragmatic trials lies in how the results of testing of the two treatments are compared. Since sample sizes are always finite, conclusions of any comparison are subject to a certain risk of errors. When the explanatory approach is adopted to discover whether a difference exists between two treatments, analysts are concerned with errors of the first kind where it is wrongly concluded that two treatments differ when in fact they don't and errors of the second kind where it is wrongly concluded that two treatments are equivalent whereas in actuality they differ. When the pragmatic approach is adopted to answer the question "Which of the two treatments should we prefer?", the comparison proceeds differently. Errors of the first kind are irrelevant because when two treatments are equivalent, it does not matter which one is chosen. Furthermore, some difference is always assumed to exist between the two treatments, so probability of errors of the second kind is null. All attention instead is given to what Schwartz and Lellouch called errors of a third kind, which occur when it is concluded that one treatment is superior to another, whereas the opposite is the case. So, analysis within pragmatic trials focuses on errors of the third kind, since it is most undesirable to choose an inferior treatment, whereas analysis within explanatory trials ignores these kinds of errors.

The article "Explanatory and pragmatic attitudes in clinical trials" ended with a warning. Schwartz and Lellouch cautioned that trials could not be conducted adequately without specifying exactly what type of problem a trial was aimed at, i.e. a problem of understanding or a problem of decision-making, and consciously matching trial design to the type of problem. The two statisticians also called for a change in the dominant approach to designing clinical trials: "Most trials done hitherto have adopted the explanatory approach without question; the pragmatic approach would often have been more justifiable" (Schwartz and Lellouch, 1967: 648) and invited further discussion.

Indifference

Discussion, however, barely started at the time. The pattern of citations of Schwartz and Lellouch's seminal paper can serve as one indication of how interest in pragmatism in clinical trials and the ability of clinical trials to inform decision-making in clinical practice developed (see Figure 1). Data from Google Scholar suggest that within ten years from publication, the paper was cited only seven times, followed by a modest increase in the next decade. In 2019 however, "Explanatory and pragmatic attitudes in clinical trials" is cited more than 1,200 times. A sharp increase in cumulative citations is visible from the end of the 1990s, perhaps signalling a change in attitude towards traditional RCT and its ability to be a means to decision-making in health care rather than as formal hypothesis testing.

How should we understand the period of apparent indifference prior to the explosion of interest? Answering this question requires turning to the topic of statistics and its convergence with the ascent of RCT methodology to the dominant position it has enjoyed for the most part of the last fifty years.

In contemporary medical science statistics is ubiquitous. Yet, despite a number of examples of statistical analysis use in medicine throughout the past centuries, the involvement of statistics in clinical research started being visible only by the end of the 1940s (Higgs, 2000; Mainland, 1960). It is after the landmark British Medical Research Council's trial of streptomycin for tuberculosis in 1947-48 and similar trials of the US Public Health Service at the end of the 1940s and beginning of the 1950s that promoted RCT methods (Bothwell and Podolsky 2016; Marks 2000b) that statistical apparatus, propelled by the rise of RCT, solidified its place in medicine. This is not to suggest that the growing importance of statistics in general spilled into medical research and resulted in the rise of RCTs. It would rather be more accurate to say that proponents of RCTs recruited statistical expertise to support their efforts. Gain in prominence by RCT in consort with statistics was greatly aided by the movement for therapeutic reform most active in the US and the UK (Marks, 2000b; Podolsky, 2010). Medical scientists, academic physicians, journal editors and governmental officials who comprised

this movement were united in their conviction that more scientifically robust knowledge about drug effects would lead to better clinical practice. Scientifically robust knowledge was to be guarded from various kinds of biases introduced into medical research by participating patients but also by investigators themselves, from manipulations with patient assignment to favour particular therapies, to expectations influencing the reporting and analysis of experimental outcomes. For reformers, the RCT with randomised treatment assignments, use of control groups, and blinded assessment of outcomes presented an impersonal standard for keeping these biases in check and, thus, producing more reliable knowledge to guide clinical practice (Chalmers, 2001). And here an opening was presented for statisticians who forged an alliance with therapeutic reformers and aided the effort with procedures and ideas about experimental design developed in the field of statistics. Statisticians came to be in charge of weeding out weaknesses in trial design, eliciting risks of bias and policing quantitative aspects of study conclusions, contributing to the cause of the reform: to provide physicians with as decisive an answer as possible regarding the therapeutic merits of new treatments. Slowly but persistently, statistics became such a distinguishing mark of a well-designed trial that, as medical historian Harry M. Marks (2000a: 351) highlights, "[b]y the late 1960s, investigators would complain of 'the benevolent tyranny' statisticians held over therapeutic research".

In a short time, statisticians became indispensable for planning and analysing medical experiments. Again, statisticians were not the primary driving force behind the ascent of RCT; but still they played an important role because they provided their expertise and tools to the movement of therapeutic reformers and, later on, to medical researchers who gradually came to rely on RCT to conduct their studies. Yet, while they were the owners of reliable tools for judging strengths and weight of evidence, they were also aware and not infrequently reminded that medicine was not their domain, it belonged to medical researchers (Marks, 2000b). Statisticians were eager to mark the territory of their expertise and to avoid venturing into areas where their knowledge could be challenged. In 1976, prominent American statistician Jerome Cornfield, one of the first sympathetic commenters on Schwartz and Lellouch's work, reflected on how statisticians, by then firmly entrenched in the clinical trials field, distanced themselves from problems of decision-making in clinical practice in an attempt to adhere to the erected boundaries. Their first move, according to Cornfield, was to delineate how statistics as a field related to questions of decision-making in general: "It is not universally accepted that the theoretical analysis of decision making is a useful part of statistics. The Fisherian view is that it may be fit for business and tyranny, but surely not for the high, free purposes of science …" (Cornfield, 1976: 409). Engaging with problems of making decisions in practice

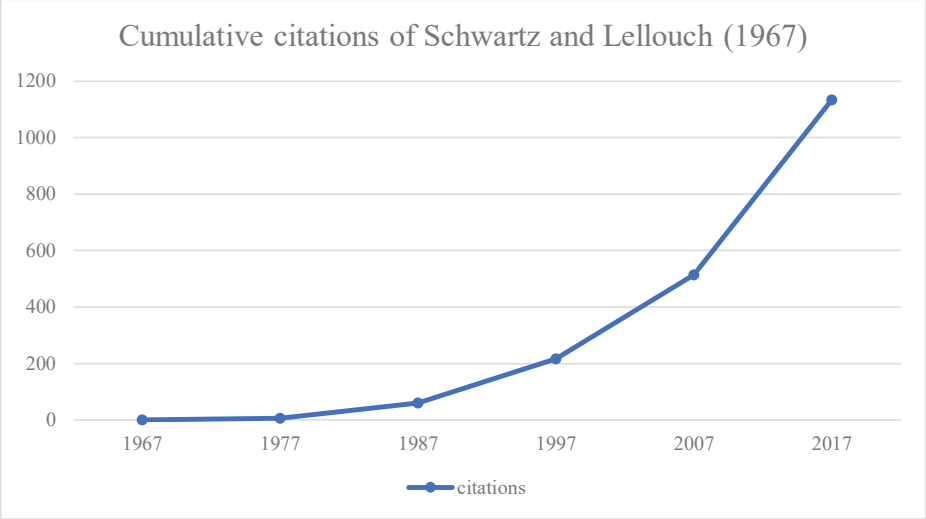

Figure 1. Cumulative citations of Schwartz and Lellouch (1967).

was not a generally accepted component of statistical expertise back then. The second move was to distinguish issues that pertained to the domain of statistics specifically in clinical trials and decouple them from the issues of decision-making in clinical practice:

> A common attitude towards these problems [of decision-making] may be paraphrased as follows: "Decisions, although important, involve non-statistical issues and should be distinguished from the purely statistical issues, which consist of asking what the data show and how certain are the conclusions they will support. Once these are known, decisions and their costs can be considered, but preferably by someone else." (Cornfield ,1976: 410-411)

Therefore, statisticians, being the primary audience Schwartz and Lellouch appealed to, were reluctant to answer the call. Considering pragmatic questions such as "Which treatment should we prefer?" as Schwartz and Lellouch (1967) proposed, would require a major revision of the field's self-conception. It is not surprising that "[t]he existence of a decision-making, or as Schwartz and Lellouch … put it, pragmatic function in clinical trials was almost entirely neglected in the original formulations [of RCTs by statisticians]" (Cornfield, 1976: 408).

Another group that could have answered Schwartz and Lellouch's call were therapeutic reformers themselves. However, those aspiring to elevate the scientific standards for judging the effects of medical treatments were busy with their own quest (Matthews, 1995). They led a campaign to persuade medical researchers to use methods of modern statistical experimentation and to convince medical practitioners to rely on RCTs as yardsticks for measuring claims of pharmaceutical companies. This campaign relied on straightforward messages meant to impress the medical audience with the opportunities opened up by statistical methods for achieving greater certainty and objectivity. In such endeavour, there was little space for delving into the subtleties behind statistical procedures.

It is illustrative here how reasons for randomisation were discussed among statisticians and how they were originally conveyed to the medical audience. Ronald Aylmer Fisher (1926), whose work became a cornerstone of the statistical theory of experimental design, proposed to use randomisation for assigning treatments to be able to estimate random error variance and obtain a measure of uncertainty that characterised the experimental results and not at all to ensure homogeneity across and, hence, comparability of the groups in an experiment. For him, randomisation allowed establishing the validity of inference[2] (Armitage, 2003). Fisher conducted most of his experiments in agriculture, not in medicine, though. The entry of randomisation into clinical trials was aided by another statistician and epidemiologist, Austin Bradford Hill, who strived to make it attractive to medical audiences. Hill relied on a set of completely different arguments (Chalmers, 2011). Randomisation, he wrote, "ensures that neither our personal idiosyncrasies (our likes or dislikes consciously or unwittingly applied) nor our lack of balanced judgement has entered into the construction of the different treatment groups —the allocation has been outside our control and the groups are therefore unbiased" (Hill, 1952: 115). That is, the reformers offered randomisation to medical community as a technique to avoid prejudice and free researchers from the pains of ensuring comparability of the groups in an experiment. Randomisation, when used in an RCT in conjunction with other recommended techniques such as blinding, was basically presented as an assurance that results are safeguarded of bias and, therefore, trustworthy.

That such promises steered clear from statistical theory and were presented as a matter of common sense certainly added to their appeal. Yet, in the pursuit of an impact, the campaign for placing clinical practice on a scientific basis by means of the RCT swept under the carpet the complexity and limitations of statistical methods. Admission that statisticians disagree, let alone an engagement in discussion of conflicting approaches to the RCT, could temper the emerging enthusiasm for the RCT and potentially undermine the movement. Moreover, making the controversy public about just how much relevance clinical trial results have for making decisions in clinical practice, would damage the very central claim

of therapeutic reformers that RCTs are useful precisely for physicians. Therefore, advocates of the RCT were not keen to acknowledge the call for pragmatism and all the challenges involved in it.

Physicians, in turn, while having their interests most directly tied to pragmatism in clinical trials, tended to be too unfamiliar with statistical foundations and reasoning to consider the difference between the explanatory and pragmatic approaches relevant. The limitations of explanatory approaches to trials appeared to be embedded in the arcana of statistical theory which was rarely a significant part of physicians' education or subject they would regularly encounter in their daily work. Consequently, all audiences who could potentially take part in the discussion proposed by Schwartz and Lellouch either lacked interest or would have their own agendas directly threatened by such discussion.

The pragmatic turn

While the ideas of Schwartz and Lellouch initially failed to give rise to discussion, the notion of pragmatism in clinical trials did get traction some thirty years later. In 2003, when the rise of attention to pragmatic trials became visible, a group of primary care researchers wrote:

> To a great extent the conduct of pragmatic trials is a recent phenomenon. While one of the earlier descriptions of pragmatic versus explanatory trials was by Schwartz in 1967 … most of the published editorials considering pragmatic trials as a methodology have been since 1998 … A Medline search … yielded 34 articles reporting on pragmatic clinical trials. All 34 were published since 1995 and 26 of them were published since 2000. (Godwin et al., 2003)

A number of shifts enabled this turn to pragmatic trials. For one, during the years following Schwartz and Lellouch's publication, the prevalent thinking among statisticians about the mission of statistics in general and its role in medical research in particular changed. Peter Armitage, a past president of the Royal Statistical Society, expressed the newer attitude in the following way: "We can accept … the implied limitations of statistical investigation, without in any way depreciating the contributions of statistical investigations, and clinical trials in particular, to the technology of therapeutic medicine — as helping to show what is *useful*, rather than what is *true*" (Armitage, 1998: 2677, italics in original). This emphasis on usefulness signalled a departure from adherence to the narrowly conceived 'territory of statistics' and the willingness to engage with clinical practice and its concerns. While statisticians did not constitute the major driving force propelling the rise of interest in pragmatic trials, the reversal of the field's self-conception created an opening for engaging with pragmatic questions and contributing to a long overdue discussion.

What appears to have been decisive for making the time ripe for the pragmatic turn is the unlikely convergence of patients' actions for recognition of their needs, the slower than expected uptake of medical research findings by physicians and the consolidation of efficiency-focused healthcare management approaches. Since the 1980s, groups such as HIV/AIDS activists entered the relatively insular world of clinical research and demanded a place in designing and carrying out clinical trials along with medical researchers and statisticians. Their actions triggered changes in drug approval standards to increase access to experimental drugs and facilitated modifications in trial procedures to increase flexibility and responsiveness of trial protocols and to use outcome measures meaningful for patients (Epstein, 1996). Addition of these new participants in research planning made pragmatic questions such as "Which of the two treatments should we prefer?" not only legitimate but urgent for clinical research.

Pressure to make trials more 'useful' for making decisions in actual practice also came from those concerned with the fate of evidence-based medicine (EBM), a powerful movement that therapeutic reformers of the past intellectually flowed to. Physicians' enthusiasm for timely incorporation of the results of well-designed experiments into their practice appeared to lag behind what proponents of scientific medicine had hoped for (Pope, 2003). The medical research community's reflections on the reasons for this disappointment tend to come back to the crucial obstacle: ordinary physicians rarely see these results as relevant (Cranney et al., 2001; Haynes et al., 1997).

The diversity of patients, conditions, and circumstances physicians face leads them to doubt the applicability of research results in their daily work. Consequently, for those concerned with sustaining EBM's momentum, one central course of action has focused on reshaping clinical research to allow physicians to recognise the realities of their work in medical experiments. It is important to highlight here that the original proponents of RCTs also saw their efforts as directed at providing clinical practice with useful knowledge. However, usefulness of this knowledge was meant to stem mostly from avoidance of bias in its production through the use of traditional RCT methodology. Such unbiased knowledge was meant to substantiate decision-making in clinical practice. But the growth of interest to pragmatic trials signalled the emergence of thinking that keeping bias at check was not sufficient to ensure relevance and usefulness of trial-produced knowledge for making decisions in practice.

Last but not least, changes in how healthcare is organised have also made the pragmatist challenge more pertinent. Recent decades have seen the evolvement of managerial approaches to governing clinical practice, with a growing group of decision makers taking upon themselves the task of ensuring uniform quality of services provided to patients, while keeping expenditures at bay (Calvert et al., 2011; Muir Gray, 2004). Ever-rising healthcare costs placed matters of choice on top of these decision makers' agendas. Which drugs should be reimbursed given that reimbursing every drug that a physician may want to prescribe is not feasible? Which treatments should necessarily be offered by health providers for specific conditions? Which procedures need to be excluded from treatment plans as not providing additional advantages commensurate with their higher costs? Consequently, more requests began to arrive for research to evaluate medical treatments taking into account parameters important for making such choices. Pragmatic trials, with their aspiration to improve the link between clinical research and decision-making in clinical practice, appear to have affinity with the concerns of this group of healthcare managers as well.

Reinterpretation

With the alignment of these different actors' interests around making clinical trials more useful, the Schwartz and Lellouch's notion of pragmatism was not only dusted off and put to service, but also reinterpreted. The reinterpreted version, while perhaps more palatable to the diverse members of the pragmatic trials bandwagon, bears little resemblance to the two statisticians' thinking in 1967.

We can trace the change in thinking about designing trials for informing clinical practice through close reading of the three recent publications that have been central to shaping the contemporary views on pragmatic trials. The first of these publications presented an extension of the influential Consolidated Standards of Reporting Trials (CONSORT) endorsed by multiple medical journals and editorial organisations (CONSORT group, n.d.). This extension guides investigators in preparing reports of findings from specifically pragmatic trials (Zwarenstein et al., 2008). The second and third of these publications offered readers a tool titled PRECIS (PRagmatic Explanatory Continuum Indicator Summary) for distinguishing parameters suitable for pragmatic and explanatory trials. The tool was presented in two versions: PRECIS-1, very similar to the CONSORT extension, and PRECIS-2 that developed the tool further (Loudon et al., 2015; Thorpe et al., 2009). The guideline and the tool were created by health services researchers, such as Merrick Zwarenstein and Shaun Treweek and a few statisticians, such as Kevin E. Thorpe and Douglas G. Altman together with an international group of trialists. From the beginning, the authors packaged their views in such formats (a standard and a tool with clear-cut design options) that invited practical application and accorded to additional influence and reach to their work. Zwarenstein wrote on his personal web page: "This guideline, which forms part of the internationally recognized … CONSORT statement has influenced the way they [pragmatic trials] are described and published" (Zwarenstein, n.d.). In such ways, Zwarenstein and others have popularised particular characteristics as hallmarks of pragmatic trials and made certain considerations almost obligatory for those who like to conduct a pragmatic trial. Widely cited, their contribu-

Table 1. Questions for explanatory and pragmatic trials.

	Explanatory	Pragmatic
Schwartz and Lellouch	**Does the drug have a specific effect?** (Schwartz and Lellouch used sensitising effect to radiation in their example)	**Which of the two treatments should we prefer?**
Authors of CONSORT extension and PRECIS tools	**Can this intervention work under ideal conditions?**	**Does this intervention work under usual conditions?**

tions do not simply reflect a general consensus regarding properties of pragmatic trials, but also disseminate specific ideas about what pragmatic approach entails. These ideas involve implicit assumptions regarding the nature of experiment, the 'real world' and the relations between the two.

Let us first take a look at how the questions to be answered by pragmatic and explanatory trials are formulated by the authors of the CONSORT extension and PRECIS tools. They write: "Pragmatic trials seek to answer the question, "Does this intervention work under usual conditions?," whereas explanatory trials are focused on the question, "Can this intervention work under ideal conditions?"" (Thorpe et al., 2009: 464). Compare these questions with the questions envisioned by Schwartzand Lellouch (see Table 1).

For Schwartz and Lellouch the difference between explanatory and pragmatic trial is the difference between distinguishing a causal connection in a laboratory and making a decision in clinical practice, all things considered. Whereas for contemporary pragmatists, the difference between pragmatic and explanatory trial collapses into a difference between the conditions under which an intervention is tested.

What is understood here as 'ideal' and 'usual' conditions? The contemporary authors clarify that ideal conditions that characterise explanatory trials conducted in laboratory settings are such that "give the initiative under evaluation its best chance to demonstrate a beneficial effect" (Loudon et al., 2015: 1). Ideal circumstances that maximise the chances of success, according to the authors, include trial participants most likely to adhere and respond to an intervention, highly trained and experienced practitioners delivering an intervention, well-resourced setting and strict standardisation of an intervention and its delivery. Illustrative here is a statement with which the authors convey that irrespective of the amount of efforts invested, trialists can never carry out an entirely explanatory trial: "no patients are perpetually compliant, and the hand of the most skilled surgeon occasionally slips, so there can never be a "pure" explanatory trial" (Thorpe et al., 2009: 465). So, this is what characterises the ideal conditions that the explanatory trial ostensibly aspires to maintain: full adherence, comprehensive knowledge, no mistakes and complete availability of all necessary resources.

The usual conditions which exist outside of laboratory, in real-world settings, in contrast, are marred by all possible imperfections and variation, which interfere with the performance of the intervention being tested. To achieve its purpose of determining "the effects of an intervention under the usual conditions in which it will be applied" (Thorpe et al., 2009: 464), the pragmatic trial is to preserve these imperfections and variation. Instead of aiming to cancel out the noise of doctor-patient relationships, patients' life circumstances, physicians' attitudes and organisational routines to achieve a clean picture of causes and effects, pragmatic trials need to preserve the messiness of the usual conditions to see how an intervention would behave in the wild. Will it be able to withstand the adverse conditions? According to contemporary pragmatists, this task exceeds by far in difficulty the challenges met by those conducting an explanatory trial. On one hand, the difficulty here appears to be in engaging the clinical practice conditions into the experiment and running a trial in such a way that it changes these conditions as little as possible:

> … the act of conducting an otherwise pragmatic trial may impose some control resulting in the setting being not quite usual. For example, the very act of collecting data required for a trial that would not otherwise be collected in usual practice could be a sufficient trigger to modify participant behavior in unanticipated ways. (Thorpe et al., 2009: 465)

On the other hand, this advocated absence of control to preserve the usual conditions still appears to be in need of strict control. Messiness that ends up being engaged in a trial may diverge from the messiness in "the settings for which a trial is intended to provide an answer" (Thorpe et al., 2009: 467):

> For some interventions what is usual for each domain may vary across different settings. For example, the responsiveness and compliance of patients, adherence of practitioners to guidelines, and the training and experience of practitioners may be different in different settings. (Thorpe et al., 2009: 467)

Contemporary pragmatists offer to read pragmatic trials as requiring release of the strict control that is characteristic of explanatory trials to open a door to messiness characteristic of practice, but doing it in a controlled fashion to ensure that the imperfections and variation cherished now within the trial correspond to those that are usual for a particular target setting. Control here is directed at ensuring that messiness within a trial is the correct kind of messiness.

The PRECIS tools in essence are meant to help trialists with exactly these tasks: to establish and maintain similarity between trial conditions and the real world (i.e. conditions of actual clinical practice, according to pragmatists) or, one can say, what is deemed usual for a particular segment of the real world. Let us take a closer look at the PRECIS-2, the latest version of the tool, and see how it offers to ensure that the experiment is conducted under the correct kind of usual conditions. PRECIS-2 presents nine domains, each corresponding to a range of choices that can move a trial closer to or farther from what is considered the real world, thus making a trial more or less pragmatic. These domains include eligibility, recruitment, setting, organization, flexibility (delivery), flexibility (adherence), follow-up, primary outcome, and primary analysis and were visualised by Loudon et al (2015) as a wheel:

> Each domain encourages trialists to think about their trial and the recipients in the usual care situation in which their results might be applied if the intervention proves beneficial. If trialists are aiming for high applicability (that is, a pragmatic approach to design decisions), then we would expect the match between trial and usual care to be very good. (Loudon et al., 2015: 3-4)

The tool offers trialists to consider how pragmatic or explanatory their choice in each domain should be for the purposes of their trial, from 1 (very explanatory) to 5 (very pragmatic).

Applicability of trial results, Loudon et al. (2015: 2) wrote,"is the outcome of these choices, which affect the ease with which the trial results can be applied to and by the usual community of users of the intervention in the settings in which the trial designers envisioned it being used". In the contemporary reinterpretation of pragmatism in clinical trials, shaped to a large extend by the authors of the CONSORT extension and PRECIS tools, pragmatic trial aids clinical practice through maximising applicability of its results. We can understand the nine domains of the PRECIS-2 tool, then, as control points investigators are encouraged to use to juxtapose a trial with usual clinical practice. Through establishing similarity between the two, applicability of trial results to a particular segment of the real world is to be established.

Overall, pragmatic trial in its contemporary formulation broke in a number of significant ways with what Schwartz and Lellouch imagined. Contemporary authors chose to focus on what French statisticians called 'normal and laboratory conditions' as a primary demarcation criteria between pragmatic and explanatory trials and develop it further while putting aside other considerations offered in the 1967 article. This move is conscious. The PRECIS-1 publication indicated Thorpe and colleagues' awareness that, when introducing the idea of pragmatism, Schwartz and Lellouch were concerned with much more than 'normal and laboratory conditions': "Schwartz and Lellouch clearly linked the

ability of a trial to meet its purpose with decisions about how the trial is designed. … [Yet,] how useful a trial is depends not only on design but on the similarity between the user's context and that of the trial" (Thorpe et al., 2009: 474). The contemporary authors warned to "not confound the structure of a trial with its usefulness to potential users" (Thorpe et al., 2009: 474) and in the rest of their writings about pragmatic trials proceeded to focus exclusively on the conditions within and outside the trial. In this interpretation, the pragmatic trial strives to achieve a similarity between the trial conditions and conditions in what is called the real world. In this way pragmatic turn seeks to change only conditions within the trial and not necessarily trial design principles and certainly not the methodological backbone of the RCT — randomization, the use of control groups, and, where possible, blinding.

Discussion: Pragmatic turn and contextualization

Tracing the changes in how pragmatic clinical trials are conceived, we can notice discontinuity in thinking about pragmatism in clinical trials. Schwartz and Lellouch's (1967) original notion had to do with dilemmas and choices that emerge in clinical practice. The specificity of these dilemmas and choices lies in that decision in practice is rarely about selecting one or another active pharmaceutical ingredient. The decision in practice tends to be between different modes or strategies of therapy, which include costs, ways of administration, additional care, particularities of the patient's condition and much more. Schwartz and Lellouch called all of these 'context' and proposed to make trials pragmatic by contextualizing them, which involves letting treatments being compared absorb the context. Trials that rely on such inclusive definitions of treatments together with other pragmatic strategies are useful because they can aid decision-making by helping choose a superior treatment, broadly conceived, as opposed to distinguishing whether a drug has a certain type of effect.

Three decades after Schwartz and Lellouch's article was published, health research community turned to the notion of pragmatism in clinical trials and reinterpreted it. Contemporary pragmatists too argue in favour of contextualization as key to pragmatism but conceive it differently. Here contextualization involves making conditions in clinical trial similar to conditions in clinical practice, often in a particular location. Contemporary pragmatists' starting point is a fundamental difference between the laboratory (traditional RCT) and the real world (usual clinical practice) in terms of behaviour of a medical intervention. This difference threatens the usefulness of trial results because how a drug behaves in a laboratory-like explanatory trial may resemble little what it would do after being let loose in the clinic, which is just too imperfect to sustain the laboratory results. A pragmatic trial, then, is a trial conducted under what is considered the usual conditions in a setting where a tested intervention is to be used, as opposed to sanitised and orderly laboratory conditions. The greatest benefit of pragmatic trials thus conceived is that their results are deemed to be more applicable in clinical practice, since the imperfections of the world, such as suboptimal adherence, differential availability of resources and variability of physician treatment strategies, which plague the clinic, have already been factored in evaluating the effects of the experimental treatment.

It is not hard to notice that the two versions of pragmatic trials attempt to bring benefits to medical practice via very different routes. Contemporary enthusiasts strive for applicability understood as a synonym or, one can say, an outcome of generalizability. Increased similarity of conditions in a trial and in a clinic granted by a pragmatic design leads to greater generalizability since patients and routines appear to be more representative of the usual care. And the more generalizable trial results are, the more applicable they are taken to be as well. This is not to say that relations between generalizability and applicability in trials are always understood in this way, but this understanding is firmly embedded in the claims of contemporary pragmatists. The described line of thinking is reminiscent of a wider discussion in biomedical literature about efficacy (which is tested in traditional RCTs with their ideal conditions) and effectiveness (which contemporary pragmatic trials with their real-world condi-

tions attempt to test) (Flay, 1986; Gartlehner et al., 2006; Glasgow et al., 2003). But this line of thinking has nothing to do with Schwartz and Lellouch's proposal. In fact, Schwartz and Lellouch were not concerned with generalizability as such. Yes, they mention 'the usual conditions' that pragmatic trials need to involve, but this is only one and rather minor component of their proposal. They were concerned with making trials more *useful*, i.e. asking relevant questions, looking for outcomes that make a difference, and defining experimental treatments and comparators in a way that makes sense in clinical practice. In short, usefulness was to be achieved through defining and designing medical experiments in a way that engages with concerns of clinical practice. But when difference between traditional and pragmatic RCTs is casted simply as that of efficacy and effectiveness as is commonly done now, the question of usefulness is not on the table anymore because it is assumed that if trial results are more generalizable and, hence, applicable then they are also more useful. However, usefulness and applicability as it is currently conceived in pragmatic trials field are very different beasts and when the quest for usefulness is abandoned and only applicability is sought instead, the promise of more contextualized Mode-2 type of clinical research cannot be realised.

The comparison of the outlined versions of pragmatism in trials also makes visible just how much the contemporary version relies on separating controlled inside and uncontrolled outside in the medical experimentation. This is how STS scholars have theorised a laboratory: as a result of a process that distinguishes an inside, an environment where only those influences are allowed that are considered relevant for making a certain epistemic claim, and an outside, an environment full of noise and irrelevant disturbances (Guggenheim, 2012). Such separation implies analytical differentiation between nature (drug's true effects, for instance) and human culture (routines and relationships that constitute clinical practice). STS scholars also highlighted problematic character of this differentiation since it does not do justice to the inextricable connection between nature and culture and does not necessarily make either one more knowable (Callon et al., 2009; Jasanoff, 2011). At least some of the challenges faced by clinical research now, such as results that would not hold and lack of trials designed to answer questions pertinent to practice, stem from taking for granted this long-established dichotomy. Contemporary pragmatists are aware of the consequences of keeping nature and culture strictly apart in clinical trials and seek to bridge the divide. In their daring attempt, however, they still do not seem to come far enough and abandon the divide. Instead, they extend the RCT's methodological backbone into clinical practice in order to involve messiness of the clinic as one more variable that cannot be ignored anymore and needs to be factored in. This move addresses the problem of external validity, making trial produced knowledge more generalizable to certain practice settings. But it does not necessarily make trial-produced knowledge as useful as it can be.

Schwartz and Lellouch's version of pragmatism, in contrast, starts with much less divisive notion, that of a decision that needs to be made in clinical practice. This decision is hybrid, necessarily combining elements of both nature and culture. In effort to decide, which treatment we should prefer, pragmatic trial seeks to align diverse elements such as data, interests of patients, experimental methodology, care strategies, side effects and ways to tackle them, and many more. Pragmatism here, instead of solving the problem of the great divide between the laboratory and the real world, avoids it altogether by locating itself in the space where elements of both intertwine. In doing so, early pragmatists opened the door to not only make trial produced knowledge more generalizable, but, first of all, to make it more useful by fully taking on board conditions, needs and concerns of clinical practice from the very beginning. In practice, in order to take their insights seriously and move towards more contextualized knowledge production, pragmatic trials could, apart from adhering to conditions usual for clinical setting, begin from research questions collaboratively defined by investigators together with those who are expected to use research results later on. In this way pragmatic trials would stem from choices physicians and patients have to make and, thus, provide answers more capable of making a difference in practice setting. Treat-

ments being compared in trials could be broadly and flexibly defined to include their optimal usage conditions in clinic to further enhance applicability of trial results. Also, conclusions about superiority and inferiority of investigated treatments could be made on a broad basis to include considerations relevant to different users, beyond narrowly understood efficacy. Discarding early pragmatists' insights now would mean losing an opportunity to strengthen contextualization of clinical research in a sense of its societal embedding, responsiveness, and relevance to the diverse needs experienced in clinical setting.

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Notes

1 The terms 'pragmatic' and 'pragmatism' are associated with American Pragmatists, including, first of all, William James and John Dewey, and school of philosophy developed by them. When these terms are applied currently to clinical trials, this is done in a manner quite distinct from what was originally proposed by Pragmatist philosophers.

2 For instance, in 1926, Fisher wrote about evaluating new crops and fertilisers: "One way of making sure that a valid estimate of error will be obtained is to arrange the plots deliberately at random, so that no distinction can creep in between pairs of plots treated alike and pairs treated differently; in such a case an estimate of error, derived in the usual way from the variation of sets of plots treated alike, may be applied to test the significance of the observed difference between the averages of plots treated differently" (Fisher, 1926: 506-507).

User Representations as a Design Resource: Achieving Accountable Design without Access to Users

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Abstract

The study of how the understanding of usages and users is achieved and turned into the characteristics of products comprises 'the sociology of user representation' in Science and Technology Studies. Whilst the early research on the topic was foremost a critique of designers' imposition of their imagination and preferences on prospective users, research has since discovered a richer research landscape by accomplishing the difficult task of anticipating the future contexts and identities of users. Our paper continues this line of work by examining a situation where first-hand access to users was blocked for human-centred design-oriented designers. Constructing an array of complementary user representations helped them to bridge the previously accumulated knowledge on users in their trade to the envisioned technology. The overlaps between the key user segment representations helped the design team to delineate an overall concept whilst the representations of specific usage details aided in the design of product features.

Keywords: User representations, design research, human-centred design

Introduction

Designing the usage of new technologies is notoriously difficult. Approaches for succeeding in it have been proposed one after another ever since the birth of industrial design and customer research early in the 20th century (Marchand, 1998; Hyysalo et al., 2016). After the human-centred design approaches became mainstream in the 1990s, the received view across the design, marketing and product development flanks of academia has been that new innovative technologies require the first-hand involvement or in-depth study of targeted users and their contexts (see, e.g. ISO 9241-210; Preece et al., 2002; Prahalad and Ramaswamy, 2003). The picture is, however, complicated by ethnographic studies of product development, which persistently show that studying users is no guarantee of success; companies may succeed without first-hand studies of users and an explicit study of users almost always turns out be but one source of knowledge in regard to

how usage and user preferences are addressed by designers (see, e.g. Kotro, 2005; Williams et al., 2005; Rohracher, 2005; Wilkie, 2010 Johnson, 2013; Hyysalo et al., 2016; Mäkinen et al., 2019).

The study of how an understanding of usages and users is achieved and turned into the characteristics of products in part comprises 'the sociology of user representation' in Science and Technology Studies (S&TS) (Akrich, 1995; Oudshoorn et al., 2004; Williams et al., 2005; Jensen, 2012; Hyysalo and Johnson, 2015). The sociology of user representation emerged in the 1990s as a corrective programme to the continued stream of problematic products and user interfaces, providing the analytical tools and empirical sensitivity with which to examine how and why an inadequate understanding of users prevailed in companies (Akrich, 1995; Oudshoorn et al., 2004). Theoretically it was part of Actor Network Theory (ANT) development, which sought to address how technology design becomes consequential; user representations lead to designers' 'prescriptions' and 'circumscriptions' for the use of artefacts, which would then meet users' subscriptions or deinscriptions (Akrich, 1992; Akrich and Latour, 1992; Johnson/Latour, 1987).

This early research on user representations had a strong message and ensuing legacy regarding what were termed 'implicit' user representations, particularly 'I-design' or 'ego-design', where designers used themselves as a referent for the future users rather than involving or studying them adequately (Akrich, 1995; Oudshoorn et al., 2004). This is aligned with human-centred and collaborative design in indicating that accountable designs result from 'explicit' representations provided by actual future users through involvement or through informing designers rather than grounding it in the designer's imagination and preferences (Woolgar, 1991; Akrich, 1992; Akrich, 1995; Oudshoorn et al., 2004; Sharrock and Anderson, 1994; Martin et al., 2007; cf. Stewart and Williams, 2005).

Since then research on user representation has been carried out in different strands of S&TS. Whilst many studies have repeated the ANT's I-design and script ideas as they were, the debate began to be shifted because of active ICT consumption in early 2000s (Silverstone et al. 1992; Stewart and Williams, 2005; Mallard, 2005). Social shaping of technology research underscored that users are *always represented* in design practice and that the knowledge of future uses and users remains difficult to anticipate with certainty and without residue even with the involvement of potential future users (e.g., Williams et al., 2005; Rohracher et al., 2005; Hyysalo, 2004; Johnson, 2013). This research suggests that there is more to the sociology of user representation than the assumedly right or wrong values of designers or the accountable and not accountable sources of user insight that are then operationalized (Stewart and Williams, 2005). This also means acknowledging that the S&TS work carried out on user representation carries a somewhat different message than human-centred or participatory design regarding the design of usages – there is simply a richer and more complex empirical reality to be tackled in designing usage than the simple recipes offered by user involvement and user research portray there to be.

This has resulted in a further shift in the lines of the questions to be asked about user representation in S&TS, both by ANT and in the social shaping of technology lines of study. Rather than asking whether user representations are constructed adequately and accountably with future users, the questions to ask address how are they constructed in the first instance and what follows if they are constructed in different ways and within different patterns, not least because the adequacy and accountability also take different forms in different product development contexts (see, e.g. Konrad, 2008; Steen, 2011; Wilkie, 2010; Jensen, 2012; Jensen and Petersen, 2016; Silvast et al., 2018). Another way to phrase this is that there is a move into examining how user representations are used as a design resource (Hyysalo, 2010; Johnson, 2013a, 2013b; Jensen and Petersen, 2016). This line of inquiry has considerable critical potential as well. Developers typically only recognize explicated representations of users, such as using personas (Cooper, 1999) as user representations, whilst research shows that a much larger array of user representation is typically at play and thus merits not only implicit but also explicit attention in design work (Hyysalo, 2004; Johnson, 2007; Wilkie, 2010; Hyysalo and Johnson, 2015).

Our paper continues this line of study by examining a situation where first-hand access to users was blocked from the designers who work in a company that has award-winning competence and a long history in human-centred design. Similarly to Johnson (2007, 2013) and Jensen and Petersen (2016), we do not examine design teams as somehow misguided actors who lack the social science competencies to study the people implicated by their designs. Neither do we see them as actors who would seek to do away with the burden of studying users, let alone try to avoid the constraints which a study of users could impose. On the contrary, the design team we study is formed of a group of skilled professionals who want to investigate prospective users, involve them and test with them but who cannot do so in this project because of strict trade secrecy imposed on their project by the top management. Because of this, they have to rely on information that they and their company already have and construct representations of users on the basis of it. In turn, the condition provides us with an extraordinary setting for examining how user representations are used as a key design resource in bridging stocks of knowledge on the users of previous products to the envisioned characteristics of a new product type. We thus ask: What kind of design resource does the construction of user representations provide for a design team who cannot have first-hand access to users?

The business-critical innovation project we observed throughout its course is particularly suited for such analysis as the designers had no other way to work than building representations of users and testing their ideas and solutions against them. Succeeding as they then did (the product got great reviews in the final testing phase) shows the power that explicit and implicit user representations can have as a design resource in a company that is mature in its human-centred design. We shall next venture into research on user representations more thoroughly, after which we describe the case context and research methods. We then move onto examining the array of user representations that informed the design work, after which we move onto elaborating how the array of user representations helped delineate the design space for the product. We finish with the discussion and conclusions.

User representations as a design resource

The sociology of user representations examines the processes by which actor positions become built-in to the characteristics of technology (Akrich, 1995; Woolgar, 1991) regarding who the users are, how they relate to producers and what they are supposed to do with that particular technology and in which situations and contexts (Akrich, 1992; Akrich and Latour, 1992). It examines how developers 'build bridges' toward eventual users during a technology's design, whether it be via business models, market studies, consumer panels, co-design workshops or even just via using their common sense (Hyysalo and Johnson, 2015). The user representations that result from these bridge-building activities link the multiple modalities of emerging technologies – ranging from visions to requirement specifications – to models and prototypes, to marketing materials and manuals, to pilot assemblies and, eventually, to the uses of concrete people in concrete settings (Hyysalo, 2004).

The most easily graspable user representations are those that directly guide development work and design decisions (Akrich, 1995; Oudshoorn et al., 2004; Hyysalo, 2004; Johnson, 2013). Within such user representations there is considerable variation as to how specific and detailed the representations are. Some are based on clearly delineated user demographics and specific use cases, and are typically found in specific application contexts or as clearly targeted parts of larger systems (Konrad, 2008; Johnson, 2013; Hyysalo and Johnson, 2015). Others are more generic and are typically those of mass-produced consumer goods and large systems. The diversity among users tends to increase beyond what can be meaningfully responded to by means of segmentation, needs analysis or product differentiation (Johnson, 2013). A common developer response has then been to respond by simply implicating no-longer-specific users and the actions that users would perform with the technology (Oudshoorn et al., 2004; Johnson, 2013; Mäkinen et al., 2019).

As noted in the introduction, the original ANT agenda related to research on user representations was premised on showing and making available tools for critical analysis of how devel-

opers chose, or ended up with, poorly considered user representations, judged by the standards of critical social scientists. This is exemplified by notions such as the 'I-methodology', ego-design or 'configuring the user as everybody', and the 'implicit vs explicit sources of user representation' that all underscore designers' misguided or inadequate orientation towards the identities, specificities and contexts of users (Akrich, 1992, 1995: 169; Oudshoorn et al., 2004: 33). Whilst important in showing that the grossly inadequate consideration of the impacted and implicated people certainly continues to happen in development labs, this early orientation has proven to be too simplistic (Stewart and Williams, 2005; Woolgar, 1991; Stewart and Williams, 2005; Konrad, 2008; Steen, 2011; Wilkie, 2010; Johnson, 2007; Jensen and Petersen, 2016; Hyysalo, 2004; Mäkinen et al., 2019; Wilkie and Michael, 2009). Firstly, it neglected the dynamics between different layers of user representation (Mallard, 2012; Hyysalo et al., 2016; Silvast et al., 2018). Some user representations are held more widely than just by a particular design team and may circulate among particular companies or even whole technology fields and be sported in the media to reach a mobilization effect on a range of actors in industry and policy (Konrad, 2008; Wilkie and Michael, 2009; Williams et al., 2005).

Secondly, the sources of user representations cannot be adequately categorized as *explicit* or *implicit*. When literature on the sources of user representation were examined analytically, over 30 different types of sources for main user representation were found, and even clustering them produces eight main areas: user representations in component systems and those encouraged by tools and infrastructures used in development work; the cultural maturation of the artefact and interaction genres; regulatory demands; business models; gathering the explicit requirements; direct user involvement; developers' using their common sense as citizens; and professionals using their experience from their previous work as a source of representing users (Hyysalo and Johnson, 2016). This last distinction is important as it shows that even I-design or using oneself as a reference simply forms too much of a lump category as designers commonly draw representations from both their own personal and professional life but in very different ways (see, e.g. Kotro, 2005).

Thirdly, and most importantly for us here, the early research assumed that recourse to actual user settings could somehow settle the understanding of user needs correctly. But humans are fickle beings whose needs, preferences and contexts continue to change and are not only affected by a particular design but also by the sociotechnical evolution around it as well (Hyysalo, 2003; Mallard, 2005 Jensen, 2012; Jensen and Petersen, 2016; Johnson, 2013). What results from this is that even if users were directly themselves involved in designing, they would be representing, for themselves as well as to others in the design team, their future selves in different future situations that even they themselves would not have an unmediated or direct access to. Users are *necessarily and always represented* in design practice (Williams et al., 2005; Rohracher, 2005; Hyysalo and Johnson, 2016). The sources of user representations are typically manifold, ambiguous and potentially in conflict with each other, indicating that all representations are but resources rather than definitive facts upon which designers can ground their decisions (Hyysalo, 2010; Wilkie, 2010; Jensen, 2012). A telling example is Johnson's (2007, 2013) analysis of on-line game development where the act most strenuously avoided in human-centred design, recourse to designing for the 'average user', was in fact used as a reflexive and democracy-fostering category among developers who were bombarded by requests from several very vocal user subcommunities. The implication here completes a full circle in orientation from the early sociology of user representation: accountable design followed from the representational practice of developers using their own professional experience and not their first-hand contact with users and certainly not the active participation of the most vocal groups of users who are busy lobbying their self-interests.

Our interest in the present study is to further the above line of studies on what kind of design resource user representations provide, particularly to the complementary effects of carefully built arrays of user representations. We can do so qua having had access to an extraordinary situation

where designers are versed in human-centred design but cannot study or involve users first hand.

The research process

The research was carried out at a case company during 2014–2018. For anonymity reasons related to the business-critical project we studied, the company will be called CompanyIM. CompanyIM is an industrial company that manufactures machinery and software, and offers services (such as training and consultation) related to a specific technology, mainly for industrial use. Their products are used more or less worldwide as they export to over 70 countries and they have a turnover of over €110M/year. They employ over 600 people. Having won several design and innovation prizes (including the Red Dot and iF Design awards), CompanyIM has a strong background in design and innovation. They have a high level of maturity in human-centred design. Based on J Earthy's (1998: 10) Human-Centeredness Scale, CompanyIM would be on level C or D of the model, having also implemented parts of level E, the highest level of maturity in human-centeredness.

The qualitative research process was mainly conducted by semi-structured interviews and ethnographic meeting observations. In addition to the interviews conducted across the different parts of the organization, a single innovation project – from here on anonymized as ProjectND – was followed in more detail in order to gain a better understanding of how the development projects function. ProjectND's goal was to develop a new type of device for the company – a battery-operated device whereas their previous devices had been wired. As the top management defined a very high confidentiality level for the project, no external stakeholders could be involved and, thus, user tests and user research with external users were also prohibited.

Our research is comprised of 37 interviews and observations of 33 weekly project meetings related to the design in ProjectND. The interviewees were selected by choosing representatives from different parts of the organization, by interviewing all the main participants of ProjectND and by snowball sampling (Goodman, 1961; Welch, 1975). Some of the main participants of ProjectND, such as the project manager and the industrial designer, were interviewed several times during the project. In addition, the company documentation was inspected. The research data are described further in table 1. All the interviews and meetings were voice recorded and transcribed. In addition, field notes were taken during the interviews and meetings. The transcriptions were coded using Atlas.ti, following open coding in grounded theory (Strauss and Corbin, 1990). After open coding, a case narrative was written and different information sources were analyzed and cross compared. User representation sources and applications were identified from the data and these are further described in the results section.

Table 1. Data types and amounts.

Data type	Amount
Interviews • The main focus is on R&D, and there is also a focus on sales and marketing • Lengths vary from 25 min to 2 h • The interviews were voice recorded and transcribed; field notes were taken	37 interviews 28 interviewees
Observed meetings • Weekly project meetings • Some larger project meetings • Lengths vary from 18 min to 89 min, on average, 38 min • An initial meeting when starting this study • The meetings were voice recorded and transcribed; field notes and some pictures and video were taken	33 meetings
Documentation • Organizational charts • Project documentation templates • User study 'guidelines' • Project documentation (requirements, specifications, concepts)	33 documents involving approx. 250 pages

Table 2. An overview of the sources of user representation in CompanyIM and ProjectND.

Source of representation	Examples in CompanyIM	Examples in ProjectND
User involvement	In-house users, co-creation with customers and partners, site visits	In-house users acting as proxies for prospective users (during product development and the testing phase)
Requirements gathering	General market studies, interviews (internal and external), site visits, care cases, an idea bank	General market studies, there were no official user studies for this project but there had been several for earlier projects
Business concepts	Business case documentation, project portfolio, brand guidelines	Business case documentation, brand guidelines represent usages and users
Regulatory demands	Regulations and standards	Standards coming from the required ingress protection level and the industry, regulations for the battery and electricity, other regulations for the industry
Parallel technologies	Earlier products, competitors, other industrial machines	Earlier products, competitor products, other battery-powered devices and machines, a parallel project that feeds into the user interface for example
Cultural maturation	A long history of products in the industry, earlier products in different categories	A long history of products in the industry, the general development of batteries and battery machines
The designer as a professional	Experience from earlier products and working in other companies in the industry, the apprentice model used to train designers in the company, a mandatory course about work done with the machines produced by CompanyIM	The product is for specific professional contexts and everyday experience provides limited guidance; the industrial designer has worked for a few days as an apprentice learning about the profession; all the employees have used the company's machines at least during a mandatory two-day course
The designer as a citizen	Using one's leisure time experience from other products, services and interfaces as a representation for how products in CompanyIM's line of business could work	The designers draw analogues from other products such as backpacks, carrying cases for tennis rackets, trumpets and biathlon rifles

User representation in the company and the focal project

We will begin by going through the sources of representations at CompanyIM. After this, we move to ProjectND, first listing the different representations constructed in ProjectND and then examining the most important representations in detail. Finally, we take stock of what these user representations, on the whole, helped to do in the development project and how they did that.

Sources of user representations

As is typical of R&D-intensive companies, CompanyIM has many kinds and sources of user representation. To give better clarity to their dimensions, in table 2 we have categorized them according to the taxonomy presented by Hyysalo & Johnson (2015, 2016). Table 2 presents the general sources in CompanyIM and more detailed sources in ProjectND. CompanyIM has a unique resource as they have so-called in-house users. These are professionals who have worked for CompanyIM's customers or in similar environments and, thus, have first-hand experience of the users and usage environments. To use an analogy so as not to give away the anonymity of the case company, if its line of business were piano manufacturing, these internal users would be former professional pianists or piano tuners.

The users for CompanyIM products do not act independently and are typically people working

in teams in different environments. Manifold sources of user representation are thus needed to provide insights into the complex environments and interactions they have with machinery and other people:

> So, a CompanyIM user can be anything from a farm maintenance team, factory maintenance team, a mobile [worker].[1] It can be [from] ship maintenance, ship repair, ship outfitting. It can be from the construction of large marine drilling platforms – so it can be heavy industry, oil-based sectors. It can be a pipe, plate ... (Product manager)

The company-wide and relatively generic user representations have to be rendered as more concrete ones when linked to the particularities of specific products. Here an example of an exchange between the project manager and service team in ProjectND reveals well the mutually defining nature of product features, and user and target group specifications:

> A couple of weeks ago [the project manager] sent a question to the [service team that has in-house users], asking if we had some ideas about what kind of features a battery-powered machine should have. And I answered that of course we'd like to comment, but in order to get to the features, we'd have to think who is the user and what is the usage environment and the target group. (An in-house user speaking in a project meeting)

Yet once such target-group, user and usage-environment questions become more clarified, user representations start to interrelate with the potential design features. Let us consider an example of the portability considerations in a project meeting. In the excerpt below, the considerations move from requirements and usage environments, and potential usage patterns to potential design solutions and then move on to a concretizing representation of a maintenance worker having to climb up a few stairs and a pairing of this with a further, more detailed design solution:

> [Let us] then [move to] the requirements related to the usage of the devices [that are affected by] the usage environments. Well, the[re is] lightness and the ease of transport; all the cables are brought along and can go in one hand. Then, as an alternative, [there is the possibility of] a wearable model. That aroused some comments noting that not many would like to wear it during the work, but I myself thought that [when the designer] showed us those straps, '[It could work] if it were possible to get that [strap solution]'. Think about a maintenance guy needing to climb a few stairs up – he could wear it like a biathlon rifle – put it on like a backpack. (In-house user)

In this meeting transcript we meet one of the key user representations for ProjectND, that of the 'maintenance guy'. Should we just examine the transcript snippet, the represented user having

Table 3. The main user representations to ProjectND.

Representation	Where the representation was deployed
A worker up a mast	In a picture in a brochure, in a marketing video, in nearly every interview
A worker with a van	In discussions
A farmer	In a marketing video, in an in-house users' list
A DIY person	In discussions, in an in-house users' list
A repairer in the wilderness	In a marketing video
A moving worker	In interviews, in discussions
The production industry, small fixes	In discussions, in an in-house users' list
A hefting worker	In an interview
An oil platform maintenance worker	Interviews, discussions
A worker maintaining a sewage pipe	In marketing video considerations
A shipyard worker	In a marketing video, in an in-house users' list
A military user	In an in-house users' list
An offshore ship	In an in-house users' list
A one-person company (doing fixing and maintenance)	In an in-house users' list
Forestry and shovel operators	In an in-house users' list

to climb a few steps of a ladder may appear as an illustration improvised for the benefit of engineering team members. Such an evocation of 'users as scenic features' of a proper design space (Sharrock and Anderson, 1994; Martin et al., 2007) is however not what happens here or in ProjectND more generally. As we see above, the user representations, the features of the usage environment, the target requirements' specifications and the design solutions all work in conjunction. Whilst the design ideas and solutions are not somehow mechanistically derived from user representations (in a manner akin to the early social and behavioural science thrust in regard to how user-centred design should work, visible in, e.g. early ISO standard models), the user representations provide both design anchors and constraints for the possible design ideas. To better understand how this works, we need to be aware that designers seldom operate with just singular user representations but use an array of them to delimit the design space (Hyysalo, 2004; Wilkie, 2010). Table 3 documents the main user representations used in ProjectND and where they are deployed during the development project.

The simple listing of user representations tells us that the portable device is to be used by a variety of target industries in similar types of repair, maintenance and small construction tasks. The separation of the categories indicates that there are some important differences in these environments, tasks, skills and interactions, which all need to be taken into consideration in the ideation and assessment of potential solutions. Some of the representations of target groups add relatively little to the mix while others are well articulated and carry substantial weight in setting the design space, as we see next.

What is being represented in a 'simple' user representation

We will now focus on the five most important user representations and the representation of competitor products and parallel technologies in order to open up what they denote in more detail. The selected user representations have often been used in internal discussions; most of them have been selected as representing key usage areas for target marketing as well. The representations are:

1. A worker up a mast
2. A worker with a van
3. A DIY person
4. An oil platform maintenance worker
5. A farmer
6. Competitor products and parallel technologies

To make sense of them, we analyse the content of each regarding the following aspects suggested by earlier studies on user representations (Akrich, 1995; Preece et al., 2002; Hyysalo, 2004; Oudshoorn et al., 2004; Robertson and Robertson, 2006; Johnson, 2013; Hyysalo et al., 2016):

- Representations of the primary user
- Representations of secondary users and other implied people
- Representations of the immediate context of use
- Representations of the surrounding context of use
- The implied characteristics of the product
- Other representations that define the user or the technology
- Implications for design
- Where the representation originates from

In addition, we will present some examples of the usage of each representation. These examples demonstrate what can be learned from the representation and how they are being applied in design work.

The worker up a mast

The 'worker up a mast' can be considered as the design driver of the new product. The representation comes up in many different discussions, both in meetings and in the interviews, when asking about the main users for the product. In addition, it has been used as the key marketing example as the picture in the product brochure features a man up a mast. An example of its use follows:

> It might be a high place somewhere, like a high mast, where you can't take long cables and someone climbs up there and has to do some [repair work] there. (An engineer)

This image appears to be borne in mind whenever designers think of the different features of the device. This representation ensures that the portable product is truly portable: it is not too heavy and can be carried around easily. It has also affected the durability tests of the product as it needs to survive certain types of handling. This was the most mentioned user representation in different meetings:

> Because there is the fact that you don't [work] there for very long; if you're somewhere at a T-line or up a mast or wherever you are, then the easy transportability is more essential than how long you can operate with it. (From a project meeting)

We can analytically discern several features of this user representation:

Representations of the primary user: This user is a professional, for whom this activity is only one maintenance activity among others. In addition to the repair equipment, the worker up the mast needs special gear for climbing the mast safely. The uniqueness of this represented user is the extreme place, high up a mast, where the repair activities need to be done. This device enables him or her to actually do the work on the mast properly.

Representations of secondary users and other implied people: The worker up the mast is working up on the mast alone and thus cannot have any help from others while doing the repair work (apart from perhaps help provided through an earbud). He or she might have a colleague on the ground and the same device might be used by others as well, but the actual work is done alone.

Representations of the immediate context of use: The represented user has to climb up to an extremely high place to do her or his work. The mast does not have a solid and spacious floor to stand on, thus, the location is rather uncomfortable. As the worker holds on to the mast with one hand, she or he only has the other hand free to do the repair with, in addition to that fact that her or his position is not very stable or ergonomic.

Representations of the surrounding context of use: The circumstances (high up on the mast) can be unpredictable; strong wind and rain can complicate the repair work. The mast might be located in a rural area, so the worker might have to drive along bumpy roads in order to get to the mast and, in addition, carry the device for a while.

The implied characteristics of the product: The user cannot carry many different things with him or her, so the product needs to have everything required, arranged neatly in one compact package. The device has to be able to be easily placed somewhere on the mast and also to be operated with only one hand. This requires very high ease of use and a high enough ingress protection level for the product.

Other representations that define the user or the technology: The length of the represented stay in the high place is not very long as the user only stays up there for the needed length of time to do the repair or maintenance work. Thus, the device needs to operate for long enough so that the needed work can be done. The user does not want to hang around up on the mast and wait for the device to cool down in order to continue her or his work, but neither does she or he want to climb down to recharge the device and then climb back up again. However, the repair work on one mast is often not that lengthy and rather consists of small tasks.

Implications for the designer: This main user representation highlights the importance of portability. When designing for the worker up the mast, the designer has to constantly keep in mind the physical dimensions of the product. In addition to the size and weight of the product, the designer needs to consider the shape of the product. It cannot have any sharp edges that would make carrying it uncomfortable as the device will be hanging against the person's back or side. In addition, the device needs to stay balanced when being hung somewhere. The designer also needs to figure out how all the other needed equipment can be carried together with the actual device. This results in different options for straps and hooks. The user must also be able to use the device while wearing gloves, which affects the user interface design. In addition, taking account of the height of the mast, different

tests need to be conducted to ensure the safety of all the designed elements. Taken together, the designer gets most of the necessary physical features from this representation.

Where does the representation originate from for these product developers? The worker up a mast is based on the company's cumulated knowledge on the different usage situations for its products. They have seen their products in use in numerous different contexts and know that their existing products do not serve this user group well.

The worker with a van

The representation of the worker with a van highlights the importance of robustness: the device needs to survive bumpy roads when thrown into the back of a van. This also added the idea of the possibility of charging the device from the van charger (the cigarette lighter). This affected the testing of the device as its prototype was thrown into a trailer during a serviceman's trip, so the designers had to ensure that it would not break due to being bumped around:

> The idea is that if this is a tool for some serviceman, he or she throws it into the back of the van and goes somewhere and [...] so it must tolerate that kind of usage. (A project manager at a project meeting)

We can analytically discern several features of this user representation:

Representations of the primary user: The user is a repair worker who drives around with his or her van to the needed repair sites but he or she can also be someone that does some constructions in the wilderness. This user's uniqueness is the fact that they drive around to different repair sites in their van and thus the device is often thrown into the back of a van. This device enables doing the repair work without the need for an aggregate device.

Representations of secondary users and other implied people: The user might have a colleague with her or him, so she or he may work alone or in a pair and thus assistance might be available. In addition, the device might be used by others so it is not a personal device.

Representations of the immediate context of use: The person may throw the device into the van and drive around on bumpy roads. The repair work can be done practically anywhere: from inside a building to in a forest or a desert. Therefore, the device must be able to function in changing weather conditions and environments.

Representations of the surrounding context of use: The environments in which this person does the repair work varies from hot to cold and wet to dry. Additionally, the device might be stored in various kinds of places, from in the van to in a hot or cold warehouse.

The implied characteristics of the product: The device needs to survive hits and bumps. It cannot be too large as the user has many other pieces of equipment and machinery in the van as well. All the needed equipment needs to be in one package.

Other representations that define the user or the technology: The device needs to function in wet and dirty environments as well as in extreme cold and heat. The device could be charged from the van cigarette lighter when driving.

Implications for the designer: The main point that the designer needs to take into account when designing for the worker with a van is the robustness. The materials need to be strong enough, and the device cannot have any easily breakable parts, such as knobs. In addition, the designer needs to think how all the needed equipment can be stored together and taken easily from one place to another. Also, testing the durability of the device needs to be well planned.

Where does the representation originate from in the development team? This representation can be observed in different discussions and is based on the project participants' personal contacts and knowledge of the type of work that can be done with their devices.

The DIY person, farmer and oil-rig maintenance worker

We shall discuss three further user representations in a more condensed form, delineating foremost ease of use, durability and safety requirements. The DIY person user representation highlights the importance of ease of use and this is particularly featured in discussions of the user interface type. In addition, it was remarkable for sales and marketing as it presented a new customer type.

This product was the first that was designed to be used in a home environment as the previous products should not be plugged into a normal AC power supply:

> The user groups also include these DIY persons who then use this for their own needs, either for small repair work or for their own building projects or something. (A representative of the sales department)

This then implies different design principles for the user interface:

> So, there're a lot of these farmer and home users and so on. So, in a way for them, they don't necessarily have the understanding of that [the professional user interface and its details]. So, should there be a similar user interface for them, like the ones they are used to using at home, with all the other things that are all digital these days? (From a project meeting)

The farmer representation complements the worker up a mast and the DIY person by designating users who are not professionals in repair activities and who move around over a large area attending to small repairs that need to be done. These can be a broken fence or a farming machine that need repair. This representation brings ease of use and robustness to the development, but it also affects the capacity of the machine:

> So, what type of applications do you need for a maintenance machine? Certainly [X capacity]. But, if you're in an agricultural environment and you've got to repair a large gate or a tractor bucket or something like that, [X capacity is] almost useless in that type of environment. (From a project meeting)

Farmers operate on large areas of land and in an environment that is at times wet, muddy and dirty:

> You [can] imagine just some old guy wearing old boots and arriving with this thing banging around in the back of a truck; next thing … dropping it into a pool of mud in the farmyard when [repairing] a gate. (From a project meeting)

During drier periods, it is hot and dusty, and the surroundings also need to be protected against the heat from the repair work, and thus, a safety blanket to cover the dry surroundings is necessary. When designing for the farmer, the designer underscores ease of use, robustness, ingress protection and air flow inside the device.

The oil platform maintenance worker's representation brings the requirements for fire safety to the product development:

> If you're talking about oil platforms and the roughest [requirements] in that environment, that would then have to be the explosion protection rate. (From a project meeting)

It also raises the issue of water resistance. (Water resistance is also important for, e.g. the repairer in the wilderness, and forestry machinery and shovel operators.)

The users in the oil platform maintenance worker representation might be quite advanced users. They might often do repair activities, as well as other related work. They are unique due to their extreme circumstances as they operate on an oil platform out in the ocean, alone or in teams. The device comes in handy for them as they can easily move around the oil platform with it, which raised the question of how to design for a higher ingress protection level. As mentioned before, the selection of materials affects this but also aspects such as the tightness and fit of all the parts. This is also the only representation that requires an explosion protection classification.

Whilst oil-rig use has been studied and targeted before, DIY users and farming use have not and the representations rest on in-house users' personal knowledge and product managers' discussions with dealers and customers rather than resting on research results.

Competitor products or parallel technologies

As a different type of representation, we chose a competitor product that was already announced when ProjectND started. This affected the product, especially in: the size and weight, the charging system and the operating time of the device. In addition to the competitor product, a product from parallel technologies especially affected the charging options for the device.

The weight issue came up in one project meeting:

> *Marketing director:*
> The whole thing – with cases and everything – the man is carrying is like 12 kilos or something like that? Isn't that quite heavy?
> *Engineer:*
> […] No, it's not …
> *Project manager:*
> Yeah, [the competitor product], the power source itself weighs 11 kilos without—
> *Product manager:*
> The legal limit is 20 …

In another project meeting, the engineers and designers discussed the charging options for the device:

> *Engineer:*
> Yes, should we get the [competitor] machine and take it apart and see what it has [inside]?
> *Project manager:*
> So, they have done – at least, judging by what I looked at on their website – they have demoed it on their webpage and there is– there's a coil in the charging station and a corresponding coil there – there inside the battery. Or in the battery package […]

The competitor device provided certain concrete benchmarks that needed to be exceeded. The main criteria were the duty cycle and charging time. The very technical details have a great effect on the user experience and, therefore, the new device had to exceed or at least match these targets. In addition to these, the weight of the competitor device in particular was set as a limit for the new device. Together these very specific details provided a frame for the physical dimensions of the product.

In sum, the most important representations provided a quite specified image of the users, their backgrounds and usage environments. A number of features and traits could be derived from these representations. In addition to the represented users, the competitor and parallel technologies provided more detailed targets and solutions for the technical specifications. These were actively referred to in the discussions and in project meetings during the development phase, and thus they affected the designs heavily. Yet, as hinted above, it is their combination that reveals how they help the design team to gain direction and focus, and this is where we now turn to in the final analytical section.

What the combination of user representations provides for designers

To delve deeper into the question of how these representations guide the design process, let us depart from the worker-up-the-mast representation which guides the design towards a small and compact device that is easy and comfortable to carry. If the device can be carried up a mast, it can be carried nearly anywhere else as well. The user also needs to be able to operate the device with only one hand while wearing gloves and hanging from the mast. This is a restrictive user representation that cuts off many design avenues and renders many potential target markets secondary.

However, the worker-up-the-mast representation is not very binding from the handling, duty cycle or battery capacity points of view. These aspects are addressed most strictly by the worker-with-a-van representation. It indicates that the device needs to be robust in order to survive the bumpy roads while in the back of the van or pick-up truck, potentially without having been tied down. In addition, it highlights the need to charge the device from the power source available in the van or truck and the need to have a carrying case so that all the additional equipment stays with the device and is potentially given some added protection.

In turn, the oil platform maintenance worker and farmer impose a high ingress protection level that makes the device survive moist and rapidly changing weather conditions. The oil rig also requires an explosion protection classification. The farmer representation adds dusty and muddy environments and adds the importance of ease of use for users not professionally trained in using the device. The DIY person representation underscores this and adds to the requirement for the device to be as maintenance free as possible, as well as pointing to potential new distribution channels.

Furthermore, input from the parallel technologies and competitor devices adds some of the technical specifications, such as the duty cycle, battery capacity, charging time and the charging method. In addition to all these, the company's product portfolio and brand image also guide the design as they provide guidelines in regard to colours and other brand elements. Figure 1 summarizes how the main user representations relate to key product features. As noted above, the interrelation is not mechanistic, but features from competitor products and previous products affected how ProjectND was positioned and hence what could be its target market segments. However, the user representations concretize the features and how to design for them.

Even more important, however, is how the user representations, taken together, delineate the design space, and in doing so, how they can guide design work. Figure 2 elaborates (in the leftmost pane) how the key user representations overlap and broadly map the target user segments. Considering further representations and requirements (in the centre pane) – such as competitor products, parallel technologies, cultural maturity and regulatory demands – intensifies the potential represented use space and design space for ProjectND. As the product cannot accommodate all features, usages and users, the array of representations helps designers to exclude aspects of the product that are secondary for the users or for ProjectND, or those that are already the strongholds of earlier or competing products (the grey areas in the figure represent the excluded aspects).

This array of key- and supporting-user representations thus delineates the design space where the product needs to operate and also renders more explicit the aspects and selling points the design targets in different target markets. Having been constructed on the basis of the company's and its designers' long experience in this industry and the accumulated stock of user studies and tests, the array of user representations further helps to explicate which target users, user environments, usage patterns and secondary users are most relevant for the design. In so doing, it renders more manageable the potentially daunting variety and complexity which this globally sold device could face and explicates design constraints, as well as clarifies the conditions against which testing of the product is to take place.

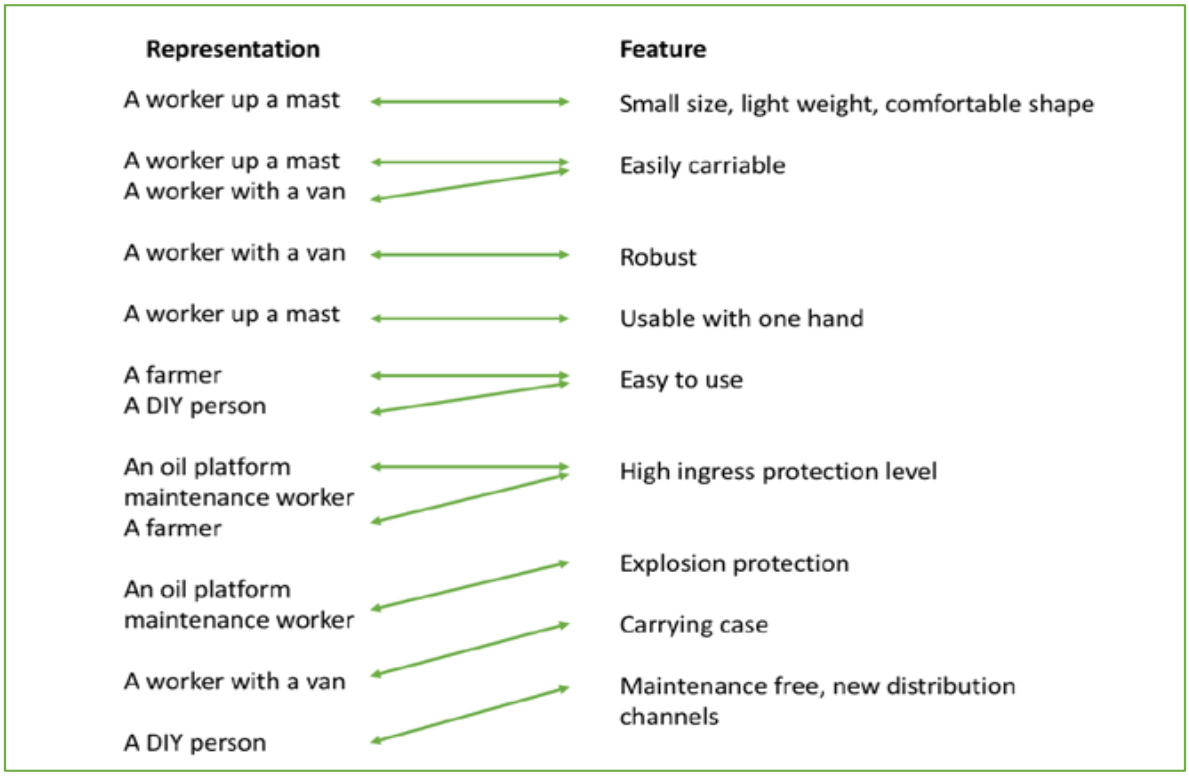

Figure 1. Interrelations between key user representations and product features.

Figure 2. Complementary user representations explicate the space for the product and its usages, help order the various demands of the product and close off potential but secondary characteristics and usages (simplified image).

The delineation of the design space does not, however, result in some miraculously unambiguous specifications for the device. Figure 2's rightmost pane draws attention to how the needs of the key represented user groups are not met in full but rather the product is targeted to work sufficiently for each group, whilst each group elaborates the most demanding aspects for a feature of the device. This allows user representations to act as checks and balances to each other in design considerations, as they do in the below example about the user interface controls and display:

> *In-house user:*
> If we think how the factory service man would use the machine, he would take the [size 1 tool]. He has the [tool package] with him. […] He knows from before what the right setting is for that [tooling], so he simply sets the power to that. If it doesn't work, he adds more.
> *Marketing director:*
> But hey, what you have there is service men and other semi-professionals that are only one target group to whom these would be sold. There are the farmer and home users and so on. And they do not have that understanding you describe. So, would they need a similar user interface to that which they are used to at home? Where all things are digital nowadays?
> *Engineer:*
> No, I would say that for them the display is even less [desirable]. That–
> *Marketing director:*
> Or only one knob? One knob at this end.
> *Engineer:*
> –just like those on coffee makers and toasters, which people are used to. You turn a knob that has numbers. And I think it seems more reliable; it creates more confidence.

Towards the end of this excerpt we see another key pattern that takes place in design discussions in ProjectND time and again, namely, how the eventual user representations blend with specific usage representations when it comes to solution ideas. Here the usage representations are from the operating conventions of devices present in the context of use, in this case, the factory and home. This is a source of user representation that has been previously aptly described as *artefact genres* within the broader category of cultural maturation (Williams et al., 2005; Johnson, 2013; Löwgren and Stolterman, 2004; Hyysalo et al., 2016). The implicated usages and contexts of use in key user representations (see and Figure 2) in a sense feed forward the search for specific representations that could provide eventual design solutions. Here the differences between usage patterns by professionals and by amateurs, and correspondingly the artefact genres suited for approximating what kind the suited design solution might eventually be were anchored by the explicated user representations – the marketing director here using one of the key user representations to prevent the in-house user from proceeding from only profes-

sional or semi-professional usage pattern point of view.

Neither does the arraying of user representations remove difficulties in managing the difficult trade-off decisions as they guidepost the path the design should take. The potentially most difficult trade-off regarding ProjectND concerned the duty cycle, so let us examine how user representations featured in decisions regarding it. Let us first rewind to a project kick-off meeting:

Designer:
I find it most important to find the right question to answer. That is, what the worker needs if we are designing a battery powered device … batteries make mobile [work] activity possible. Then, if we bring a car-size battery machine, it is not very portable anymore.
Engineer:
Yes, we need to keep that clearly in mind. What our competitor has forgotten is that mobility is exactly what batteries provide … and they have done a [heavy] battery machine but not at all used the greatest strengths it could have.

And then we fast forward to situation much later when the duty cycle limitations and product heating limitations begin to become revealed to the design team:

Product manager:
But [this product design] is so unusual in terms of [this line of] product that it makes it extremely interesting: what it is and why it's like that. But, many think: 'OK, [size 1 tooling]'s not too bad in terms of battery capacity'. But then the duty cycle is cripplingly low.
Designer:
What it should be? If we think of the markets, what kind of work [do the users need to do]?
Product manager:
I see this being used. It's very much a maintenance machine. That's what it's going to be used for. So, what type of applications do you need for a maintenance machine? Certainly [size 2 tooling] would be used. But, if you're in an agricultural environment and you've got to repair a large gate or a tractor bucket or something like that, [size 2 tooling] is almost useless in that type of environment. So, if you want to do some hard servicing or you want to do a repair [...] then, for example, the other day, up at the golf range, no balls came out of the machine because the tractor was broken down. The bit of the machine that picks the balls up from the golf range […] had broken. Typically, this is the type of machine that you'd have […]. And probably, in that situation, [size 1] capacity would probably get you out of trouble.
Designer:
With one or two [tooling sets deployed]?
Product manager:
With one. And then you haven't got to have a power generator: you haven't got to have ... You [just] take this [machine] anywhere with you, and bingo! There is your solution. But I'm thinking that in an agricultural environment, the capacity is a little bit on the light side. And I see the ...
Designer:
And you always have a water bucket [to cool the device].
Product manager:
But then you always have … But you just need to make sure it's close by. But then you maybe have the capacity, if you have the capacity for one [size 2 tooling].
Engineer:
Sounds a little …
Product manager 2:
Also, there are some applications in the industry for example where you need to [work similarly]. Let's say you are installing some water pipeline, and there're some supports.
Product manager:
Ventilation.
Product manager 2:
Whatever ...
Product manager:
Hanging brackets.
…
Designer:
One session, one … attachment or whatever. And (when) they move and move all the stuff and go ...
Engineer:
This [duty cycle] is enough.

Here we see how the demand for portability, underscored by the key user representations, eventually trumps over the received wisdom in

the industry regarding what is a plausible duty cycle for a device and leads to relabelling ProjectND as designing a 'maintenance machine' that only needs a fraction of the capacity of a machine that could be used in 'production' of any kind. This characterization of the product is then considered against the implications arising to it from two central user representations: farmer, DIY person and industrial maintenance person (implied by man in the mast). This decision is one of the most differentiating decisions taken by the design team in contrast to competitor solutions, and in this example we see how well-articulated user representations can occasionally go as far as to settle a key design decision.

Noting this, we want to underscore that many tensions and uncertainties about design remain regardless of how well articulated user representations may be – their capacity should perhaps be best seen as one of guideposting issues of the desirability and customer value amidst for instances technical and business considerations.

Discussion and conclusions

In the course of this article we have analysed a case where none of the project's user representations were derived from a first-hand user study or user collaboration designated for this new-to-the-world device. Instead, the user representations originated from and were refined on the basis of accumulated information in the company and on the basis of the experience of in-house users and designers. The user representations could not be tested with prospective external users prior to market launch either. The designers were thus left to deal with the designing of usage only by indirect means, and they constructed a small array of user representations to help them do so. This allows us to make two sets of inferences about what user representations provide for designers that are at once anchored in the case project and also have wider implications to designing usage more generally.

Firstly, it may initially seem that the trade secrecy in the ProjectND resulted from a kind of representational practice that was targeted at the early critique of user representation that replaces real users with developers' imagination of them (see, e.g. Akrich, 1992, 1995; Oudshoorn et al., 2004). Yet, what these user representations did in the design process was exactly what the early critique hoped technology developers would do, that is, it systematically countered casting the user as 'everybody' or conjuring the images of users from designers' poorly scrutinized imaginations (Akrich, 1992; Oudshoorn et al., 2004). ProjectND's array of user representations was developed on the basis of a wealth of earlier direct engagements with users and it was used by designers in order to focus and justify a finite set of the target groups, their work practices and the usages to which they would put the device, leading to designing a novel 'repair' machine rather than a 'production' machine. We are thus inclined to join Johnson (2007) and Mäkinen et al. (2019) who insisted that it is not user research or user collaboration in design that renders design work accountable but the nature of representational practice regarding the prospective users and usages. As was the case with the company studied by Johnson (2007, 2013), the user representations in ProjectND and CompanyIM were the result of many years of studying users and communicating with the users and customers. Indeed, there appears to be a practical application for human-centred design visible in the analysis: pursuing user representation carefully can be seen as an effective *alternative* strategy to first-hand study and engagement with users in cases in which there are sufficient organizational and professional starting points to build deeply considered representations of prospective users. The real difference is thus based on the grounding and carefulness of the knowledge that goes into building user representations and the carefulness with which this is done, not on whether or not there has been direct contact with users.

This leads to our second point, which is what user representations can do in design depends on the effort that has gone into constructing them. It was the designers' capacity to compile and arrange the accumulated user information that allowed them to produce in-depth notions of the users and their usage environments. Our study supports the now many studies that show that most present-day companies are not lacking information on users – as was implied in the early sociology of user representation – but operate with many user

representations derived from several formal and informal directions (for similar findings on the multiplicity of user representations, see Kotro, 2005; Williams et al., 2005; Wilkie, 2010; Johnson, 2007, 2013; Mozaffar, 2016; Benker, 2019). The array of user representations in ProjectND helped them to keep the differences and similarities of prospective users at the forefront in the project's discussions and to directly affect several requirements for the product's technical specifications and features. User representations were also contrasted with other design representations (of competitors, of parallel technologies, of viability and of markets) in the development of technical solutions and in the specification of the device's requirements. In this capacity, user representations act as safeguards against falling short of user needs and desires because of technical conveniences or economic prospects (Hyysalo, 2010).

To conclude, product development can be done without contact to prospective users and can be based on user representations and still retain the accountability associated with human-centred design. However, this requires careful anchoring of the user representations to the previously cumulated information on users and usages and their reflexive use as a guiding design resource. The sociology of user representation continues to be a vital and practically relevant strand of study in the intersecting areas between S&TS, design research, human–computer interaction and information systems and one that continues to provide relevant new insights despite what is soon 30 years of work in the area. The actual sources of user knowledge and particularly the variety of accountable representational practice are wider than could be anticipated in earlier academic literature. There remains ample room for further research on detailed studies of the practices of user representation as well as attempts to grasp the overall contours of how users are represented in different development contexts. Particularly interesting would be studies that would examine in-detail the situations where trade-offs or other mutually exclusive design choices are made between valid but mutually conflicting user representations.

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Notes

1 The original data is in Finnish, a Fenno-Ugric language. It does not translate into English anywhere near as neatly as an Indo-European language (particularly in its spoken form), the translations of which readers may be accustomed to, based on having read translations from other Indo-European languages into English. We have sought to foremost retain meaning in the translation but also seek to retain the form of expression whenever we can, yet this results in a some 'imperfect English' that does not pretend to be transliterated to English and has to be accompanied with somewhat more clarificatory detail, provided in square brackets, when compared to translations of Indo-European languages into English.

Mapping Case Studies of Public Engagement and Participation in Science and Technology

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Abstract

In recent years, increasing criticism has been levelled against case study based research on public engagement and participation in science and technology (PEST). Most critics argue that such case studies are highly contextual and fail to provide global, holistic and systemic views of public engagement phenomena. In this study, we mapped the case study literature on PEST by identifying a robust sample of articles, and analysed it looking for emerging patterns that could provide empirical evidence for new frameworks of public engagement design and analysis. Results show that the case study based literature on PEST continues to grow, although concentrated in a few countries and knowledge domains. The trends that emerged from the sample reveal high centralisation and planning and suggest that deficit science communication models are still common. We argue that future frameworks may focus on decentralising hierarchical power and dependency relationships between agents.

Keywords: case study research, public engagement, public participation, science and technology, knowledge mapping, science communication

Introduction

The case study literature on public engagement and participation in science and technology (PEST) has recently become a subject of increasing criticism. In general terms, most critiques argue that case studies only produce micro-level insights and fail to provide global, systemic or holistic views of participatory phenomena (Braun and Könninger, 2018). The body of literature that is being criticized emerged in the early 2000s under the name of the 'participatory turn' (Cass,

2006; Jasanoff, 2003), which called for greater involvement of the public in science and technology governance and decision-making in response to the flaws of the then widespread deficit model of science communication.

The deficit model had greater prominence between the 1960s and the 1990s, and aimed to quantify and improve the public's scientific literacy. It can be defined as top-down "one-way communication from experts with knowledge to publics without it" (Trench, 2008: 119). Experts are not only scientists but also policy makers, science managers and science communicators who plan and provide the means to inform and educate the public in a one-way top-down manner. But this model began to be questioned by scholars who argue that science has deeper political, economic and regulatory implications, and that the public's views should be incorporated into decision-making processes. This critical perspective proposing a participatory model is also known as contextualism (Sturgis and Allum, 2004). From this perspective, a consensus emerged that 'public engagement with science and technology' refers to practices involving lay people, scientists, policy makers and a variety of other social actors interacting with each other to integrate a wider range of views on science governance (Rowe and Frewer, 2004).

The theoretical paradigm shift from the deficit model to the participatory models also implied methodological changes in public engagement studies, from survey-based quantitative measurements to qualitative methods that would capture the social context of participation (Wynne, 1992). Since then, case study research followed by critical assessment has become the most widely applied practice in PEST studies (Irwin et al., 2013; Sturgis and Allum, 2004).

Case studies of public engagement provide contextual results based on specific details. Bensaude-Vincent (2014) suggests that from a linguistic perspective, 'public engagement' is a buzzword coming from official science policy bodies, and therefore the operationalisation of the concept in different social settings may explain some discrepancies between the signifier and the signified. In a cross-analysis of the UK and the US, Jasanoff (2005a) argues that all publics are different in that they are motivated by culturally determined 'civic epistemologies' and each democratic structure generates specific engagement strategies (Jasanoff, 2005b). Similarly, Nowotny (2014) suggests that publics are defined by political and cultural collective imaginaries that largely emerge from the interaction of citizens with the new media. Other studies focused on publics' attitudes towards science (Allum et al., 2008; Callon, 1999; Castell et al., 2014) support the idea that different social contexts produce different outcomes in participatory processes.

In other words, the interaction between agents involved in participatory processes, as well as the outcome of each case, is significantly determined by cultural, social, political and scientific factors that may vary from region to region. In this sense, multiple models of participation and engagement processes arise as a response to different patterns of social activity. However, this trend brings other problems. Irwin et al. (2013) point out that case studies and critical assessments frustrate policy makers as they are always in the critical eye of social scientists; and Stilgoe et al. (2014: 6) go further by proposing that the literature may be turning into a never-ending "litany of engagement case studies and evaluations" in need of new research strategies that point to the "broader project of dialogic governance". Braun and Könninger (2018) suggest that researchers' focus may shift from the evaluation of isolated case studies towards a wider inquiry that includes a large share of contextual forms of engagement. However, these claims are conjectural and lack empirical evidence.

Aligned with this wave of critical views is the growing idea of a 'systemic turn' emerging in deliberative democracy studies (Curato and Böker, 2016; Ercan et al., 2017; Owen and Smith, 2015) and studies of participation in socio-technical change (Chilvers et al., 2018; Macnaghten and Chilvers, 2014) that investigate how participation interconnects in wider systems. Despite criticism to case study research, we believe that case studies still bring in-depth and detailed information of the subjects under study, but on the other hand we acknowledge the potential rewards of a systemic view of participatory phenomena.

In our study we create a map of the case study literature of PEST and draw systemic patterns from it. Analysis of systemic patterns deliver key map features and provides strong evidence of shared practices across isolated cases, regardless of their context. In this sense, this research provides empirical evidence for the design of general frameworks and may guide future case studies. The analysis used a set of articles published in the international indexed literature, which were analysed in three stages using different methodologies from scientometric studies focused on disciplinary-based or theme-based mapping analyses (e.g. Zheng et al., 2015). First, descriptive statistics and trend analysis were implemented to show the country distribution of the production of PEST literature based on case studies. Second, cross-country network analysis of the sample was conducted to identify and analyse the main academic communities involved in the PEST literature using case studies. Third, using text-mining tools and text analysis strategies, we sought evidence of common language patterns throughout the sample, and also within each academic community. From the combination of these methods, we not only deliver a broad understanding from isolated contextual and expectedly unrelated case studies, but also outline the landscape of the public engagement and participation case study literature, which may serve as a tool for future studies.

Data and Methods

Data

This study draws on the Scopus database, one of the largest abstract and citation indices of international peer-reviewed research literature, frequently used in studies focused on mapping thematic areas and fields of knowledge (Vega-Almeida et al., 2018). Scopus was chosen as the literature index platform for this analysis for a number of reasons. Compared with other indexing platforms such as Clarivate Web of Science, Scopus has better coverage of publications in the social sciences and health sciences, and also of journals covering multidisciplinary and emergent research approaches, such as the ones covered by the present study (Mongeon and Paul-Hus, 2016). Additionally, although the high correlation of Scopus and Web of Science data makes either an acceptable choice in principle (Archambault et al., 2009), studies have shown that Scopus has fewer inconsistencies and errors than other publication indexing platforms, indicating that Scopus yields more reliable findings (Adriaanse and Rensleigh, 2013).

The data were extracted in July 2018 and further verified at later dates for the sake of reliability and consistency. We selected all articles published from 2002 to 2017 that were returned after a Boolean search of the words or a combination of the words 'public engagement' or 'public participation', and 'case study' or 'case studies' in the title, abstracts, and keywords. This permitted the identification of publications focused on public engagement and/or participation in science and technology that used 'case studies' as the main or one of the core methodologies of analysis, consonant with the purpose of the research question in this study. The decision to set the extraction from 2002 was based on the shift identified in the scientific and research environment that called for a new relationship between science and society (Chopyak and Levesque, 2002) and which became known as the 'participatory turn'(Jasanoff, 2003). The 2017 end date coincides with the rise of criticism aimed at the participatory model and mostly with the emergence of a wave of articles that discuss the beginning of a 'systemic turn' in public participation. This exercise led to the identification of 855 articles. To avoid duplicated publications and ensure that the publications under analysis were relevant to our study purpose, all of the publications were read by the authors, which led to 437 publications being filtered out. This was in accordance with best practice in this type of analysis for ensuring the validity and reliability of the sample (Horta and Jung, 2014). The final sample of publications was composed of 418 articles from the PEST literature published between 2002 and 2017 that included case studies.

Methods

The analysis of the data involved three complementary methodologies that provided a comprehensive analysis and mapping of knowledge on

the topic of public participation in science and technology, based on publications. These were as follows: descriptive statistics and trend analysis, network analysis, and text analysis.

Descriptive statistics and trend analysis

The analysis of the 418 articles commenced with a presentation of the sample's descriptive statistics, followed by a trend analysis. The purpose was to give a general characterisation and mapping of the topic from both static and dynamic perspectives (e.g. Boyack et al., 2007). The static perspective served to identify the countries and authors that produced the greatest number of publications on the topic, while the coverage of journals and fields of knowledge indicated the extent to which the broad theme of publications on public engagement in science and technology was concentrated or dispersed among journals and fields of knowledge. The dynamic perspective enabled the same type of analysis but in an evolutive way, so that the mapping of the theme could be understood in a temporal dimension. As has been done in other scientometrics studies (see Horta, 2018) the dynamic perspective was provided on a quinquennial basis (5-year periods) to mitigate yearly or short-term fluctuations, thus preserving the analytical value of the general trend without adversely affecting it.

Network analysis

The publications and their relevant metadata were converted into a country-based nodes and edges dataset using the Table2Net tool. The resulting dataset contained 57 nodes linked by 131 edges, in which a node represented a country and an edge represented a collaborative venture between two countries. This allowed the dataset to be imported into Gephi, a social network analysis software package, whose use is increasingly common in bibliometric studies to analyse co-author and co-citation networks (Horta and Jung, 2014). On the Gephi working platform, the Giant Component filter was applied to the network to filter out isolated nodes that were not part of the main structure. This reduced the number of visible nodes to 42 and edges to 130. Then, we used Gephi's clustering/community algorithm based on the Louvain method to identify collaborative communities within the sample. This algorithm permits the identification of communities as sets of interconnected modes though a three-stage modularization process that is recognized for its high optimization accuracy (Blondel et al., 2008). In addition, network centrality measures were computed namely, average degree and betweenness centrality to identify the countries with the greatest influence and impact on the network.

Text analysis

The aim of the text analysis was to find linguistic patterns within the sample. To that end, we sought to emulate the network in sets of articles representing its entirety, as well as the identified collaboration communities. Through this exercise, our intention was to perceive the main discursive trends of case studies on public participation in science and technology, and also to examine any significant discursive variations between communities. First, the articles corresponding to the isolated countries were removed from the sample with the Giant Component filter in the network analysis, leaving 379 articles that were uploaded to the Nvivo text analysis tool.

Each article was assigned one or more countries, according to the authors' affiliations. Then, the text of each article was coded, generally starting at the beginning of the introduction section and ending at the end of the conclusion; that is, the abstract, keywords and the list of bibliographic references were all excluded from the coding, as these parts of an article, having different objectives, show different linguistic traits that could interfere with the results (Loureiro and Conceição, 2019; Samraj, 2005). Non-scientific content, such as declarations of interests and acknowledgments, was not coded.

After the coding process, stemmed words such as 'environment', 'environments', 'environmental' and 'environmentally' were clustered into the same group of meaning. Additionally, some words were removed for the word frequency analysis according to the following criteria: (1) expected buzzwords, such as the terms of the sample definition, e.g. 'public', 'participation', 'engagement', 'case' and 'study'; (2) words from which it is not possible to derive special contextual meaning, such as 'make', 'use', 'also'; and (3) stopwords, such as 'or', 'then', 'of', 'and', 'if', which were removed automatically by the software. The elimination of these

words aimed at decreasing the residual effect of any result extracted from the sample.

Different techniques of text analysis were implemented: word frequency ranking, which lists the most frequent words or concepts within the coded text; comparative analysis of word frequency ranks in the different subsets of the sample, looking for language variations between them; and collocation analysis, which correlates the use of two or more words within the sample. Furthermore, semantic categorisation and analysis were implemented to enable the results to be read in the context of the debate on public engagement and participation in science and technology.

Results and Discussion

Geographic distribution

Statistical analysis of the bibliometric data of the sample showed that productivity in this area was increasing, particularly in Europe, North America and Asia since 2014 (Figure 1). The geographic distribution of the publications, based on total counts of the authors' country affiliations (548), demonstrated that the concentration was mainly in Europe (278) and in North America (135), followed by Asia (68), Oceania (44), South and Central America (12) and Africa (11). Notably, the knowledge produced on the topic seemed to be increasingly driven by Europe-affiliated researchers, which in the last quinquennium produced almost half of the total of publications on PEST that used case studies as their main or one of their core methodologies (48%). However, the regions of the world with the highest compound annual growth rates in the time period under analysis were Oceania and Asia, both starting with very low output values. Europe's compound growth rate was higher than that of North America. African and South and Central America production on this theme was residual. Their production in the last quinquennium represented less than half and around one third of the production in North America and Europe, respectively, in the initial quinquennium. These findings are in alignment with regional shares of global knowledge output (King, 2004).

From a country aggregate perspective, there was a high concentration of publications in English native-speaking countries such as the UK (90) and the USA (86), followed by Canada (49) and Australia (41). These countries have scientific prominence worldwide as major producers of knowledge; they also have large populations

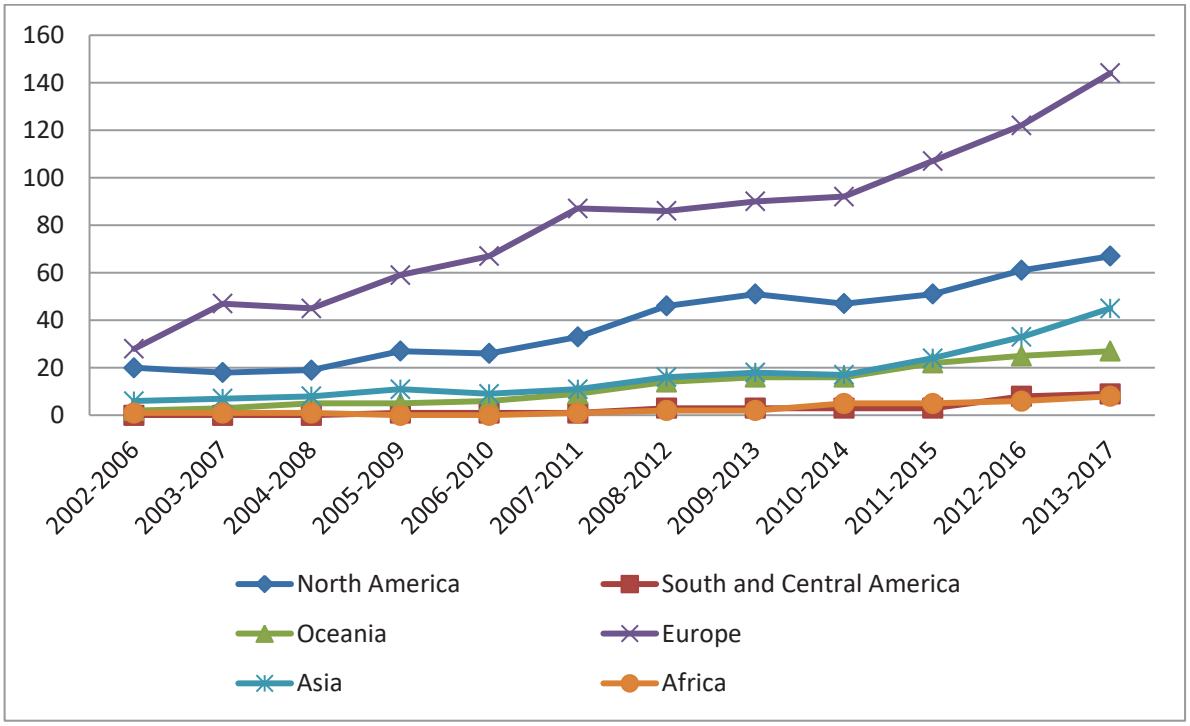

Figure 1. Evolution of publications on the topic of public participation and engagement in science and technology.

and strong economies. Still, in the range of 10 to 30 publications produced during the timeframe under analysis, other countries and jurisdictions such as the Netherlands (29), Italy (19), China (18), Germany (17), Denmark (16), Portugal (13), Sweden (13), Switzerland (12), Hong Kong (10) and Spain (10), also had a significant role. The countries above accounted for 77% of the literature produced. All the remaining publications were scattered across 43 countries.

The greater concentration of publications in native English-speaking countries, particularly in the UK and USA, may be initially explained by the fact that these countries are leaders in the publication of academic documents in the social sciences (Mosbah-Natanson and Gingras, 2014). Although the overall production of social sciences in the US is larger than that in the UK, our sample showed that the UK had about the same productivity as the USA in the PEST literature using case studies. This high productivity in the UK may also be related to the incentives that science funding agencies have given research institutions in recent years to capture the impact of science through case studies, as described by Van Noorden (2015). This is also aligned with the fact that since 1985 the Royal Society has taken a clear position to encourage the engagement of science with society (Royal Society, 1985), which gave rise to the academic movement known as 'The Public Understanding of science' (Miller, 1992; Thomas and Durant, 1987). Furthermore, as a member state of the European Union, the UK was subject to the European science funding framework calling for science and innovation to address the values, needs and expectations of society through multi-stakeholder and public engagement (European Commission, 2014; Owen et al., 2012). On the other hand, the lower relative productivity of the USA, when compared to the UK, may be due to the fact that the rules and incentives created to bring science and society together, such as the Broder Impacts programme of the National Science Foundation (which was roughly adopted by other funding institutions like the National Institutes of Health, and the Bill & Melinda Gates Foundation, using social impact criteria in the evaluation of research projects funding proposals), encountered internal resistance (Holbrook, 2005). Furthermore, they also seem to have a discourse more oriented towards the benefit of science, technology, engineering and mathematics, while societal benefit is considered as a natural consequence of the programme rather than a goal (Davis and Laas, 2014).

The idea that some countries are more prone to studying participatory phenomena than others, and that the geographic distribution of publications does not depend exclusively on the total volume of academic output, was underlined by some concentration of this production in less well-ranked countries, such as Denmark and Portugal. Taking the latter country as an example, the national strategy for science that has been implemented since the mid-1990s, based on the renewal of science education, the fostering of scientific culture and the opening of science to society (Gago, 1990, 1991) may well explain the results obtained by our study. The reverse was also true, as some well-ranked countries had very few publications on the topic, such as Japan, India and the Russian Federation. This raises questions about the reasons for the lack of interest in PEST studies in some developed countries. Our intuition leads us to hypothesize that general interest in PEST may be related to civic engagement rates of each country. We compared our results with two civic engagement indexes and found some correlation between interest in the topic and civic engagement rates: Japan, India and the Russian Federation show low rates of civic engagement, but the UK, USA, Australia and the Netherlands, consistently have high rates. But if it is true that civic engagement rates may be related to interest (or lack of interest) in PEST, it also seems to be true that public policies and national long-term strategies may contribute to invert this trend. Again, the case of Portugal is of interest: despite having low rates of civic engagement, the country shows a relatively high concentration of publications of PEST case studies, which may reveal that long-term open science strategies and policies may be a generator of national differences and have a potential impact on academic output. In sum, it seems evident that each country has a specific proclivity to address (or not) case studies of public engagement and participation in science and technology, but the reasons for each one

remain to be determined and should be studied individually in more depth.

Country based network

A social network was created to map and visualise the structure of international collaboration (i.e., co-authorship) between countries within the sample. The aim was to identify local and global patterns of activity in the form of communities, as well as to locate the most influential countries in the network. We began by computing the modularity of the network with a resolution limit adjusted to 1.2. Modularity is primarily used to reduce the complexity of a network by dividing it into communities. It is represented on a scale between -1 and 1, and measures the density of links within communities as opposed to links between communities (Blondel et al., 2008). Positive values suggest the presence of community structures (Newman, 2006) and values higher than 0.3 are clear indicators of community within the network (Fortunato and Barthélemy, 2007: 37). The resolution limits of modularity determine the level of detail of the communities; that is, lower resolution values tend to identify a greater number of small communities, and higher resolution values identify fewer but larger communities. The resolution limit was set to 1.2 so that the resulting communities would present a clear modularity value above 0.3.

The results yielded three distinct communities with a modularity value of 0.424. The nodes were colour-coded to visually identify each community (Figure 2). The analysis proceeded with social network statistics. First, we computed the average degree, which represents the average number of edges connected to each node. This returned a value of 3.095 indicating that each country was on average connected to approximately three other countries. In Figure 2, the size of the nodes is defined according to the average degree of each country, where larger nodes represent countries with more international connections. In this figure, the dominance of native English-speaking countries is conspicuous. Next, we calculated betweenness centrality (Brandes, 2001), which is measured by the number of times a node is located in the shortest path between two nodes. High betweenness indicates the most central and

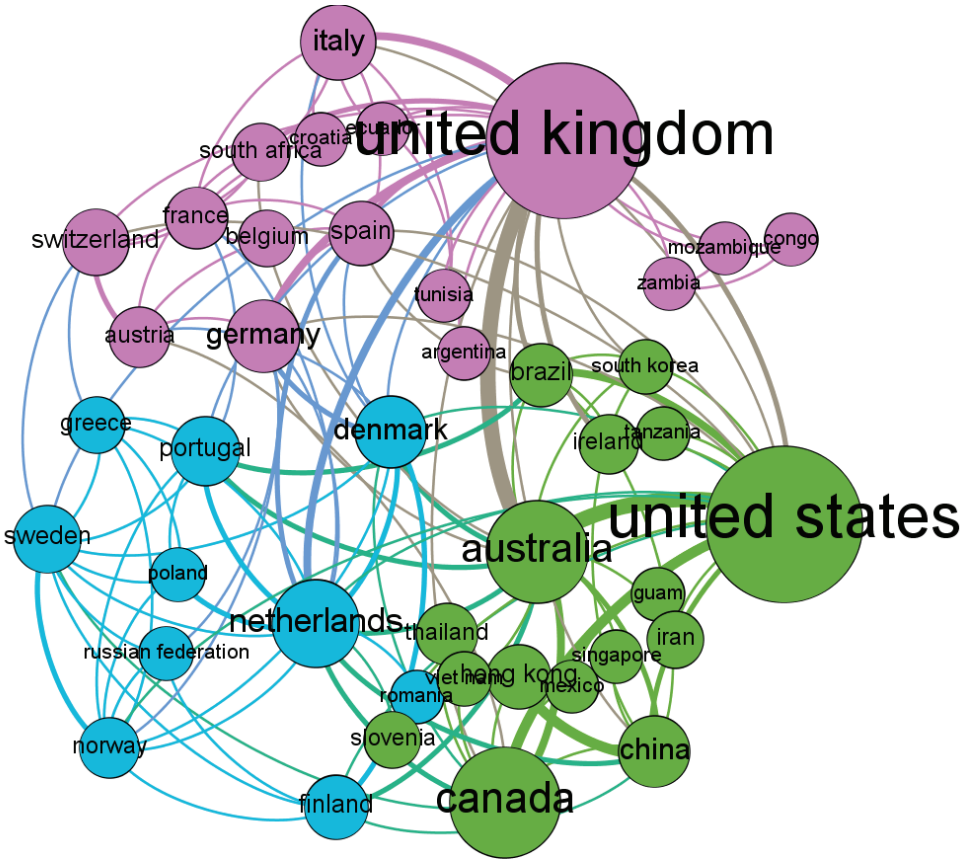

Figure 2. Co-authorship community clustering and networking of countries.

influential nodes in the network. The countries with the highest betweenness centrality values were the UK (274.6), the USA (183.8) and the Netherlands (104.6). Each of these countries was also the most central in each one of the identified communities.

The purple community gravitated around the UK and was mostly composed of European countries, namely Italy, Germany, Switzerland, Spain, Belgium, Austria, France and Croatia. In this community, although with less influence, were African countries such as South Africa, Tunisia, Zambia, Mozambique and Congo, but also Argentina and Ecuador from South and Central America. In the green community, set around the USA, Australia and Canada also stood out, with high average degrees. Out of the three communities identified in the sample, this one stood out for greater range and global distribution in that all of the continents were represented, with particular emphasis on the number of Asian countries and jurisdictions such as Thailand, Vietnam, South Korea, China, Hong Kong, Singapore and Iran. From Europe were Slovenia and Ireland, from South and Central America were Brazil and Mexico, and from Africa was Tanzania. The blue community was centred on the Netherlands and was composed entirely of European countries, namely Denmark, Portugal, Sweden, Finland, Norway, Greece, Romania, Poland and the Russian Federation.

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The causes underlying the formation of these country clusters are not explicit in these measurements and can be multiple, from researchers' affinity for specific phenomena in the form of pre-existing research networks to the impact of academic mobility protocols signed between countries or research institutions that may contribute to the arrangement of collaborations among authors (Bhattacharya et al., 2015; Patrício et al., 2018). For the purple and green community clusters, formed around the UK and the US respectively, path dependence seems to be a highly plausible cause, as both the UK and the US are pioneers in engaging the public in science policy. Historically, the relationship between science and the public has been deeply rooted within these countries' democratic cultures, notably through the endeavours of the Royal Society in the UK and both the American Association for the Advancement of Science and the National Science Foundation in the US. These institutions, among others, have been recognized over time for advocating and implementing broader processes for integrating society into science such as: funding research in the fields of science and society; developing studies on the public's ability to understand science and participate in science policy and decision making; and creating modern, interactive and educational science museums in which the public shifts from mere spectators to active participants, see e.g. (Besley et al., 2013; Haberer, 1983; Miller, 1992; Rennie and McClafferty, 1996; Royal Society, 1985; Thomas and Durant, 1987). The blue community revolved around the Netherlands, as the most influential country with the highest betweenness centrality values. Along with the UK, the Netherlands is a leading country in Europe in terms of promoting public engagement with science; this is where the concept of Responsible Research and Innovation emerged in the 2000s (Rip, 2014; Stahl, 2013). Responsible Research and Innovation was later implemented in 2014

Table 1. Journals with the highest number of publications on the topic of public participation and engagement in science and technology.

Journal	No. of publications
Journal of Environmental Planning and Management	11
Land Use Policy	10
Public Understanding of Science	10
Local Environment	9
Ecology and Society	7
Energy Policy	7
Environmental Management	7
Journal of Environmental Assessment Policy and Management	6
Journal of Environmental Management	6
Journal of Science Communication	6
Society and Natural Resources	6
Environmental Impact Assessment Review	6
Environmental Science and Policy	5
Journal of the American Water Resources Association	5

as a science-funding framework of the European Union, calling for broader public involvement in science. This may well explain the fact that this community consists of European countries only.

Journals and research fields

All 418 articles were distributed among 249 journals, of which 185 journals had one single publication, and only 14 journals had 5 or more publications referring to the PEST literature using case studies (Table 1). This indicates a very low concentration of publications (with an approximate average of 1.6 articles per journal), compared, for example, with publications on industrial wastewater research (Zheng et al., 2015). The small concentration in few journals can be interpreted as a sign of an emerging topic in the academic literature, but may also indicate a topic that is multidisciplinary and of interest to researchers from different fields of knowledge, similar to the case of higher education studies (Horta and Jung, 2014). It seems likely that the explanation encompasses both rationales simultaneously, because some of the journals that publish most on the topic are devoted, to a large extent, to the study of the social phenomena of public engagement with science and technology, such as Public Understanding of Science and the Journal of Science Communication, while others are dedicated to varied fields of knowledge with high levels of public interest and, therefore, participation.

The scattered distribution of the articles across many journals was not matched by a scattered distribution across fields of knowledge, as one might intuitively expect.[1] Bibliometric data showed that the social sciences and the environmental sciences were the most significant fields of knowledge in the sample, with 241 and 238 publications respectively (Table 2). It was unsurprising to find the social sciences at the top of the fields list, partly because of the social nature of public engagement and participation processes, but also because case studies are research methods specially applied by social scientists (Yin, 2014) but iterative process." This statement is supported by a visual which is displayed on the first page of each chapter. Each chapter contains one step in the linear process of case design (planning, designing, preparing, collecting, analyzing, and sharing. The expectation that the environmental sciences would assume a prominent place in the fields list was also met. It stresses the growing inter and multidisciplinary focus of environmental research as it faces complex challenges that derive from human behaviour and interactions with the natural environment (Virapongse et al., 2016).

Table 2. Distribution of journals with publications on the topic of public participation and engagement in science and technology by field of knowledge.

Journal Field of Knowledge	No. of publications
Social Sciences	241
Environmental Science	238
Agricultural and Biological Sciences	60
Engineering	37
Earth and Planetary Sciences	35
Business, Management and Accounting	30
Energy	30
Medicine	30
Arts and Humanities	29

Most prolific authors

The figures for the authors of the publications also pointed to a disparity in terms of the authors' participation in the topic using case studies, with only a few dedicated to the topic and publishing frequently and consistently. Of the 1064 authors identified in the sample, 974 had published only one article; 69 authors had published two articles; 15 authors had published 3 articles; 3 authors had published 4 articles; and 3 authors had published 5 articles (Table 3). This appears to indicate that the use of case studies tends to be an occasional methodological tool to observe and better understand PEST phenomena. Again, as in the analysis described in the previous section, this suggests an emerging topic in the literature, insofar as research topics often emerge in the social sciences first by the arrival of a large number of case studies, which have a strongly rooted exploratory nature, and are later consolidated into further theoretical foundations and the application of more confirmatory methodologies (Hyett et al., 2014).

Another relevant fact pointing to the emergence of a combination of theme and method is that for all but 1 of the 20 authors, the publications were just a small part of each author's research profile (usually representing around 1 to 10% of their total publications). Exceptions included Carmel Anderson, whose career publications all focused on case studies on PEST-related issues, and Chutarat Chompunth, for whom case studies represented 33% of her total publications. This again points to an opportunistic dedication to the topic using case studies, or an interest that is evident but merely part of broader themes and issues rather than a core interest.

As expected, the most prolific authors were based in countries that had the largest production of publications identified in previous sections. However, it was interesting to find in the top five an author based in Thailand, and in the top 10, an author based in Hong Kong. There was also a somewhat surprising lack of prolific authors based in the Netherlands, China, Portugal, Switzerland and Spain, suggesting that the contribution of these countries to this combination of topic and methods is produced by different scholars, not led by a single scholar or group of scholars in particular. A further note of interest is that Australia had the most prolific author (Greg Gordon Brown) and was the only country with three authors in the top 10 for prolificacy. Finally, the profile of the authors was strongly multidisciplinary, with most of the main fields of publication concentrated in the environmental sciences and social sciences.

Discursive patterns

To better understand the research produced by those case studies on PEST (and possibly identify commonalities or common patterns between communities), we conducted textual analysis to shed light on what has been said in the literature about case studies of public engagement and participation in science and technology. A second purpose was to better understand what was similar and dissimilar in terms of focus and content among the communities identified by

Table 3. Most prolific authors on the topic of public participation and engagement in science and technology by field of knowledge (with at least three publications during the period 2002-2017).

Author	No. of publications (case studies/topic)	Total publications	Affiliation	Main fields of publications
Brown G.	5	110	University of Queensland, Brisbane, Australia	Environmental Sciences, Social Sciences, Agricultural and Biological Sciences
Newig J.	5	67	Leuphana Universität Lüneburg, Luneburg, Germany	Environmental Sciences, Social Sciences
Sinclair A.J.	5	91	University of Manitoba, Winnipeg, Canada	Environmental Sciences, Social Sciences
Anderson C.	4	4	Australian National University, Canberra, Australia	Environmental Sciences, Social Sciences
Chompunth C.	4	12	Thailand National Institute of Development Administration, Bangkok, Thailand	Multidisciplinary, Environmental Sciences
Schirmer J.	4	44	University of Canberra, Canberra, Australia	Environmental Sciences, Social Sciences, Agricultural and Biological Sciences
Allansdottir A.	3	17	Toscana Life Sciences Foundation, Siena, Italy	Energy
Antonson H.	3	29	KMV Forum AB, Nacka, Sweden	Environmental Sciences, Social Sciences
Chan E.H.W.	3	150	Hong Kong Polytechnic University, Kowloon, Hong Kong	Social Sciences, Engineering
Cinderby S.	3	44	University of York, York, United Kingdom	Environmental Sciences, Social Sciences
Davies S.R.	3	33	Københavns Universitet, Copenhagen, Denmark	Social Sciences, Arts and Humanities
Forrester J.	3	19	University of York, York, United Kingdom	Environmental Sciences, Social Sciences
Jeffrey P.	3	127	Cranfield University, Cranfield, United Kingdom	Environmental Sciences
Jordan A.	3	243	University of East Anglia, Norwich, United Kingdom	Environmental Sciences, Social Sciences
Jordan R.	3	82	Rutgers, The State University of New Jersey, New Brunswick, United States	Environmental Sciences, Agricultural and Biological Sciences
Renn O.	3	198	Institute for Advanced Sustainability Studies (IASS), Potsdam, Germany	Environmental Sciences, Social Sciences
Thurston W.E.	3	75	University of Calgary, Calgary, Canada	Medicine, Social Sciences
Tuler S.	3	45	Worcester Polytechnic Institute, Worcester, United States	Environmental Sciences, Social Sciences
Watt A.D.	3	114	Natural Environment Research Council, Swindon, United Kingdom	Environmental Sciences, Agricultural and Biological Sciences
Webler T.	3	54	Western Washington University, Bellingham, United States	Environmental Sciences, Social Sciences
Young J.C.	3	50	Centre for Ecology & Hydrology, Wallingford, United Kingdom	Environmental Sciences, Agricultural and Biological Sciences

Figure 2. To this end, the sample was divided into subsets of articles to emulate the collaboration network in Figure 2. Word frequency ranks of the full network and of each community were generated. Table 4 shows the 15 most frequent words for each subset and their respective weighted percentages (WP%). WP% is the frequency of a given word (including stemmed words) relative to the total number of words counted in the analysis. The results of the word frequency ranks in Table 4 showed that there were no substantial discursive differences among the three communities, as the same words were consistently in the rank of each subset, with very few exceptions. From this we could infer a stable discursive homogeneity across the knowledge produced, regardless differences in the national affiliation of the authors or collaborative groups developing and/or observing case studies of public participation. This lack of diversity may also indicate a state of saturation of the case study literature, as pointed out by critics. However, some differences between the communities emerge if we consider the 30 most frequent words . Possibly, the main difference concerns the disciplinary setting in which public participation is implemented: the word 'forest' only appears in the blue community (ranked 15th), and is mostly used in the context of participatory forest planning; the word 'energy' appears only in the purple community (ranked 15th), and is collocated with worlds like 'renewable', 'wind', 'geothermal', 'policy', 'systems', 'sources' and 'consumption'; and the word 'land' is limited to the green community (ranked 23rd) and is mostly collocated with (in order of frequency) 'agricultural', 'industrial' and 'urban' land use, management and planning. Other small, but perhaps relevant, differences were found: the blue community is the only one containing the word 'quality' in the ranking (ranked 27th) referring to quality of life, decisions, policy, participation and environment, whereas the purple community placed more emphasis on 'risks' (ranked 27th) in the context of environmental risk assessment, management, governance and mitigation. Finally, the words 'science' and 'responsibility' are present in the purple and green communities (ranked 22nd and 24th, and 24th and 26th respectively) and absent from the blue community. These small differences may indicate a greater tendency towards 'quality' in the European countries in the blue community, while the English-speaking countries that dominate the purple and green communities, appear to have a greater inclination to ethical issues of science focusing the debate on the idea of 'responsibility'.

To complement the analysis of Table 4, discourse analysis was simplified into three distinct semantic fields identified by the results of

Table 4. - Word frequency ranks of the full network and of the three identified communities.

	Full Network		Green Community		Purple Community		Blue Community	
	Word	**WP%**	**Word**	**WP%**	**Word**	**WP%**	**Word**	**WP%**
1	Process	0.95	Community	1.00	Process	0.88	Process	0.93
2	Community	0.82	Process	0.99	Project	0.66	Plan	0.80
3	Plan	0.70	Plan	0.72	Community	0.66	Manage	0.69
4	Project	0.61	Information	0.60	Local	0.63	Stakeholder	0.67
5	Local	0.58	Project	0.55	Plan	0.61	Community	0.65
6	Information	0.57	Local	0.55	Decision	0.55	Local	0.59
7	Manage	0.53	Decision	0.55	Stakeholder	0.52	Information	0.51
8	Decision	0.52	Manage	0.54	Information	0.50	Project	0.50
9	Stakeholder	0.52	Govern	0.50	Water	0.49	Decision	0.47
10	Environment	0.43	Environment	0.46	Manage	0.45	Policy	0.46
11	Govern	0.43	Stakeholder	0.45	Govern	0.43	Citizen	0.45
12	Policy	0.41	Policy	0.39	Environment	0.41	Water	0.40
13	Water	0.38	Citizen	0.39	Policy	0.41	Environment	0.35
14	Citizen	0.37	Water	0.36	People	0.34	Govern	0.33
15	People	0.32	People	0.31	Energy	0.31	Forest	0.31

Table 5. Semantic Fields based on the results from the frequency ranks analysis.

Semantic Fields (SFs)		
SF1 Disciplinary context and research fields	**SF2 Social setting**	**SF3 Organization and administration**
Environment, Water, Energy, Forest	Community, Citizen, Local, Stakeholder, People	Process, Plan, Project, Information, Manage, Govern, Decision, Policy

the frequency ranks (see Table 5). Semantic fields are logical generalisations of natural language concepts that are grouped by meaning and used to refer to specific subjects (Akmajian et al., 2010). The first semantic field (SF1) included words related to the disciplinary context and research fields of the case studies under analysis, such as 'environment', 'energy', 'water' and 'forest'. The high frequency of these words confirmed the trend observed in the analysis of journals and research fields, which pointed to a high incidence of environment-related fields of research. SF2 referred to the social settings of the case studies, with words like 'community', 'local', 'stakeholder', 'citizen' and 'people'. The third and largest semantic field (SF3) referred to the organisation and administration of participatory practices, with words like 'process', 'plan', 'project', 'information', 'manage', 'govern', 'decision' and 'policy'.

This analysis, which permitted a closer look at the top of the ranks, showed minor variations between each community. The blue community put more emphasis on the SF3 words ('process', 'plan' and 'manage') than on the SF2 words ('stakeholder', 'community'). The word 'community' was emphasised more in the green community cluster than in any other cluster. Further investigation is needed to understand whether these small changes in rankings are evidence of the emergence of local discursive patterns. In this regard, the words 'process', 'plan' and 'community' were the most noticeable within the full network. To better understand the context of the use of these main words, we implemented collocation analysis, which correlated each of them with other words in the text to provide further contextual meaning (Mello, 2002). The results were delivered in the form of a word tree representing the various contexts in which the word occurred. The results were ordered by the number of matches. Table 6 ranks the higher correlations for the main words 'process, 'plan' and 'community'. The results show the most frequent words in the same sentence at a distance of two words before or after the main word.

Process. The semantic property of the word 'process' refers to a method or way of doing something. In research, it concerns the how rather than the why. The highest correlations with the word 'process' listed in the table fell under semantic fields SF2 and SF3, which meant that case study scholars were mainly focused on how participatory processes work, how they should be managed and how they can assist public policy and decision-making. 'Process' was also strongly correlated with 'plan'.

Table 6. Correlations for the main words 'process, 'plan' and 'community'.

Process		Community		Plan	
plan	SF3	member	SF2	process	SF3
participation	SF2	group	SF2	urban	SF1
consultation	SF2	local	SF2	participation	SF2
engagement	SF2	region	SF2	manage	SF3
policy	SF3	engagement	SF2	collaboration	SF2
decision	SF3	participation	SF2	forest	SF1
manage	SF3	stakeholder	SF2	decision	SF3
deliberation	SF3	involvement	SF2	authority	SF3

Community. The term 'community' was expected to be among the most frequent, given that the main topic of the case studies was the involvement of the public in science and technology decision and policymaking. A community is a group of people in a specific place or united by common interests. The main concepts that emerged from the collocation analysis of the word 'community' were all related to the context or social setting in SF2. These could refer to the agents involved in participation, such as in 'member', 'group' or 'stakeholder', or to the geographical background of the case studies, such as in 'local' and 'region'. Although the terms are somewhat generic and vague, they lead us to the notion of localised context, which has been central to the most recent critiques of the case study literature on public participation.

Plan. In our analysis, the word 'plan' had a more diversified application and was correlated with all the three semantic fields we had defined. 'Urban' planning and 'forest' planning fell under SF1, as they are disciplines that increasingly require public involvement. However, most of their applications were related to SF2 and SF3: collaboration and participation planning, management planning, decision planning and authority planning were some of the main concepts that stood out in the sample. However, the strongest correlation of the term 'plan' was with 'process'. 'Planning process' seemed to be the key concept in the case study PEST literature. To plan is to define in advance a set of actions or intentions in order to control the outcome of those actions. In the context of our object of study, this concept brings us to the notion of centralised organizational structures of public engagement, where institutions in a higher hierarchical position engage the public or other institutions in a top-down manner. This is aligned with the deficit model of communication, which is currently (although not unanimously) considered obsolete in the mainstream literature.

Conclusion

Our study was motivated by the need to map the research done on the increasingly important topic of PEST (Delgado et al., 2011; Loureiro and Conceição, 2019; Stilgoe et al., 2014). The focus on case studies derived from the growing criticisms that have been levelled at PEST literature relying on case studies. Critics claim that this literature has become a chaotic set of contextual case studies that might not provide comprehensible data for systemic or holistic approaches (Braun and Könninger, 2018; Chilvers et al., 2018).

We gathered a robust set of articles published between 2002 and 2017, and generated a map of the case study literature on public participation in science and technology to extract any emerging patterns that characterised the sample and that could be admitted as general trends in public participation. We used different methodologies with a particular emphasis on quantitative methods, including computational tools that facilitate the organization, analysis and visualisation of large datasets.

Our findings showed that the PEST literature using case studies was highly concentrated in native English-speaking countries, and in multidisciplinary research that mostly combined environmental studies and social sciences research. This suggests that public engagement in science and technology is not yet widespread in either a multitude of knowledge domains or globally, although it is growing. This is aligned with the argument of some scholars, such as Apostolopoulou and Pantis (2009) and Wynne (2007), that public participation in science and technology is still a scarce social phenomenon.

Despite the high contextualization of case studies, we were able to find some strong cross-sectional patterns across the whole sample. Three research communities were identified, and textual analysis was conducted on the full network and also comparatively between each community. We found very small discursive variations among the three communities and assume that the reasons for this are multiple and connected. (1) The emergence of public participation in science and technology is common in developed countries, particularly in native English-speaking countries where efforts to communicate science to the public have been in place for decades. (2) It is typical of developed economies, considering the expected link between the value of science and technological advancements with potential benefits for economic competitiveness. (3) It has

a higher incidence in countries structured on democratic regimes, with a few exceptions, such as China, which has undergone a 'hard road' to secure increasingly successful public engagement with science over the last three decades (Jia and Liu, 2014). (4) Nevertheless, policies and long-term strategies aiming to open science to the rest of society may be agents of change with a strong potential impact on the discourse and academic productivity of PEST studies.

The widespread criticism aimed at the PEST literature, particularly its reliance on case studies as a central methodology, points to a wide range of subjects. The patterns found in our analysis may be the cornerstones of participatory action but also may reveal the problems that are turning the literature into a litany of case studies. We are inclined to admit that a large part of the identified patterns reveal that deficit practices still remain a major tendency in public participation insofar as the key concept emerging from the sample is 'planning process', which denotes top-down organization on the basis of public participation. Top-down public engagement is the main structural condition of deficit practices in which the public is prone to be controlled or manipulated by stronger players (see e.g. Lezaun and Soneryd, 2007).

The frequency of the words 'planning' and 'process' may also point to the fact that the literature has been over-emphasising methods and procedures of public participation. Furthermore, 'planning' and 'process' are key words in project management methodologies ('project' and 'management' are also listed in the top of the word frequency ranks in Table 4). In this context, it seems right to ask how project management methodologies and managers are equipped with tools to allow the uncertainty of bottom-up citizen agency, and how to combine top-down management with bottom-up unstructured citizen initiatives. These questions seem to lead us to a similar discussion in political science in which the concepts of governing and governance are confronted. From this we can infer that the disciplines of political science may have some answers and should be incorporated in the analysis and design of public participation processes. In addition, we suggest that new frameworks for PEST design and analysis may focus on decentralising hierarchical power and dependency relationships between agents, by building a democratic setting that allows the engagement of top-down organizations with bottom-up initiatives.

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Notes

1 The acronym 'PEST' is commonly used to refer to public engagement with science and technology. However, to enhance the participatory nature of the concept of engagement, which is fundamental to our analysis, we chose the term 'public engagement and participation in science and technology'.

2 http://tools.medialab.sciences-po.fr/table2net/

3 OECD Better Life Index http://www.oecdbetterlifeindex.org/
Global Civic Engagement Report 2016 https://www.gallup.com/195686/2016-global-civic-engagement-report.aspx

4 The research fields related data do not refer exactly to the content of the articles, but instead indicate the fields of the journals where they are published, with possible overlaps of more than one field in each journal. Nevertheless, these data provide a fair if simplified insight into the distribution of the fields of knowledge of PEST studies using case studies as the main or a core method of analysis.

5 Our word frequency queries returned the 500 most frequent words. Results on a line graph show that word count increases slowly from the bottom of the ranking and grows exponentially approximately from the 30th rank to the top. This makes interpretation of word counts in rankings under 30 problematic and perhaps not recommended.

The Democratisation Myth: Open Access and the Solidification of Epistemic Injustices

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Abstract

Open access (OA) in the Global North is considered to solve an accessibility problem in scholarly communication. But this accessibility is restricted to the consumption of knowledge. Epistemic injustices inhering in the scholarly communication of a global production of knowledge remain unchanged. This underscores that the commercial or big deal OA dominating Europe and North America have little revolutionary potential to democratise knowledge. Academia in the Global North, driven by politics of progressive neoliberalism, can even reinforce its hegemonic power by solidifying and legitimating contemporary hierarchies of scholarly communication through OA. In a critique of the notion of a democratisation of knowledge, I showcase manifestations of OA as either allowing consumption of existing discourse or as active participation of discourse in the making. The latter comes closer to being the basis for a democratisation of knowledge. I discuss this as I issue a threefold conceptualisation of epistemic injustices comprising of testimonial injustice, hermeneutical injustice, and epistemic objectification. As these injustices prevail, the notion of a democratisation of knowledge through OA is but another form of technological determinism that neglects the intricacies of culture and hegemony.

Keywords: Epistemic Injustice, Democratisation of Knowledge, Scholarly Communication, Open Access, Recognition, Social Epistemology

Introduction

Openness, democratisation, and prevailing imperialism

Discourses and practices around open access to scholarly publications (OA) in academia in the Global North often treat a narrow notion of accessibility as a pressing problem and, in return, offer wider readership access as a solution. More radical or bottom-up approaches conceptualise accessibility more widely with the result that it is not readership but active, participatory access to discourse that is to be problematised. While there are bottom-up initiatives in all parts of the world, large-scale initiatives within the Global North still receive the majority of investments and retain the hegemonic order. This tends to blind for wider notions of accessibility: that is, who is allowed to publish where, for what reasons, and what are the non-materialist, cultural premises. It can be argued: wider accessibility is primarily a matter of recognition, while narrow accessibility is one of redistribution only.

I argue that OA, and the narrow accessibility problem it is said to solve, are ill-equipped: they do not lead to positive social change or a democ-

ratisation of knowledge but reinforce a Global Northern knowledge hegemony. Indeed, the implementation of OA in academia in the Global North demonstrates how it solidifies inequities in scholarly communication: it largely manifests the proprietary communication structures of established publishers and shows no change regarding epistemic injustices. Moreover, that OA is signified as a normative good disguises that it, in fact, solidifies these inequities. There is growing evidence that, by building on the narrow accessibility problem, subjects pushing for large-scale OA initiatives in academia in the Global North such as national OA deals, or for more OA even in commercialised form (exemplified in the UK: Finch, 2012; or Germany: Projekt DEAL, 2019), are not interested in democratising knowledge but seek to retain owning and governing the means of communication. These modes of ownership and governance are fundamental constraints on a democratisation of knowledge in a global perspective. This globalisation is, thus, but an expansion of ideals of the Global North instead of an inclusive engagement of local particularities in a global context, driven by the imperatives of rankings and the rhetoric of a Global Northern notion of quality and reputation.

The concept of epistemic injustice is crucial for understanding the shortcoming of OA in the light of a democratisation of knowledge. It provides theoretical grounds for forms of injustice that a minority social group faces because either their testimony is doubted, or their experiences do not find corresponding representation in the hermeneutical resources of the majority. Epistemic injustices are a central problem in scholarly communication and the illusion of a *real openness* of OA disguises that its current large-scale modes of implementation reinforce these injustices.

State of discourses

Conceptions of these issues are available, yet underdeveloped in their connection of theory and manifestation, or of OA and injustice more generally. There are mostly unconnected contributions and discourses about OA, its unachieved potential for a democratisation, or epistemic injustices in the context of academic imperialism.

Implied is the notion of democratisation through mutual sharing of knowledge in one of the founding documents of OA which states that this publishing mode is supposed to "share the learning of the rich with the poor and the poor with the rich" (Budapest, 2002; you may find similar terms in: Berlin, 2003; Bethesda, 2003). Like crossing the Rubicon, this statement leads the way to holding OA accountable to its implicit ideals. One of the earliest to discuss a democratisation of knowledge through OA and, thus, making this ideal explicit, has been Willinsky (for instance: 2006). As an early strong OA advocate, he introduces aspects of the social epistemology of scholarship, engaging with the work of Longino (2002; see also: Willinsky, 2006, chapter 2) as well as with Sen (1999) and Canagarajah (2002). Within his consideration of the need of a democratisation of knowledge and the ways OA might help achieve this (Willinsky, 2006, chapter 7), Willinsky looks at structural improvement and warns about the extension of a Western colonisation of knowledge, instead of local empowerments, early on. What he did not foresee is how forms of large-scale implementation of OA in academia in the Global North achieve to extend their hegemonic colonisation. Nevertheless, the founding of the *Public Knowledge Project* and the provision of technological means such as infrastructure, especially the *Open Journal System*, have been vital steps towards a substitution of established infrastructures. The development of OA is itself closely connected to the development of open source and software (Tennant et al., 2020). See in this respect also the interconnectedness of socio-cultural practices and technology, driving potential for change in circular reinforcement (Okune, 2020). The importance of such technological means cannot be stressed enough. Still, though, the recent work on continuing injustices proves that technology alone is not enough.

Quite the contrary, technology can likewise provide the means for a continuation of dominant politics and ideals. Recent developments revived the discourse on the democratisation of knowledge. Both Holbrook (2019) and Inefuku (2017) are wary of the trajectory of OA regarding achieving its ideal. Though they emphasise positive aspects of some OA developments, their

strong criticism dominates: Holbrook is highly critical of the unlikely democratising and equalising impact recent large-scale implementations of OA may have, while Inefuku remains critical of its cultural impact and implicitly signals a sort of technological determinism. Sengupta (2021) goes further and explicates the academic colonialism that OA pursues. Chan and Gray (2020) further argue that OA can help achieving to break a hegemonic order, but it remains to be outlined and maintained globally how new principles may look like.

In close relation to the democratisation of knowledge, but distinct in its discursive formation, there is a broad range of work on cognitive, intellectual, or knowledge imperialism. Bhargava (2013: 415) articulates "a loss of epistemic autonomy" where a colonising society shapes the culture principles, identity frameworks, or heritages of a minority. Alatas (2000) is similarly vocal about this issue and illustrates both the political and historical foundations of intellectual imperialism as well as contemporary manifestations. Among others, he accounts for publishing practices that result in a disregard of local discourse such that

> there is more scholarship on our region [Singapore] done abroad, reviewed abroad, assessed abroad and consumed here. Therefore, there is less scholarly debate locally (Alatas, 2000: 30).

Important in this respect is also the discussion of centre/periphery (or periphery/semi-periphery), articulating the appropriation of practices of knowing and understanding by foreign discourse (see, for instance: Lander, 2000; Luczaj, 2020; Monteiro and Hirano, 2020; Rodriguez Medina, 2015; de Sousa Santos, 2016). Marginality or periphery can take on various forms here, such as building on rendering notions of geography, history, minority, or, more elusively but pertinent for my argument: the epistemic other. This often, but not necessarily, reflects political-historical dimensions of colonisation just as the notions of Western or Global South/North do (see below for a terminological differentiation for this article).

Further in this line of critique is the matter of academic dependency, as outlined by Alatas (2003) or Andrews and Okpanachi (2012). Alatas discusses the implicated academic imperialism beginning with "the setting up and direct control of schools, universities and *publishing houses by the colonial powers*" (Alatas, 2003: 601; emphasis added) which directly connects to my argument. By making the means of digital access to established discourse available, publishing houses of the Global North extend their epistemic reach on a worldwide scale so that academic dependency prevails. Thus, mere access to past discourse is not as such a democratisation of knowledge but, first of all, the potential for academic dependency. Alatas defines various such dependencies, some of which relate to cognitive modes. Precisely those modes are the issues that I aim to define in more detail by discussing epistemic injustices. Vital in this regard is also the work of Ogone (2017: 33) who outlines different epistemic injustices and concludes that "only by means of a vibrant tradition of scholarship that African thinkers can succeed in deconstructing the prevailing knowledge hegemony in pursuit of epistemic justice".

Does the openness—and the notion of democratisation said to underpin this openness—in OA allow for more of such vibrant tradition, or to overcome epistemic injustices? This is to be regarded quite nuancedly, of course. On the one hand, there is a broad discourse on the technicalities of implementing OA (see, for instance: Björk, 2012; Bosman and Kramer, 2018; Brehm and Neumann, 2018; Eve et al., 2017; Eysenbach, 2006; Martín-Martín et al., 2018; Tanner, 2017). Discussions in favour of OA can be encountered in politically more radical versions (Swartz, 2008; Swartz and Lessig, 2016) as well as conservative or neoliberal ones (Crossick, 2016; Finch, 2012). Moreover, ideological centring of OA often inheres—though mostly only implicitly—in notions of knowledge as a public good (Hess, 2012; Hess and Ostrom, 2011; Moore, 2019; Suber, 2009) or universal access to knowledge (Bowman and Keene, 2018; Tennant et al., 2020). More fundamental theoretical discussions on moral implications such as the contribution by Bacevic and Muellerleile (2017) are rather rare.

On the other hand, there is a diversity of radical approaches towards OA. There are, for instance, South or Latin American approaches which are

prominently represented by *AmeliCA* or *Redalyc*. These approaches aim to foster a democratisation in that they build on regional and scholar-driven infrastructures (Aguado-López and Becerril-Garcia, 2019; Becerril-García, 2019). Such scholar-drivenness, or being scholar-led, can in newer initiatives also be found in the Global North, for instance in the *Radical Open Access Collective* or *ScholarLed*. Of particular importance here is that small-scaling OA publishers are set-up to replace or provide alternatives to existing, established publishers (Barnes, 2018). The notions of small-scaling and scholar-led indicate the desired diversity and closeness to scholarly endeavours, thus, being a service within the scholarly community and its epistemic diversity (Adema and Moore, 2018; Barnes and Gatti, 2019). I further discuss such initiatives below.

What these discourses demonstrate is that a democratisation of knowledge is thematic for OA in the sense of epistemic freedom. But the two examples for radical OA are small in comparison to, for instance, *Projekt DEAL* or *PLAN S* (the former is the German coalition for reaching transformative OA agreements with corporate publishers; the latter is a coalition of research funders aiming to advance OA as a transnational agenda; I discuss both in more detail in the section: Narrow Accessibility: Allowing Consumption). These disparate modes of manifestation and their implicated meanings make a comprehensive assessment of the potential of a democratisation of knowledge a pressing topic. Moreover, the discourses on epistemic injustices/academic imperialism and OA seem disunited, so that a unified contribution may help identify pertinent issues: connections between manifestations of OA and consequential, deeper theoretic conceptions of social epistemology are often missing. Existing contributions in this respect are the collected works of, for instance, Smith and Seward (2020), or Eve and Gray (2020). Particularly the work of Mboa Nkoudou (2020) about redressing OA as a means for epistemic justice as well as Posada and Chen's (2018) about injustices resulting from ownership of publishing infrastructures are vital in this respect. I build on these recent contributions and aim to provide a more thorough conception of social epistemological injustices in the context of scholarly communication and OA. I argue that—for accessibility to apply in the general sense of a democratisation of knowledge—these injustices need to be overcome.

Structure and terminology of this article

I proceed in this article by highlighting cases of manifestations of OA that evidence the shallowness of a narrow accessibility problem (section: Narrow Accessibility: Allowing Consumption). These cases underscore the agenda of progressive neoliberalism (Fraser, 2019), that infiltrates academia and is taking advantage of OA in unprecedented ways. Most of all, the cases illustrate that OA is not driven by the objective to democratise knowledge. I go on to discuss the connection between general accessibility and the democratisation of knowledge (section: General Accessibility: The Democratisation of Knowledge and Epistemic Injustices). I propose three forms of injustices here. This is followed by a discussion where I connect and critically engage the discursive threads of my argument.

A note on terminology: I acknowledge that there is a diversity of approaches to OA within the *Global North* as well as the term *Global North* itself having its ideological problems. Regarding the former: there are bottom-up approaches across the globe, as mentioned already. The cases discussed below only illustrate a particular mode of OA that is ill-equipped for matters of democratisation and, nonetheless, receives major financial means in praxis. Regarding the latter: China, a country that is included in the realm of the *Global North*, shows clear tendencies to gear their practices towards North American/European notions of knowledge. The use of the term *Global North*, therefore, seems imprecise here. Still, a discursive referent is required.

The use of a *Global South*/*North* divide cannot be explained by geographical reference alone, since countries such as Australia and New Zealand are sorted into the Northern cluster. The separation bears connection to the term *Third World*, which was to "distinguish the formerly colonized or neocolonized world from the modernizing worlds of capitalism and socialism" (Dirlik, 2007: 13). As such, referring to the development stages of *Global Southern* countries built on the notion

of a development towards *Global Northern* ones. Eve and Gray (2020: 11) use these terms in this sense to "refer to a worldwide division in equity of wealth as a result of colonial legacies and ongoing prestige practices". Others deploy *Western* to refer to what is similarly seen as the *Global North*, such as Willinsky (2006), Paasi (2015), or Ogone (2017). Again others such as Pitts (2017: 150) synonymise "Western/Global Northern knowledge", or use both terminologies of *North*/*South* and *Western* (e.g.: Smith and Reilly, 2014). The use of such terms can be critiqued for solidifying assumptions or ideologies that are indeed matters of the object to be critiqued themselves. Moreover, more focussed differentiations can also be made where, for instance, a distinction is possible based on publication patters in West European/Nordic and Central/Eastern European countries (Kulczycki et al., 2018). All of this shows that the terminology needs to be handled with caution; nevertheless, *Global North* is a helpful term to refer to particularly capitalist societies or countries that, as I show in the ensuing analysis below, are responsible for developments influencing countries beyond themselves, both materially and ideologically. It is in this sense that I use the term which means that it refers to dominant practices and ideology without disregarding of the fact that there are many other practices and culture principles at work within the *Global North* as well. Furthermore, I retain the ambiguity of the terms where, for instance by discussing Paasi or Willinsky, the terminology of *Western* slips in.

Some notes on methodology: though I do not employ a Marxist critique, as a cultural sociological work, this article stands in close relation to, and draws on, Gramsci and his conception of hegemony. First of all, the ontological perspective needs to be clarified. I follow the cultural sociological paradigm that stresses the relative independency of culture vis-à-vis materiality; that is: the material is mediated by culture instead of vice versa (see for more on this: Alexander, 2005; Alexander and Smith, 2001; Emirbayer, 2004). This is a vital break from conflict theorists whose analytic predominance is the material over culture (for an illustration of the difference, see the contribution of: Gartman, 2007). This by no means determines irrelevancy of conflict or Marxist theory. Quite the contrary, I draw heavily on it. This only issues a perspectival focus which means in the context of practices concerned with openness—OA, open science, open humanities—that subjects approach the materiality of discourse—its artefacts: publications—through the lens of specific culture principles (such as of competition, reputation, or openness eo ipso). The purpose and existence of a publication is mediated by such principles so that different communities perceive publications with different dominant principles. To give an example, where scholar-led approaches consider a publication as a means for the communication of scholarship, large-scale OA initiatives such as those behind *Projekt DEAL* may tend to consider a publication to also be a means of hierarchical reputation (I illustrate this further in the following chapter). Likewise, disciplinary cultures may pose difficulties for adopting principles of openness in a transdisciplinary manner as the meaning of artefacts and discourse is dissimilar (Knöchelmann, 2019a). Thus, corresponding subjects mediate the artefact through culture which shapes their understanding of it. This brings me to, secondly, the matter of hegemony.

Hegemony in the Gramscian sense is the dominance of particular culture principles which allow for capitalist institutions to persist. In other words, a capitalist worldview, its values and explanations, is diffused throughout society, across classes or societal sub-systems, such that all correspond to this particular worldview. This is the short version of the diversity of concepts referred to as hegemony in Gramsci's *Prison Notebooks* (1992, 1996). That is, within Gramsci's texts themselves, the term is not used unambiguously, connoting quite distinct concepts which, most basically, refer to "mechanisms of bourgeois rule over the working class in a stabilized capitalist society" (Anderson, 1976: 20). Applications of discourse or power analysis by means of hegemonic culture principles is likewise diverse. Pertinently for my argument, Moore works with the concept of hegemony and issues that "[s]ubscription publishing is the current common sense of humanities publishing […] and certain articulations of OA pose a counter-hegemonic threat" (Moore, 2019: 27). In a similar methodological approach, Knoche discusses OA and the

hegemony of profit-oriented publishing and reputation (Knoche, 2019: 143; further in regards to critical communication studies, see the discussion of ideology critique in: Fuchs, 2020: 228–232). It is in this sense that I deploy the term, though within a cultural sociological fundament.

That this is a cultural issue is vital for understanding my argument, and important for the Science and Technology Studies (STS) discourse more generally. The issue of different modes of accessibility can be seen in the light of a debate over redistribution or recognition in the sense of Fraser and Honneth (2003). Nevertheless, I argue that cultural issues (and, thus, potentially recognition) precede redistribution or technological equality (see also for a discussion of hegemony and ideological struggle in the light of culture analysis: Hall, 1986). STS discourse builds upon the understanding of the intricate interconnectedness of culture and materiality, rejecting notions of disunified ontologies (Latour, 1993). An analysis of material and epistemic means of accessibility and their interconnectedness, therefore, may find a valuable place for dispute within STS.

Further in relation to a critique of hegemony, the matter of belief in principles, practices, and their righteousness stands the Bourdieuian *illusio* (Bourdieu, 1998: 76). The importance of this category is that individuals actualising practices do so without questioning, or even without intelligibility of, the culture principles and institutionalisations involved. They are, so to say, unintelligible or blind towards the rules of the social game being played (which may not imply they are cultural dopes). Observe as a Bourdieuian *illusio*, for instance, the systemic unawareness of matters of social closure in respect to the distribution of research funds in Germany (Münch, 2011: 276–287; further in a similar methodology, Münch's critique of academic capitalism in Germany: 2007). Matters of recognition, venue publishing, or the individual publication under the guise of journal reputation are particularly pertinent to OA and can be seen as further exemplifications of *illusios*, since the majority of scholars actualise practices that bear culture principles which they are unaware of. By so doing, they support a hegemonic order: most crudely exemplified by the working of the journal impact factor (Brembs et al., 2013; Brembs, 2018; Lariviere and Sugimoto, 2018; McKiernan et al., 2019; Vanclay, 2012). The connection becomes more apparent below.

Narrow accessibility: allowing consumption

There are, in essence, two ways accessibility problems can arise in scholarly communication: by way of accessing the results of past discourses or by way of accessing ongoing and future discourses in their making. The former is the premise upon which large-scale manifestations of OA in academia in the Global North are built: accessible means affordable consumption. This premise exposes a political trajectory: retaining the established order of a Global North hegemony by reducing structural change to affordable consumption. This conception of an accessibility problem resonates the lofty ideal of increasing equity through a one-sided distribution of knowledge. Accessibility, here, is a matter of redistribution only.

Problematising narrow accessibility

Illuminating for how the fallacy of narrow accessibility slips into even radical OA advocacy is the following example. Tennant et al. (2016) engage an anecdote to support their argument of the democratic impact of allowing more widespread access to knowledge from the Global North. The authors point to a paper (Knobloch et al., 1982) that provides evidence for why Liberia should be within the Ebola endemic zone. Up to and during the 2014 outbreak of Ebola, this paper is supposed to have been unknown to Liberian officials for it was published behind a paywall, the authors argue. OA would have changed this which implies that solving narrow accessibility would have been a solution. But can this argument justifiably be made? I suggest it cannot, for simply tearing down paywalls does not resolve the issue that Knobloch et al. (1982) published their research in a French journal (the *Annales de l'Institut Pasteur* in France), thus, gaining authorship recognition for a Global North sense of reputation. Tennant et al. (2016) insist that "OA provides a mechanism to level the playing field between developed and developing countries" but they do not work out what this

mechanism might be. It is implied that allowing others to access knowledge for free constitutes this mechanism. And yet, the anecdote shows that when this mechanism is explicated—that Liberian officials would have incorporated knowledge provided in this article if a paywall would not have been in place—it seems unjustified. Consider the question of why Knobloch et al. (1982) have not published their research in a Liberian or African journal in the first place. It was not a paywall preventing them from so doing.

By focussing on narrow accessibility as a problem in academia, discourses miss to connect the dots between the co-optation of OA by politics of progressive neoliberalism and the failed revolution of a democratisation of knowledge. This politics enabled neoliberal economic principles to become legitimated because of a coating of meritocratic diversity. The appearance of equality allows for hierarchies to continue to exist. In the context of academia in the Global North, solving a narrow accessibility problem provided the established order with a "patina of legitimacy", to utilise the language of Fraser (2019: 15). Those subjects of established scholarly communication that have been strong in the past—corporate publishing, financially well-equipped academic institutions, and research management staff in countries from the Global North—found a way of manifesting their position: they repurposed accessibility as a form of affordability and merely shifted this affordability from the reader to the author (or their institutions).

This co-optation can be shown with a range of cases. And yet, my critique shall not be one of capitalist profit-making as such. Also, I do not intend to represent a diversity of OA approaches divided along the dualisms of corporate/small-scale, established/radical, or capitalist/collaborative. Much rather, with the range of cases discussed in the following, I aim to illustrate the large-scale manifestations in the Global North that receive heavy investment, public attention, and, thus, are firm in their dominant position. As in the tradition of case studies (Flyvbjerg, 2006), these cases are articulating the particularities of a paradigm. This paradigm resides on the notion of a closed infrastructure that resists the principles of a democratisation of knowledge (which is discussed in the subsequent chapter).

Co-optation of OA by corporate publishers

Publishers, especially the oligopoly of large for-profit institutions (Larivière et al., 2015), have been the first to co-opt OA and re-shape its purpose. The collective of these publishers successfully responded in a capitalist fashion to the reputation-making requirements of academia. That is, the practices of corporate publishing presuppose that academia in the Global North rests on the *illusio* of a market imperative such that all scholarly endeavours are to gain reputation and advertise its achievements through established publishing infrastructures. Scholars and especially research policy makers could have rejected corporate publishing by steering towards alternative approaches such as: open instead of proprietary publishing infrastructures, encouraging publishing that does not depend on authorship reputation, or allow for cost-effective green OA. These alternatives could have led the way for tackling a more general accessibility problem in academia as do the scholar-led publishers in a small-scaling fashion. Yet, where academia compromised on commercial solutions to the narrow accessibility problem, it also compromised negatively on working on rectifying accessibility in general.

The successful commodification of OA is visible in a variety of instances, one of which is the compromise made for embargo periods, outlined in 2007 as "a period of exclusivity for the publisher followed by free online access for the public" (Suber, 2007). In other words, the future OA article is paywalled for a fixed period until it is actually freely available. This mechanism essentially concedes that there is a right to economic exploitation on sides of the publishers, a period of about 12 to 24 months given for a future OA publication to be placed behind a paywall so that publishers may sustain revenue from subscriptions. It is here not coincidental that just those embargoed OA venues had in their times considerably higher citation rates (Laakso and Björk, 2013), which made them required subscription assets in libraries. This jeopardised positioning OA as a solution to the journal crisis in the first place (so

that it could not even be claimed to be a solution to the affordability problem in this instance).

Alongside embargo periods, academia in the Global North accepted to invest in hybrid OA which is at the core of solidifying existing power structures in scholarly communication. Hybrid refers to the mechanism of keeping a journal published as a subscription journal while offering authors (or their institutions) to purchase an OA option for the individual article. This mechanism substantially subverted the idea of OA to a neoliberal ideology in which individuals can access OA by means of considerable financial investment. The required fees outgrow those of any other form of OA making hybrid an excessively highly priced expenditure (Björk, 2012; Björk and Solomon, 2015; Khoo, 2018; Solomon and Björk, 2012). As of 2021, the *Nature* journal family issues the stunning price of €9,500 (US$11,390, £8,290) for making an article OA (Else, 2020). *Cell Press* (held by *Elsevier*) charges €8,500 (US$9,900, £7,800) for its name-giving flagship journal (Cell Press, 2021). This development is, even within financially well-equipped countries, ridiculing notions of democratisation. We may witness the usual counter-argument put forward by proponents of unfettered high-impact brands: the notion that all fields of scholarship offer alternative publication venues with much less expensive OA. This only highlights the blinkered attitude in the light of academia's *illusio*. Since academic career advances depend primarily on visibility and reputation, being published in a high-priced publication venue is desired above everything else. Consider in analogy an election where access to some polling places needs to be bought, but in return, votes in these places count twice. Sure, you *can* go for the less expensive contribution. But, without question, those who wish to make their voices heard will keep investing.

Next to the corporate repurposing of OA, commercialisations such as that of *Knowledge Unlatched* or the acquisition of OA publishing initiatives by publishing conglomerates (especially *F1000Research* by *Taylor & Francis* and *Hindawi* by *Wiley*) show how fruitfully the efforts of bottom-up approaches turn into perpetuations of economic agendas: *Knowledge Unlatched* was launched as a not-for-profit institution and got stealthily integrated into a for-profit company, showing increased efforts to centralise and commercialise on the formerly community-focussed infrastructure (Esposito, 2019; Gatti, 2018; Knöchelmann, 2018). Such switches to for-profit, either from within or by acquisition, show that these technological means are not in the hands of scholars who shape them. They are being integrated into an established order instead of being built collaboratively alongside new developments of culture principles which might help replication or distribution in the wake of an actual democratisation. The high-priced OA is, likewise, building on the exploitation of academia's *illusio*, instead of trying to re-shape it. This shows that the narrow accessibility, though being somewhat open at the end of established discourse, remains or becomes exclusive at the end of being allowed to participate actively. This exclusivity becomes more apparent by looking at large-scale transformations.

Large-scale transformations as narrow accessibility: Projekt DEAL

The disproportionate costs associated with OA and the additional costs of the bureaucracy around organising OA led to the demand for large-scale OA deals. Among others, such deals are instituted in the Netherlands, Sweden, Norway, or Germany (Knöchelmann, 2020; Kwon, 2019; Max Planck Gesellschaft, 2019; de Rijcke, 2020). They are hailed as being transformative and ground-breaking. In detail, however, they are mostly a continuation of established practices.

The case of Germany is epitome in this regard: *Projekt DEAL*, representing a consortium of more than 700 libraries and research institutions in Germany, closed large-scale OA deals with both *SpringerNature* and *Wiley*, while discussions with *Elsevier* are ongoing (see for more details: Projekt DEAL, n.d.). Effectively, these deals are perpetuations of hybrid journal publishing in that German research institutions subscribe to read a publisher's entire non-OA journal portfolio while paying substantially to publish their articles OA.[1] Through such deals, German scholars gain a considerable advantage compared with scholars in other countries in that they can, based on the contract and national financial backing, read the whole

portfolio and publish OA without bureaucratic or financial hurdles. It is highly questionable whether other countries can afford to institute similar contracts. Likewise, it is unlikely that publishers will contemplate lowering the costs to publish hybrid, considering that such deals secure a safe revenue.

It follows that such deals are, on the one hand, segregating scholars and countries into those who can afford to publish OA, either by means of large-scale deals or excessive publishing fees, or they are excluded from the benefits of OA. On the other hand, with a further increase of such OA publications, free access to them will create a two-class system, dividing journals and series internally. The affluent and financially well-equipped institutions and scholars can push their visibility further, while the rest must hope that others remain willing to subscribe to the journals publishing their paywalled scholarship. By enforcing such exclusivity in two respects, this is OA as a means of hegemony instead of a tool for breaking power. It reproduces the standing of a few by granting others (an excluded, periphery majority) the right to access their knowledge.

To be sure, there are non-fee OA venues; but the high-impact journals or book publishers demanded for career advancements in many fields remain paywalled or hybrid, ensuring that authors stay committed to the established hierarchy. Prominent institutions of this hierarchy regularly appeal for sympathy, such as *EMBO* (2019) or *Nature Research* (n.d.), putting forward the questionable argument that their high costs are justified because of the expensive selection processes and rejection rates. Precisely this, though, selectivity through rejection, maintains their positions in the hierarchy. In return, if the academy would agree to reshape its *illusio* and diminish the importance of reputation and hierarchy—that gamut of contingent post-publication impact based on pre-publication selection—this kind of business model would not survive. As long as this is not the case, investing in these publishers (paying their APCs or subscriptions) translates into investing into the perpetuation of the established hierarchy: these institutions do not gain their income *because* they are at the top of the impact gamut—they gain their income to *maintain* this impact gamut.

The national deals have further implications on the future of scholarship where today's narrow accessibility is traded against tomorrow's decision-making sovereignty in regard to digital infrastructures and system integration. In the context of the national OA deal in the Netherlands, for instance, making the works of Dutch scholars published in *Elsevier* journals freely available comes at the cost of providing the publishing corporation primary access to fostering their research intelligence service. In a market where rates of profit reached an unprecedented peak, this is a strategic positioning for future means of exploitation. With entering such a deal, a country concedes to support that business strategy which has long-term effects beyond mere cash-for-openness. Observe de Rijcke's (2020) reflections on this deal which "may effectively transfer crucial means to influence Dutch science policy to a monopolistic private enterprise". Future retrospections may well observe the realisation of a downward spiral in the context of such deals: they are solutions to an affordability problem that was exacerbated because of monopolistic market structures—and by actualising such solutions, those monopolistic market structures got carried into the future where renewed efforts were required to find solutions for an affordability problem. And so on. Note, here again, the exclusive position private entities as well as selected countries gain by means of large-scale deals about openness: the path towards open infrastructures is, thus, indifferent to being shaped by democratic means.

Large-scale transformations as narrow accessibility: Plan S

Plan S stands in line with these large-scale OA deals in that it fares as an embodiment of the progression of a neoliberal OA logic. The coalition of (predominantly, but not restricted to, the Global North) funding bodies was established in 2018 and its policy (or mandate) is in effect as of 2021. It requires all authors receiving funding from participating funding institutions to publish their results OA with particular conditions (Schiltz, 2018). These conditions have been widely debated with a diversity of voices in favour as well as

against them. Conservative voices show concern about academic freedom in the wake of *Plan S*, since it might lead to reducing publishing options for authors as they have to choose a very liberal Creative Commons licence. This argument seems weak in light of what academic freedom may entail, especially that a scholar's freedom may be seen as more than the reinforcement of an individualist position in which some are active and others only passive participants. It may instead be seen as a member's right within a community so that a sense of solidarity is the fundament on which all participants tread in ways to allow all to be—de facto active—participants; a freedom implying constraints already by the acceptance of an other. But such dialectics is a delicate model and it seems to be rather absent in the heated debate on academic freedom. Whether or not it is coercion or freedom: *Plan S* does not achieve to address issues of Global equality so that even progressive OA advocates show *sympathies* with the objections to *Plan S* (Moore, 2021). It is guided by a non-inclusive perspective, on a both disciplinary and Global level (Istratii and Demeter, 2020). Thus, though its objective to foster more openness may be laudable, the coalition's mode of implementing this openness is an enforcement of a form of an OA market. This enforcement and the resulting requirement to compete in a single OA market may be the more pressing concerns that speak against *Plan S* in the light of either freedom or equality.

In essence, *Plan S* perpetuates some of the principles of the large-scale deals, even though it aims to discredit hybrid OA: scholars supported by charitable or national funders in the Global North are provided the means to afford openness, while the bulk of other scholars is required to rely on individual deals or personal subsistence. All the while, the funded scholars can grant access to their knowledges to an unfunded other. It might be argued that the implementation of the mandate and the prolonged discussions preceding it might have resulted in some of the price hikes showcased in the preceding section. The high-impact journals are indeed pressured to make an OA option available to potential authors. That these journals are a costly business is not a matter of OA, though: the recent mandate only made the underlying prices beyond subscriptions visible. And recent submission numbers are revealing in the context of a geographic agenda setting: while the "mandate for immediate open access will apply to authors who produced only about 6% of the world's papers in 2017", "35% of papers published in Nature and 31% of those in Science cited at least one coalition member as a funding source" (Brainard, 2021: 17). *Plan S*, thus, concerns only a fraction of all authors; all the while, high-impact journals need to address this fraction's needs disproportionately.

Exemplary for the neoliberal reasoning underpinning *Plan S* is a talk given by Jean-Claude Burgelman who served as OA Envoy of the European Commission, which is responsible for the founding of *Plan S*. Speaking about the future of open science, he consistently suggests OA to be a key mechanism to advance returns on investments and to capitalise on the OA standing European countries already possess (Burgelman, 2020). In the same vein, Burgelman, among others, voiced the option of a "geo-specific access model" which would mean that OA would be restricted geographically (quoted in: McKie, 2019). The rationale is that this mechanism would pressure countries who have as yet not done so to invest in OA or related policies. And as long as they do not follow suit, these outsider countries should not benefit from the OA publications of European institutions, the reasoning goes.

Note that *geo-specific* and *OA* are conceptually contradictory: if access to a publication is restricted geographically, it is an exclusive club good and not openly accessible. This may evoke a version of the notorious tax-payer argument of OA (Suber, 2003, 2016) which in this case might look as such: since countries in the EU are paying for the EU's research funding, they should benefit from the fruits of this funding, the reasoning of *geo-specific* goes. Though it may be claimed that this argument seems to be a powerful governance tool to enforce more openness in the short run and on the national level, it is particularly illustrative for the differences of accessibilities, or a redistribution/recognition divide in scholarly communication. On the one hand, it is based on a materialism that is easily misinterpreted as coercion and reputation within a country: scholars have to be forced

to publish openly so that taxpayers may benefit from it; a beneficial by-product is the wider distribution and reputation-making potential for the country (as is visible, for instance, in the UK: Crossick, 2016; Finch, 2012). On the other hand, the argument neglects culture within a somewhat supranational scholarly endeavour. That is, it is indifferent to recognition and epistemic injustices of scholarly and scientific community as it builds on the premise that the production of knowledge is a fragmented endeavour of individual countries or scholars (which feeds back to the matter of solidarity in academic freedom). It eradicates the OA reasoning in the debate of whether knowledge is a public good and, thus, contradicts its conceptual basis. If a country would want to be the sole beneficiary of its knowledge production, why not create a publishing platform to which only individuals in that country have free access? It seems ludicrous to pose this question. But then, what else as a patina of legitimacy is behind the logic of a *geo-specific* OA solution? It is certainly not an appeal to democratisation. Much rather, it is an appeal to the rule of reputation.

Speaking from the perspective of the Global South, Becerril-García critically comments on the development of *Plan S* and argues that "a model is being set up which again makes the South and North confront each other, in lieu of seeking to construct common platforms that use technologies for preventing henceforth the possibility of simply being controlled" (Becerril-García, 2019. Precisely such assessments direct attention to the ideal of a democratisation of knowledge that is made impossible by solving a narrow accessibility problem. Yet, by claiming to solve *an* accessibility problem, the subjects pushing for the large-scale OA discussed so far reinforce imperialist structures that are morally disguised: publishing OA is presented as a better publishing as, by so doing, the Global North grants others access to the results of their scholarship. In the following section, I turn to the problems of such a patronising notion.

General accessibility: A democratisation of knowledge and epistemic injustices

A democratisation of knowledge requires not just the dissemination of gratis knowledge, but holistic access to the means of communication, involving authorship, readership, and governance alike; a widening of accessibility to ongoing and future discourses in their making. Only problematising and solving this accessibility would bring about a democratisation of knowledge, which necessitates overcoming epistemic injustices. Accessibility, here, is a matter of recognition preceding redistribution. And in this sense, "questions of distributive justice are better understood in terms of normative categories that come from a sufficiently differentiated theory of recognition" (Honneth, 2003: 126). That which Honneth subsumes under the category of solidarity (1994: 208–210), or *weness* in the terminology of Alexander (2006: 43), is the recognition encountered in, and required for, the understanding of a democratisation of knowledge. Forms of epistemic injustice explain how such recognition is disturbed.

A democratisation of knowledge

The meaning of democratising knowledge is investigated in a variety of approaches (Biesta, 2007; Canagarajah, 2002; Dewey, [1927] 2012; Freire, [1970] 2017; Fuller, 2013; Ogone, 2017; Paasi, 2015; Pitts, 2017). It can be understood as the ways in which knowledge contributes to processes of democratisation and, in dialogue with this, how no individual shall be excluded from being able to know. This takes as its premise that knowledge is more than mere information or fact. Dewey ([1927] 2012: 137) argues that "knowledge is communication as well as understanding" but that

> [d]issemination is something other than scattering at large. Seeds are sown, not by virtue of being thrown out at random, but by being so distributed as to take root and have a chance of growth (Dewey, [1927] 2012: 137).

Witness also how Trotter and Hodgkinson-Williams (2020: 346) ascribe both empowerment and breaking hegemonic statuses of knowledge systems to being able to "assert and define one's

own understanding of what constitutes valuable knowledge". This expresses the requirement of not just consuming knowledge but gaining access to influencing what is being known. Having the ability to understand as well as the capacity to affect what, and how, something is known are equally crucial for the democratisation of knowledge which is, thereby, also related to being able to critique hegemonic orders. This is the case because knowledge is situated so that being a knower presupposes a social interdependence: "those who are not positioned well to influence epistemic resources will find that the dominant resources for knowing are less likely to be suited for knowing those parts of the world toward which their situatedness orients them" (Pohlhaus, 2011: 717). Issues of academic dependency (Alatas, 2003), intellectual imperialism (Alatas, 2000), or the neglect of "epistemic rights of marginal societies" (Ogone, 2017: 13) are likewise articulations of such issues of not being allowed substantial epistemic power. Underpinning the processes of knowing and, accordingly, the processes of producing and communicating knowledge, are themes of power and oppression that are captured by the concept of epistemic injustice.

Miranda Fricker developed a comprehensive concept and established two forms of epistemic injustice:

> [t]estimonial injustice occurs when prejudice causes a hearer to give a deflated level of credibility to a speaker's word; hermeneutical injustice occurs at a prior stage, when a gap in collective interpretive resources puts someone at an unfair disadvantage when it comes to making sense of their social experiences (Fricker, 2007: 1).

The concept was further developed into more wide-ranging social epistemologies and also applied to a general discourse on knowledge (Fricker, 2017; Fuller, 2013) as well as cultural and intellectual imperialism (Alatas, 2000; Bhargava, 2013; McConkey, 2004; Medina, 2011, 2012; Ogone, 2017). Bhargava (2013: 413) calls epistemic injustice in this context a "colonization of the mind and intellectual cultures". Mboa Nkoudou (2020) works out the impact of OA as a driver of epistemic alienation, just as Albornoz et al. (2020) question whether open infrastructure may help achieve more epistemic justice. I build on these theoretical conceptions and concrete investigations, and propose a threefold conception of how oppression and marginalisation take place in scholarly communication:

Testimonial injustice

Firstly, testimonial injustice happens across disciplines in that groups of scholars are pre-emptively silenced. Paasi (2015) implies this in his conception of a Western hegemony that emerged as a power manifestation building on three forms of marginalisation: discrimination of scholars on grounds of their origin, exclusion based on the power of citations and evaluations of journals governed by Anglophone editorial boards (which is further connected to the marginalisation of languages other than English in scholarly communication—a trend non-native-English scholars within the Global North increasingly come to experience first-hand; see also: Gordin, 2017; Hyland, 2015), and, lastly, "the supposedly inferior quality of knowledge produced in non-Anglophone social spaces" (Paasi, 2015: 515).

By means of the unshakable entry threshold—closed, pre-publication peer review—journals in the Global North hold power to the shibboleth to establishing knowledge: English language, specialised terminology, citation networks, and their modes of application in highly specialised discourse communities. The inequity produced through such testimonial injustice is the exclusion from discourses—one that occurs undeterred by economic or bureaucratic hindrances that a narrow accessibility OA may change, for this is not a readership access problem. In the historical development of the production of knowledge, this silencing recursively created, and continues to create today, more silencing by ignoring social groups in the conduct of discourses that are maintained by a Global North hegemony. That the legitimacy of produced knowledge hinges upon the apparatus surrounding its production is one of the truisms of academia in the Global North (see, for instance: Dewey, [1927] 2012; Latour, 1987; Knorr-Cetina, 1981). This includes an agenda setting and the ways of determining what is established knowledge: what are the methods, methodologies, conditions, and terminologies of correct

and justified understanding, and what are the right places for this understanding to be disseminated with. This inherently has an exclusionary effect which is actualised by entry thresholds qua selection, foremost peer review and editorial decision-making. The resulting exclusion turns into oppression when it is no longer justifiable by a crude layperson/expert binary: non-Global North scholars are excluded from discourses despite being experts, for their expertise does not accord to norms of the Global North.

Hermeneutical injustice

Secondly, hermeneutical injustice takes place especially in scholarly fields of meaning-making since their epistemologies are highly socially context-dependent. Bear in mind that this form of injustice refers to cases where the experiences of some social groups in a collective are not reflected in and through interpretive schemes of that collective, for those social groups do not contribute to the collective's hermeneutical resources (Fricker, 2007; Medina, 2012). Medina (2017) even goes so far as to refer to hermeneutical death.

The imbalance of contributions and the resulting hermeneutical indifference disadvantages social groups culturally and materially. To be sure, this disadvantage hinges on the notion of the collective: in the context of an (aspired) global production of knowledge, the collective must comprise of all human subjects. Normatively, then, the drive towards globalisation marks the creation of a new collective that translates—epistemologically—to an inclusive expansion of hermeneutical resources. An exclusive expansion of a particular social group's interpretive schemes results in a hermeneutical oppression of those social groups which are included in the collective, but excluded from being contributors.

The arts and humanities as well as the humanistic social sciences aim to understand meaning by studying products of the human mind as well as the signs and symbols of meaningful human relations and actions (Beiner, 2009; Bod, 2013; Dilthey, [1883] 1922; Small, 2013). They, thus, aim to provide accounts and theories about being human and social or societal interdependence. Such accounts and theories, however, are always geared to just those products, relations, and actions studied. The resulting hermeneutical resources are effectively community efforts. The theories developed are tied towards communities in that the practices of developing them always depend on the particular forms of the social existing within this community at a specific moment in time. Some disciplines are more reflective of this—the philologies or history—but others are less so. Essentially, then, in the sense of a globalised production of knowledge, non-Global North scholars are treated unjust in that they contribute far less to global hermeneutic resources, or their modes of contribution are disturbed by the Northern-influenced global discourse. Moreover, especially within a Global North hegemony, clusters of epistemes are often artificially specialised and outsourced which renders their idiosyncrasies as *another* preemptively: race studies, indigenous studies, or gender studies are but a few examples here.

Consider how W.E.B. du Bois is side-lined among the founding figures of sociology or the way scholars of gender studies are continuously required to authorise their field beyond its scholarliness. The reason for the existence of the scholarly disciplines corresponding to these fields can both be internalised and externalised: the discursive realms exist so that their epistemes have a space for recognition and scholarly advancement on their own. The other reason for why they exist is grounded in the fact that they have not been recognised and advanced within an establishment of disciplines in the first place. The hermeneutic void that the established scholarship generated necessitated their disciplinary independence. All the while, their disciplinary existences remain to be ambiguous solutions that embody their—both intellectually critical and politically non-affirmative—struggles already in the processes of formation (see, for instance, Wendy Brown's (1997) deliberation about the intellectual project of women's studies).

Such hermeneutic void continues in a global scholarly context and its borders are marked by the binary of inclusion and exclusion of scholarly communication. Imagine a Great Library of Alexandria of the 21st Century that strives to represent what it means to be human by collecting memoirs, myths, and meditations from around the world. If

it consisted of, say, 90% of contributions from 10% of the world population, how representative of being human would it be?

Epistemic objectification

I issue a third category of injustice which is that of epistemic objectification: an exclusion by means of silencing the epistemic subject such that an individual (or social group) is treated as an informant while being undermined in her (or their) capacity of being an enquirer. The higher level of thinking is accorded only to one group—scholars in the Global North—while others remain to be mere objects, for their epistemic subjectivity is made structurally defective. Dotson (2012: 24) calls this epistemic exclusion "an infringement on the epistemic agency of knowers that reduces her or his ability to participate in a given epistemic community". This process is exemplified in a case Ogone communicates: the injustice that an African community has been objectified while being entirely excluded from the ensuing discourse and its benefits:

> the Maasai people's genetic resources were 'harvested' without their informed consent […]. The researchers are therefore guilty of conveniently keeping their subjects [turned objects] in unjust ignorance for their own selfish gains (Dotson, 2017: 24).

This intellectual imperialism can be summarised as a colonisation of information in that knowledge is drained from the World to circulate within discourses of the Global North and, first and foremost, make a benefit there.

Discussion: Hegemonic openness and counter-hegemonic initiatives

Solving a narrow accessibility problem does not change epistemic injustices. Quite the contrary, by maintaining hierarchies and the governance of the means of communication, OA solidifies injustices and disguises that imperial structures prevail and do harm. This argument is based on the premise that the production of knowledge becomes more globalised—and that this globalisation is, above all, an expansion of the Global North (or, in alternative terminology: a Westernisation).

Reinforcement of hegemony

Hegemony is reinforced by the impact of large-scale OA. The journal as a "white epistemic institution" (Pohlhaus, 2017: 15) as well as the established book publishing venues keep their structural dominance by manifesting existing power structures in scholarly communication. They keep being governed by scholars of the Global North and their epistemes. Instead of an opening up of discourses—a globalisation in form of a global inclusion—the Global North governance causes an expansion of discourses to be an expansion of the dominance of the Global North that either excludes epistemes or demands the adjustment of other social groups to Western norms. Such an expansion is unreflective of the situatedness of knowledge in that it leads to epistemic adjustments to the norms of existing discourse practices of the Global North. Understanding and meaning, thus, loose parts of their specificity and contextual relevance for the community it was produced in and, originally, for.

Particularly for the assessment of large-scale OA implementations, the impact beyond the hegemonic order has not yet been acknowledged. The push of progressive neoliberal agendas through such implementations has a twofold impact. Firstly, these deals crystallise the way OA is perceived: as a costly endeavour that needs to be purchased and that many countries and institutions cannot afford. Underlying this is the cultural mediation of scholarly publishing: the broad investment into financially-heavy OA manifests culture principles that portray openness as a good to be bought. Such culture principles contradict principles of democratisation that are based on solidarity instead of on commodification (just as the individualist conception of academic freedom). And secondly, they effect a furthering of market imperatives and a commodification of knowledge in that they imply an emphasis on competition which demands even more focus on league tables and rankings which are predominantly concerned with the Global North. Underlying this aspect is academia's *illusio* of the dominance of reputation, extended into a global domain. Neoliberal principles permeating academia allowed for an evaluative structuring that positions everything in relation to each other

in rankings, lists, and units of reputation to be monitored (Brink, 2018; Dowsett, 2020; Moore et al., 2016). This has created an "academic nationalism" where the "claims for the need to internationalize national science are often made in the name of national competitiveness" (Paasi, 2015: 513).

It is this latter point that drives local producers of knowledge globally towards discourses of the Global North so that inequities are solidified in terms of epistemic injustices: scholars are more and more compelled to access means of communication of the Global North, for those count in league tables and rankings. Since large-scale OA developments correspond to such mechanisms, they are manifestations of this solidification. And yet, the task of accounting for the subtle but crucial differences of the drive of non-Global North scholars to Global North publishing venues, or of the latter trying to expand towards non-Global North scholars, is a delicate endeavour. Building inclusive infrastructures regionally is particularly at risk of replicating what Babini (2020: 338-339) calls the "traditional international scholarly communications system built in past decades, concentrated in 'mainstream' journals of the Global North and their evaluative indicators". If *Projekt Deal* or *Plan S* were to democratise knowledge, their enforcement of accessibility would have to account for the fact that their openness is a Global North expansion that risks the potential of democratisation of local projects on a truly—participatory—global scale.

Prevailing language issues

The example of China further illustrates this: studies of the publishing behaviour of Chinese scholars and scientists are very much historical accounts of efforts of formal adaptation to the Global North—or North America and Western Europe—where for "most Chinese scientists […] the gold standard is English-language journals" (Hvistendahl, 2013). Moreover, though China (like India or the United States) does not officially sign the plan, it now also endorses the general principles of *Plan S* (Brainard, 2021; Schiermeier, 2018), which supports their efforts for more national visibility in discourses of the Global North. The monetary reward system in China—where scholars publishing in high-impact journals are financially-rewarded—centres around visibility in the Global North-focussed *Web of Science* publishing index (Quan et al., 2017). Not coincidentally, native Chinese OA journals fail to attract high-impact research submissions, for they have low visibility in Global North publication indices (Shen, 2017). The technicalities of these shifts are easily accessible by means of indices and policies. The epistemic consequences, though, are rarely articulated.

The problem of missing multilingualism only feeds into the structural divides between the Global North and an inclusive idea of Globalisation (Salager-Meyer, 2008): in the UAE "the local language (Arabic) has been sidelined by English as the main language" where the publishing landscape is dominated by commercial publishers and fee-driven OA (Boufarss, 2020: 1712). Other studies provide similar evidence for a pressure to publish in venues of the Global North such as for India (Singh, 2018) or Chile (Broekhoff, 2019). Ogone (2017: 27) describes the futile aim for a balance as a "tendency for African scholars to seek validation from their Western counterparts while simultaneously trying to appeal to their African roots". Ultimately, indicative in this respect is that predatory publishing venues often target institutions outside of a Global North hegemony, especially Asia and Africa, to lure them into a false international visibility (Berger, 2017; Gasparyan et al., 2016; Omobowale et al., 2014; Shen and Björk, 2015). That the OA initiatives discussed above manifest existing hierarchies and, thus, the corresponding mechanisms of reputation and scholarly meaning-making shows that tackling such issues of language and uptake of local OA venues outside the Global North is not of interest. The claims of a democratisation cannot justifiably be made here, since we see much more of a sharing of the rich with the poor than a balanced, mutual sharing.

The counter-hegemonic impact of small-scaling

It should not be left unacknowledged that there are indeed ways the global sharing of knowledge produced in the Global North can be beneficial for all, and that there are institutions successfully acting against the hegemonic order. Firstly,

where knowledge—especially directly appliable knowledge such as from STEM or medical science fields—is made available globally for free, this can have an undeniable positive effect in the short run. Initiatives such as *Hinari*, *research4life*, *AGORA*, or *OARE* aim for global access to knowledge as a bridge to increase the viability of humanitarian efforts. Yet, short term is the keyword here: these initiatives need to be separated from the OA that is pushed for in academia in the Global North. The humanitarian efforts seek short term solutions put forward to solve crises today. Progressive neoliberalism puts OA forward as a solution that aims to keep the established order in the long run.

Secondly, as already mentioned, there are initiatives highlighting that a different OA is possible, one that is bottom-up driven, tied to communities, and conceiving of accessibility in a more democratic way. Sharing knowledge is bound to the notion of solidarity here; neither to taxes nor reward. It is this approach to openness, as Joy forcefully puts it, that means "taking back from commercial publishers the full reins of the means of production of academic publishing and reinventing the academic press as a critical arm of both the research and teaching mission of the University" (Joy, 2020: 324).

I may refer to initiatives such as the small-scaling publishers united in the *Radical Open Access Collective* or the *Open Library of Humanities*. Its institutional philosophies are based on collaboration, co-ownership, and the focus on scholarly communities just as Moore (2019: 129) explicates: "[s]cholar-led publishers are embedded in their disciplinary networks, reflecting a nuanced publishing praxis that is sensitive to the working practices of particular scholarly communities", allowing for initiatives to be experimental and "emancipatory from the assumptions and structures of traditional publishing" (Moore, 2019: 130). To be sure, as these initiatives originate in Global North scholarship, being tied to this scholarship does not make them in any way non-Global North. But they invite replication, create open infrastructures to be re-used globally, and showcase that governance of the means of communication can be democratised. They, thus, provide points of reference for both cultural and material change. In fact, since these initiatives are small-scaling—achieving their potential by many small community-owned initiatives (Barnes and Gatti, 2019)—their success does not depend on the uptake of those publishing initiatives already within the network, but on replication. Since this is the case, these initiatives may as yet seem to be weak in their implementation and have only little structural effect compared with the shift towards large-scale implementations of OA. Moreover, by bypassing established publishing structures entirely, it can be argued that their efforts are not about OA at all, but about a radically new version of collaborative publishing more generally. Precisely this, uptake through collaborative replication, may mark their potential for a different future that claims power as a diversity of bottom-up initiatives in the sense of Wright's eroding of the established system: building "more democratic, egalitarian, participatory economic relations where possible in the spaces and cracks within this complex system" (Wright, 2019: 60).

Furthermore, this category needs to account for initiatives already going a different way such as *AmeliCA* or *Redalyc* which achieve a democratic accessibility, allowing for community-owned processes and open publishing without author charges. Governance of the means of communication is spread across scholarly communities here. Especially these are important as counterparts to *Plan S*: in the end, investments in large-scale OA deals and *Plan S* could have likewise been investments in European imitations of such South American initiatives. Initiatives focussing on the minutiae of, for instance, intellectual property rights (Beer and Oguamanam, 2014) or the governance and local applicability of open data infrastructures (Bonina et al., 2020) are likewise vital for the success of a democratisation of knowledge, particularly if they do not simply put up technological means but accompany a corresponding culture change as well.

Conclusion: The reciprocity of technology and culture

"The solution is not to 'integrate' [the oppressed] into the structure of oppression, but to transform that structure so that [the oppressed] can become 'beings for themselves'" (Freire, [1970] 2017: 47).

What Freire suggests as a solution to the banking concept of education is precisely what OA does not achieve with its large-scale manifestations in academia in the Global North: fundamentally transform its communicative power structure so that epistemic injustices can be overcome. This is what I explicated in this article.

I provided the argument that the hegemonic accessibility problem is short-sighted and that, by pushing for such OA, established subjects in academia in the Global North are not interested in democratising knowledge but seek to retain owning the governance of the means of communication. I showcased dominant solutions to this accessibility problem, culminating in a critique of the current large-scale implementations of OA in light of an ideal to democratise knowledge. The development of a deeper understanding of epistemic injustices helps apprehending the shortcoming of the narrow accessibility problem. This approach to openness solidifies the powers inherent in the established means of scholarly communication and, thus, reproduces existing inequities. It reinstitutes that large parts of the means of communication remain within a Global North hegemony, despite all counter-efforts of small-scaling, community-centred publishing initiatives. Moreover, and highly problematic regarding the normative statements of OA being a better publishing, these practices of OA disguise that the existing inequities prevail and that the cultural orders of knowledge embodied by practices have not changed: knowledge produced by the Global North is deemed superior.

Conclusively, this diagnosis positions OA next to other technologies that promised more equity but could not deliver on this promise. Early conceptions of revolutionary change are often driven by a technological determinism: Marx's historical materialism provides a reductionist account as do premises in McLuhan's media analyses. Up until today, new technology is often welcomed as transformative in that it is said to allow for a restructuring of established power relations. Materialist conceptions focus on redistributional mechanisms and neglect cultural aspects and a preceding conception of recognition that are significant for making such redistribution necessary in the first place. Technology is not fully conceptualised if the culture it is rooted in as well as its governance and entrenched hierarchies are ignored. Above all, the history of the internet is one such example where neutrally-networked machines could have provided a level playing field (Morozov, 2011, 2013). Today, however, it is but a replica of the hegemony as it has existed before the establishment of HTML. The Dark Web is the anarchic manifestation sidelining the establishment just as SciHub does for academia. And at least in academia, such anarchy will stay as a solution until better alternatives are established on a broader scale. Similarly, OA in its large-scale, commodified formation in the Global North, was not able to take advantage of the redistributional potential of new media technologies, resulting in the replication of old hierarchies, since it did not build on an improved notion of recognition. Successful change through technology is contingent on the problem that it is set to solve: the problem of accessibility is posed in a way that allows for OA to being only a cosmetic shift within existing epistemic hierarchies, without posing significant change to these hierarchies themselves. We need to look at culture principles just as we go along establishing technological means.

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Notes

1 According to early estimates of about 10,000 articles annually published with *Wiley,* the annual costs for the deal with this one publisher alone will amount to €27,500,000 plus additional publishing fees; see: Knöchelmann (2019b).

Godin Benoît (2020) *The Idea of Technological Innovation: A Brief Alternative History*. Cheltenham: Edward Elgar Publishing. 208 pages. ISBN: 978 1 83910 401 5.

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Science and technology are often treated as inextricably linked, whether we talk about Science, Technology and Innovation policies, Responsible Research and Innovation or our own field of Science and Technology Studies. It is this link that is challenged by Godin in his historiography of the concept of technological innovation. Focusing on developments in the UK and the US from the Second World War onwards, he provides ample evidence that technological innovation is not only more than applied science, but also "that practitioners (...) have been pioneering theorists of technological innovation, beginning in the 1950s. It is the practitioners' view that scholars articulated later on and theorized about" (p. 3).

The book is detailed and rigorous in supporting this claim throughout. Godin analyses a rich collection of policy documents and consultancy reports from the 1950s to the present day to support his thesis. He systematically investigates the definition of technological innovation these documents use to identify (overlapping) phases of how technological innovation has been conceptualised: as science applied, as an outcome, as a process, and as a system. The final chapters of the book show how these different conceptualisations have affected innovation policy in the past and today. This systematic investigation paints a picture of technological innovation as a field of practice with its own actors, policy recommendations and trends. Scholars are shown to have contributed to this field not by laying its foundations, but by explaining and articulating extant views and developments. Furthermore, Godin's systematic investigation into the idea of technological innovation allows him to make meaningful connections to topics outside the scope of the book, such as earlier trends that paved the way for the idea (e.g. fears of unemployment due to industrialisation in the 1920s) and, more recently, a proliferation of non-technological innovation concepts (inclusive, responsible, sustainable...).

Some insights from the book that I found particularly helpful as an innovation researcher concerned Godin's focus on organisations rather than nation-states, his emphasis on the driving force of economic growth and competitiveness as innovation policy goals, and the consequences of the innovation discourse on the relationship between science and innovation.

First, Godin does not focus on nation-states and their policies, but on the institutions within and behind them and their influence. This allows him to identify a number of actors that have strongly shaped policies in their own nation and beyond. The US Department of Commerce is an important one, but particularly the OECD emerges as an organisation influential with respect to the innovation policies of its members. Its role certainly seems to warrant greater attention by innovation scholars.

Second, a stark contrast emerges between discourses and policies on technological innovation, which are constantly in flux, and the monolithic economic policy goals of growth and

competitiveness that drive them. Replacing 'full employment' as economic policy focus after the Second World War (p. 22), economic growth and competitiveness have remained in place ever since. The book documents almost no reflection among practitioners on the importance of those goals, only on how they could best be achieved. Given public controversies over scientific and technological developments at the time, one wonders if those policy goals were never challenged, or whether challenges were brought forward but dismissed.

Science and science policy remain on the periphery of Godin's book. However, his analysis shows a progressive erosion of the assumed importance of science among innovation practitioners. The linear model still conceptualises innovation as science applied, and thus considers science necessary and sufficient for technological innovation. Later conceptualisations focus more and more on meeting (market) demands, technology adoption and commercialisation. The book thus makes clear that there has long been scepticism among powerful innovation actors about the relative importance of science for the economy. With ongoing calls (especially from the OECD) to integrate science and innovation policy further, the book serves as a warning to scientists that such developments might challenge their societal legitimacy (and funding) if they do not pay close attention.

The main limits of this book arise inevitably out of Godin's choice to focus on meticulously documenting practitioner work on innovation. This gives us a clear, comprehensive and verifiable picture of the *entities* that have been involved in the technological innovation discourse, and the evolution of the *discourse* itself. However, it limits insight into the influence, power and *contextual significance* of those entities. Typical STS tools such as narrative research and sociotechnical imaginaries might carry their own risks when developing data into a coherent story, but I regularly found myself wondering which of the many reports had been more or less influential, and how, and why. When Godin draws wider causal or normative lessons from his findings, his claims are intriguing, but more as suggestions for further research than as arguments. For example, at the end of chapter 7, Godin warns that academics think about responsible, sustainable, etc. innovation as contestations of, and alternatives to, technological innovation (p. 139). However, policymakers are so entrenched in the *technological* innovation framework that they rather see such concepts as its extensions and legitimation. In this way, academics could unintentionally strengthen rather than contest the notion of technological innovation among practitioners. While this is a legitimate concern, the opposite could also be argued on the basis of Godin's data: that a concept such as responsible innovation has only been able to become influential among practitioners by engaging with the innovation discourse, where a different and more radical concept might not have gained any traction.

A similar limit is visible in the relation between science and innovation sketched in the book. Godin argues that "science policy has its historians (...) but innovation policy has none" (p. 143). Unfortunately, he does not draw on these historians to explain whether scientists and science policy have responded to the increasing marginalisation of science by innovation practitioners. More generally, it was not always clear to me whether the lack of interactions with non-practitioners in the book is due to its particular focus on the practitioner community, or whether such interactions had largely been absent.

To call these limits criticisms would not do justice to the book: it promises to be a historiography of the idea of technological innovation, and to show that practitioners rather than scholars have developed this idea. It fully delivers on both promises. Its empirical material is rich and detailed and the different conceptualisations of technological innovation are clearly described. As such, it is a valuable resource for STS scholars researching the concept of technological innovation, its significance, and its possible futures. Moreover, by showing the discourse's deep roots, its consistent focus on growth and competitiveness, and its movement away from fundamental science, the book cautions academics against optimism that developing concepts of 'responsible' or 'sustainable' innovation is itself enough to drastically reorient a discourse that has been developing continually, but always in fundamentally the same direction.

Benjamin Ruha (2019) Race After Technology: Abolitionist Tools for the New Jim Code. Medford: Polity Press. 172 pages. eISBN: 9781509526437

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The myth of technological neutrality—the idea that technology and tech creators are neutral actors free of implicit ethical dimensions and values—has received increasing pushback in recent years. As technology becomes increasingly ubiquitous and troubling tech incidents grow in number (like Google Photo labeling Black people as gorillas), more people are questioning the exalted status of technology in society. However, these incidents are still frequently perceived as 'one-offs' rather than symptoms of an underlying malaise.

This blinkered analysis is precisely what Ruha Benjamin critiques in her 2019 *Race After Technology: Abolitionist Tools for the New Jim Code*. The book lays bare the ways in which modern technology creates, supports, and amplifies racism and white supremacy. Offering a wide-ranging examination of how racism in its many forms is manifested in modern technology, the work journeys through predictive policing systems, AI-judged beauty contests, genetic and biometric testing, robot labour, pop culture, virtual reality, and other modern inventions.

The book opens by establishing a broad foundation for understanding technology, race, and what happens when they collide, effectively setting up Benjamin's later chapters by cracking open default assumptions about technology and specifically challenging the idea of technological neutrality. Benjamin productively broadens the definition of 'code' away from narrow considerations of computer instructions to understanding the way names and race are themselves code and are coded with important information. We are then asked to think of race itself as a technology; a *techne*, a way of doing things and structuring society. With this eye to the intertwined nature of race and technology, she defines her central idea of the 'New Jim Code' as "*the employment of new technologies that reflect and reproduce existing inequities but that are promoted and perceived as more objective or progressive than the discriminatory systems of a previous era*" (p. 3, italics original). Building on Michelle Alexander's 2012 book *The New Jim Crow*, which highlights how the façade of modern 'colourblindness' masks and justifies the disproportionate incarceration of Black people, Benjamin compares historical and contemporary technologies to show how racism via technology has changed forms rather than disappeared.

Each of the 5 chapters examines a specific aspect of the New Jim Code: Engineered Inequality, Default Discrimination, Coded Exposure, Technological Benevolence, and Retooling Solidarity, Reimagining Justice. They read largely independently of each other; the book's argument is less a sequential development of ideas than an exploration of theme. Benjamin herself frames the book as a "field guide" (p. 4) and acknowledges that "in writing this book I have admittedly been more interested in connections rather

than in comparisons" (p. 109). Her monograph is structured as a flow of short case studies, each of which is concisely examined and revealed as a specific instance of technological racism. Food for analysis is gratifyingly wide-ranging: résumé screening software, Kodak's 'Shirley Cards', search engine results, popular TV and film, personalized advertising, the science fiction genre, facial recognition algorithms; there is seemingly nothing that escapes her holistic focus.

The book reads smoothly, but may be too challenging to readers without a modest understanding of social sciences or critical theory. The writing style has an elegant and natural flow and distills complex ideas into wonderfully quotable and pithy phrases—Benjamin quips that "institutional racism in this country is an ongoing unnatural disaster" (p. 56) and notes how tech firms ask us to "*pay no attention to the man behind the screen*" (p. 6, italics original). Her compositional style of arguing through repeated example, rather than through large case study or via purely theoretical analysis, is highly effective and each new example is neatly tied into the flow of ideas. Over the course of the book, *Race After Technology* spins this web of examples over the reader's own understanding of technology and leaves the reader with a new lens to view the world around them.

The book's great strength is its holistic framing of how technology supports and is supported by racism. Benjamin clearly and repeatedly demonstrates how human racism—implicit and explicit—manifests itself in the design of technology. She convincingly lays out how the selective *use* of technology is a factor in reinforcing racism—most prominently, arguing that investing in supposed 'genetic' causes of better learning, without examining environmental ones, amounts to a modern eugenics. Throughout the book, Benjamin pulls back this layer of racial innocence and so-called 'evidence-based' or 'neutral' approaches that are used to market the deeply racist technologies underneath. Fundamentally, *Race After Technology* asks us to understand how historical racism and technology inform their modern versions, and shows us that this understanding is vital if we want to escape its current and future manifestations. This is a critical intervention, given how "[d]etachment in the face of this history ensures its ongoing codification" (p. 40).

Benjamin's approach does have its limitations. It is largely America-focused; while there are examinations of international issues like the Chinese social credit system, the majority of the examples are American. Similarly, while Benjamin does not avoid intersectional approaches when examining how technology affects racialized people, most of the book's analysis is on American Black people as a group. Perhaps the clearest of its limitations is that readers enticed by the subtitle (*Abolitionist Tools for the New Jim Code*) may be disappointed at the lack of concrete suggestions on how to achieve said abolition. Benjamin provides examples of successfully anti-racist technologies, highlights the work of several organizations challenging racism in technology, broadly advocates for incorporating anti-oppressive values, and suggests technology audits, but stops short of general recommendations. Yet this reluctance to advocate immediately actionable 'fixes' comes from the book's demonstration that the New Jim Code is a shapeshifter and real and lasting solutions will need to be crafted to the form it takes at any moment.

The book is a beautiful synthesis of real-world examples and disparate ideas, but consequently advances few truly new concepts aside from the idea of the New Jim Code. Instead of a revolutionary new theory, its major contribution may be in exposing these ideas to a broader audience and as a catalyst for deeper examinations of the technologies and situations that Benjamin touches on. Scholars studying the intersection of technology and society, and those in technical fields looking for an outside critical understanding of their own work, will find it an important jumping-off point or a valuable resource to deepen their knowledge on understanding racism within their fields. The book is more urgent and relevant than ever, given social reckonings with Black understandings of systemic racism following the murder of George Floyd in May 2020. Benjamin's work also helps expand the growing public understanding of technology's harmful effects, beyond well-established concerns about social media, tech culture and hardware manufacturing.

Valuable to a broad array of audiences including the general public, the book is an important addition to the small but growing niche of well-researched yet accessible books on technological discrimination including Virginia Eubanks' *Automating Inequality*, Safiya Noble's *Algorithms of Oppression*, and Cathy O'Neil's *Weapons of Math Destruction*. Overall, *Race After Technology* is an extremely well-crafted and timely work on how society produces and perpetuates racist technology. Despite its recent publication, this book is set to be a foundational work and modern classic in multiple fields.

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