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Testing Reflexive Practitioner Dialogues: Capacities for Socio-technical Integration in Meditation Research

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Abstract   To put frameworks of Responsible Innovation and Responsible Research and Innovation (R(R)I) into practice, engagement methods have been developed to study and enhance technoscientific experts' capacities to reflexively address value considerations in their work. These methods commonly rely on engagement between technoscientific experts and social scholars, which makes them vulnerable to structural barriers to interdisciplinary collaboration. To circumvent these barriers, we adapt Socio-Technical Integration Research (STIR) for broader use within technoscientific communities. We call this adaptation: reflexive practitioner dialogues. While the primary aim of this article is to introduce and explain the methodological adaptation, we also analyze results from a pilot study with participants who are involved in research on contemplative practices such as mindfulness meditation. The analysis is guided by research questions that sought to assess whether and under what conditions the practitioner dialogues support reflexive and practical engagement with value considerations in participants' work. The results indicate that reflexive practitioner dialogues can stimulate reflexive awareness of value conflicts and help re-direct decision-making responsively. We characterize the conditions facilitating such responsiveness as "value exonovators," highlighting the oft-unacknowledged interpersonal relational practices that support collaborative engagement with value considerations. We suggest that "exonovation"—exposing the strengths of given practices for their improvement—can support R(R)I practices by directing analytical attention to their micro-level carriers.

Keywords   Responsible innovation · Socio-technical integration · Capacity building · Decision-making · Exnovation · Value levers

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Introduction

Interrelated discourses on Responsible Innovation and Responsible Research and Innovation, summarized by the acronym R(R)I [1], have been widely embraced by policy makers and academic scholars who seek to better align research and technology development with value considerations. In these discourses, technoscientific experts such as natural scientists and engineers are often presented as key actors

expected to deliberately engage with values in their work. R(R)I scholars have pointed out that it is difficult to impose such engagement from the outside and suggest that it should be nurtured by scientists themselves [2–5]. To that end, "socio-technical integration" was introduced as a policy concept, which denotes the requirement to integrate societal concerns and value considerations directly into research and development practices [6]. In response to the proliferation of respective policies and programs, expert engagement methods have been developed that facilitate "collaborative socio-technical integration" ([7], p. 39) between, on the one hand, social scientists and humanities scholars, and, on the other hand, natural science and engineering researchers. A core group of these methods builds on the assumption that socio-technical integration already takes place in expert practices; it is "any process by which technical experts account for the societal dimensions of their work as an integral part of this work" ([8], p. 74). Socio-Technical Integration Research (STIR) is one such method and seeks to both study and enhance the "capacity" [9–11] of technoscientific practitioners to reflexively recognize and modulate socio-technical integration.

Numerous studies that employ such methods have analyzed the barriers to R(R)I [12–14], expert engagement (as opposed to public engagement) [15–17], and collaboration as a route to socio-technical integration [18–20]. Barriers commonly refer to structural issues, such as power asymmetries, cultural norms, institutional infrastructures, limited resources, and management imperatives of increased productivity. These barriers constrain open-ended, time-intensive, and experimental engagement across disciplinary divides—qualities that some think are needed to explore alternative values and perspectives collaboratively [21–23]. Although scientists acknowledge the importance of taking time for reflection, they tend to perceive activities with social scholars as additional, cumbersome impositions on their already busy schedules [24]. Moreover, these activities seldomly integrate into the cultural practices of technoscientific communities, but rather remain set apart from what scientists consider as their core epistemic work (ibid.).

To circumvent these and related difficulties pertaining to interdisciplinary collaboration, we field-test an adapted version of STIR that we call *reflexive practitioner dialogues*. We find that these dialogues provide scientists and engineers with a systematic way to identify and consider value considerations on their own, independently from an embedded social scholar. As these dialogues do not require the same kind of intensive social scientific collaboration as most applications of STIR, we suppose that they could become incorporated into daily research routines. In this article, we present the results from a pilot study which tests the potential of reflexive practitioner dialogues to elucidate socio-technical integration in meditation research, the study of contemplative practices like mindfulness with neuroscientific, psychological, and clinical approaches. The analysis examines the conditions and process of reflexive practitioner dialogues, highlighting the micro-level carriers of dialogic interactions—interpersonal dynamics, improvisational skills, and embodied experiences of affects—which have received little attention in R(R)I literature (for exceptions, see [25, 26]). The following research questions guide the analysis: How do technoscientific experts perform and experience reflexive practitioner dialogues? Can these dialogues elucidate and modulate socio-technical integration? Which conditions enhance the process and outcomes of expert engagement in reflexive practitioner dialogues?

While the primary aim of this article is to introduce and explain the methodological adaptation, we also report on initial results. The results indicate that reflexive practitioner dialogues can elucidate and modulate socio-technical integration. They enable identification and reflection on socio-ethical issues, deepen the understanding of known value conflicts, and so enhance the practical management of such conflicts. This finding contributes to R(R)I literature on expert engagement, in particular collaborative socio-technical integration. As interdisciplinarity is a characteristic of collaborative socio-technical integration methods, they typically do not provide practical tools that can be deployed by technoscientific practitioners themselves. This study, however, suggests that reflexive socio-technical integration is not contingent on ongoing interdisciplinary engagement, but can emerge in dialogues between technoscientific practitioners if these dialogues are structured by an integrative technique for reflection.

The analysis further identifies conditions that support reflection and modifications of work-related practices. These conditions are found to be

relational practices elicited in reflexive practitioner dialogues. To analytically capture relational practices that open up productive reflections on values and value conflicts, we coin the concept "value exnovators." We examine three value exnovators—extending STIR questions, recognizing shared epistemic living spaces, and attending to embodied ethics—by analyzing our empirical material through the theoretical framework of midstream modulation [27]. This analysis contributes to the body of practice improvement studies guided by Mesman's concept of "exnovation" [28], which exposes the strengths of given processes or practices for their improvement. Whereas prior practice improvement studies have focused on optimizing the efficiency and safety of professional work in medical settings [29–31], we deploy exnovation as a lens to foreground the latent competencies within the application of a social science method [32]. Hence, we widen the use of exnovation by investigating whether it could improve our own expert practices in conjunction with those of our collaborators.

This article is structured in eight sections. After this introduction (Introduction section), we situate reflexive practitioner dialogues in existing R(R)I literature on expert engagement (Review of R(R)I Expert Engagement Methods section) before introducing the method (Method of Reflexive Practitioner Dialogues section). The method section also describes the methodological core elements of STIR: the STIR decision protocol (STIR Decision Protocol section) which guides reflexive practitioner dialogue and the midstream modulation framework (Midstream Modulation Framework section) which is used for analyzing the effects of the dialogues on practitioners' workflows. Subsequently, we introduce the analytical concept of value exnovators (Analytical Concept of Value Exnovators section) which is applied to our pilot study. We outline the design of the pilot study (Pilot Study Design section) before presenting the empirical analysis (Empirical Analysis section). The empirical analysis is organized into three sub-sections, each elaborating on another value exnovator. Finally, we discuss our findings (Discussion section) and conclude by highlighting our contributions to R(R)I expert engagement methods (Conclusion section).

Review of R(R)I Expert Engagement Methods

To situate reflexive practitioner dialogues in R(R)I literature, we first introduce the ways in which engagement methods have been mapped. We then zoom into different forms of expert engagement to discuss their strengths and weaknesses, which establishes the methodological background against which we develop reflexive practitioner dialogues. R(R)I expert engagement methods—sometimes also referred to as "practices," for instance in the RRI-Practice project (rri-practice.eu) funded by the European Commission—are seen here as systematically conceived (sequences of) actions or events that aim to realize values, dimensions, or characteristics of R(R)I. Although definitions of R(R)I are multiple and complex [33], it is sufficient for our purposes to briefly distinguish between Responsible Innovation (RI) and Responsible Research and Innovation (RRI) to identify the values and frameworks that engagement methods seek to put into practice. Although there is significant overlap between them, RI is generally thought of as an academic concept proposing a governance framework with several highlighted dimensions, including anticipation, inclusive deliberation, reflexivity, and responsiveness, which should be embedded in research and technology development [34]. By contrast, RRI is typically seen as a public policy label originating in the European Commission's Science in Society program [35] which has six characteristics, also labeled as "keys" ([36], p. 217): ethics, governance, public engagement, science education, gender equality, and open access.

Scholars have mapped engagement methods according to which RI dimension or RRI key a method promotes. For example, Long et al. categorize tools into the four RI dimensions [37]. For this purpose, they adapt and combine prior reviews of activities associated with R(R)I, including one by Lubberink et al. in business contexts where knowledge management is identified as an additional RI dimension [38]. The RRI Tools website (rri-tools.eu) organizes methods according to RRI keys and the profile of the person searching for information. These ways of mapping engagement methods, however, neglect that some approaches do not neatly fit into an RI dimension or RRI key. Collaborative sociotechnical integration, for example, tends to address multiple RI dimensions in the engagement process,

in which several RRI keys may turn into objects of interdisciplinary inquiry [7, 39]. Therefore, we find it more useful to distinguish between methods in terms of the actors they engage (wider public, technoscientific experts, industrial actors, university students) as well as the research and development stage at which engagement takes place (upstream, midstream, downstream) [40, 41]. More specifically, we focus on methods that engage technoscientific experts in the "midstream" of innovation projects, when their capacity to reflexively direct research and technology processes is neither fully constrained by "upstream" funding agendas, nor is it limited to an instrumental "downstream" approach to their implementation [42].

There are different forms of midstream expert engagement: time-intensive regular interactions between a social scholar and a specific group of technoscientific practitioners [7, 43, 44], workshops and walkshops [37, 45, 46], card-based discussion groups [47, 48], and tools for self-use [49–51]. Each form comes with different opportunities and drawbacks. Whereas time-intensive engagement has been more successful in modulating research practices and development trajectories than one-time workshops or discussion groups [52], regular interactions between a social scholar and technoscientific practitioners are vulnerable to the aforementioned barriers to interdisciplinary collaboration. Workshops, walkshops, and card-based discussion groups eschew such barriers if they invite technoscientific collaborators to collaborate with one another rather than with a social scholar. Card-based discussion groups further support reflection with material elements that help participants who possess less rhetorical resources to express their thoughts [53]. While card-based discussion groups are suitable for PhD workshops and team-building events, it seems difficult to incorporate them into busy work routines when researchers may feel reluctant to take the time for assembling a group and playing a game that may appear unrelated to day-to-day research. Reflection tools for self-use, by contrast, appear to be much more suitable for use on a day-to-day basis. Yet, Malsch concludes from her review of these tools: "Even though the tools are suitable for individual use without prior training, they may only contribute in a substantial way to responsible innovation by employment in a societal context" ([51], p. 60). Her understanding of the "societal context" refers to workshops, education curricula, or

research projects where tools for self-use can be monitored, tested, and developed further.

Against this backdrop, the development of reflexive practitioner dialogues combines the strengths of different expert engagement methods while addressing their weaknesses. To put it in a nutshell, reflexive practitioner dialogues involve dyadic interactions structured by the STIR decision protocol between technoscientific practitioners. Regular use of the decision protocol is assumed to promote reflexive and practical modulations of technoscientific workflows. The material component of the protocol, a 2-by-2 grid that practitioners complete together during the dialogue, offers additional rhetorical resources by inviting participants to articulate thoughts in writing. As the dialogues take place among technoscientific practitioners from the same field of research, they evade the obstacles pertaining to interdisciplinary collaboration. Moreover, as they are short in duration (20 min for one dialogue) and directly relate to everyday decision-making, their integration in work routines seems feasible. Although we consider reflexive practitioner dialogues as a tool for self-use, we acknowledge that promoting socio-ethical reflection in science and engineering cultures does not only require tools that structure thinking and discussion, but also guidance on how to use them. Therefore, they are introduced to specific technoscientific communities in workshops curated by social scholars. In the following, the theoretical background and methodological components of reflexive practitioner dialogues are described in greater detail.

Method of Reflexive Practitioner Dialogues

Reflection is considered the core of many methods, techniques, and tools that aim to put R(R)I into practice [2]. These practical approaches frame reflection on the underlying assumptions and values in technoscience as a means to change research and innovation systems. Although change is needed across various spheres, temporalities, and actors to bring about R(R)I, expert engagement methods focus on the level of technoscientific practitioners, presupposing that they play a significant role in making research and development more socially responsive. These methods ask practitioners to reflect on their practices so as to recognize possibilities for shifting science and

technology trajectories into more responsible directions. Strictly speaking, reflection can be distinguished from reflexivity [54]. While reflection mirrors what lies in someone's field of view, reflexivity goes beyond reflection in that it also includes a focus on the self. Reflexivity recognizes how attributes of the subject constitute and are constituted by objects in the field of view.

To facilitate reflexivity, collaborative socio-technical integration methods tend to rely on interdisciplinary collaboration. This is because technoscientific expertise is often bounded by its specialized focus. Technoscientific framings of problems and solutions entail blind spots, for instance with regard to how researchers' attributes and the socio-cultural orchestration of laboratory practices shape the object under study [55–57]. Interdisciplinary collaboration reveals and addresses these blind spots either by building experts' reflexive capacities or by supplementing their disciplinary capacities [7]. Methods that seek to build reflexive capacities assume technoscientific practitioners to already have capacities for reflection on societal concerns and values, but acknowledge them to be constrained by disciplinary logics, cultures, and structures. Such latent capacities can be accessed and enhanced if frictions in working across disciplinary boundaries throw field-specific norms into relief and leverage deliberation on alternative ways of doing research in a collaborative process. Methods that supplement disciplinary capacities, by contrast, represent capacities for socio-ethical reflection as absent or otherwise missing from technoscience. By embedding a social scholar into a technoscientific environment, new goals and commitments as well as alternative forms of knowledge, content, and resources can be introduced from the outside (ibid.).

Both types of methods involve interdisciplinary collaboration, which makes them vulnerable to a range of obstacles, including but not limited to cultural and language barriers [58], asymmetric power hierarchies [59], diverging expectations and work routines [60], lack of trust [61], and time-intensive research processes that clash with management demands for efficiency and quick tangible outputs [22]. As social scholars stand outside the professional domain in which they seek to collaborate, technoscientific practitioners may perceive their involvement as slowing down research processes or hampering innovation. Therefore, social scholars' contributions may be silenced or remain unembraced by their technoscientific collaborators.

To mitigate such difficulties, the idea of "planned obsolescence" ([62], p. 1150) has recently been introduced in practice improvement research. While planned obsolescence has negative connotations in economics and industrial design where it refers to purposely frail designs that limit a technology's period of use artificially [63], Carroll and Mesman use the term in practice improvement research in a positive manner [62]. Their premise of planned obsolescence is that "learning through reflection [on practice]" [64–66] ultimately becomes an element of professional teamwork. Through facilitation from a social scholar, professional practitioners learn techniques for reflection. The techniques are used among practitioners, which over time makes the social scholar's presence obsolete.

The idea of planned obsolescence has the potential to be highly relevant to R(R)I expert engagement. Introducing an "outsider" into technoscientific environments who flexibly adopts different roles (e.g., critical friend, change agent, armchair critic) in interactions with scientists or engineers is thought to be "a useful way to have legitimate concerns about sociotechnical practices heard in a context that [is] otherwise quite closed to friendly criticism" ([59], p.18; see also [67]). If we assume, however, that technoscientific practitioners have their own capacities to critically approach their sociotechnical practices, planned obsolescence becomes promising as a form of R(R)I expert engagement. Based on this assumption, Fisher and Mahajan suggest that socio-technical integration can be enhanced by "humanistic engineers" who are "able to perform their own socio-humanistic critiques in the absence of [interdisciplinary] dialogue" ([68], p. 1). This suggestion has recently been echoed by Smith et al. who point out that R(R)I research "does not demand a particular methodology such as interdisciplinary collaboration" ([69], p. 202). In fact, they argue that project-based interdisciplinary collaboration is not potent enough to build new institutional norms, organizational configurations, and routine ways of thinking that embed R(R)I science and technology development. For such institutional change to happen, more durable infrastructures and approaches for opening up reflexive spaces in technoscientific routines need to be created, which transcend individual projects.

Yet, the literature is "surprisingly silent" ([52], p. 201) on what such infrastructures and approaches, let alone ways in which technoscientific practitioners perform their own socio-humanistic critical reflection, actually look like. In an attempt to develop a method that facilitates this kind of reflection in a sustainable, enduring manner, we introduce reflexive practitioner dialogues. The method pairs practitioners from the same field of expertise to engage in collaborative reflection guided by STIR. We investigate whether reflexive practitioner dialogues have effects similar to those produced by STIR studies that rely on interdisciplinary collaboration (see examples below).

Reflexive practitioner dialogues draw on the STIR method for the following reasons. First, it is a pre-existing, already-developed approach that provides a structured way to explore socio-ethical considerations in technoscientific decision-making. Second, the method has been tested in over 80 empirical studies worldwide, which have shown that STIR can facilitate reflexive, discursive, and material changes across diverse contexts [9, 25, 27, 70–74]. Comparable expert engagement methods (e.g., reflexive tools for self-use, upstream engagement, Constructive Technology Assessment) appear to be equally successful in stimulating reflexive changes, but, to the best of our knowledge, document few if any practical changes [51, 75–77]. As we aim to develop a method that puts R(R)I directly into practice, we choose to build reflexive practitioner dialogues on the basis of STIR. Third, STIR was developed to access technoscientific practitioners' own capacities to reflect on values. Instead of introducing values and wider contextual dimensions through the expertise of a social scholar, scientists and engineers are assumed to widen their value horizon automatically by responding to reflexivity-inducing questions inspired by a Socratic mode of inquiry [39, 78]. Accordingly, not a social scholar but an integrative technique is needed to elucidate socio-technical integration, which is why STIR lends itself to be used in the planned obsolescence mode.

The methodological core of STIR consists of three elements: the decision protocol, midstream modulation, as well as an ethos and set of approaches deployed by an embedded social scholar. As reflexive practitioner dialogues seek to render the embedded social scholar obsolete, only the first two elements will be presented in what follows. While the decision protocol is the integrative technique structuring reflexive practitioner dialogues, the midstream modulation framework helps analyze the reflexive and practical changes that these dialogues may stimulate.

STIR Decision Protocol

The STIR decision protocol structures reflection on the contextual dimensions of technoscientific decision-making [9]. The protocol posits that in any given instance, technoscientific experts make and remake numerous, overlapping decisions, each of which is situated within a broad range of contexts. These wider contexts imply a diverse array of ethical, political, economic, historical, social, cultural, personal, material, and other considerations that any decision could potentially take into account. STIR treats routine decisions as the unit of analysis for documenting, probing, and assessing how experts can, do, and could take into account and respond to a variety of considerations in work-related practices. In this way, it elucidates how the technical is integrated with the social and how it could be integrated differently so as to address or resolve conflicts between value considerations and technical logics. To probe experts' reflexive capacities, the STIR decision protocol is an integrative technique for collaboratively mapping out an impending decision in real-time (ibid.).

The decision protocol structures dialogic interactions in four conceptual components: opportunity, considerations, alternatives, and outcomes. They are collaboratively mapped out in a 2-by-2 grid through questions meant to unpack each conceptual component. One dialogue partner takes on the role of a "maieutic inquirer" ([78], p. 163) who guides the other through the questions by first identifying an opportunity for decision-making and then moving through the grid clockwise while leaving flexibility for iterations. The questions follow the "ethos of engagement" in STIR (unpublished 2018 STIR manual by Erik Fisher), a set of principles and approaches that are meant to ensure methodological rigor, ethical transparency, and careful listening. Such questioning animates the use of reflective and relational skills underutilized in work environments, which prioritize fast over deep and individual over collaborative reflection [79]. The decision protocol aids the technoscientific practitioner whose impending decision is being discussed to employ such oft-dormant

skills, which help him or her reflexively engage with value conflicts and change work practices in response to value considerations.

Midstream Modulation Framework

Midstream modulation is an analytical framework that theorizes changes in expert practices over time [27, 42]. The framework is commonly used to identify and analyze such changes in empirical material gathered in STIR dialogues. While the "midstream" refers to the research and development phase of innovation projects, "modulations" denote gradual alterations that subtly shape research trajectories and innovation pathways. Taken together, "midstream modulation" captures such socio-material alterations and relates them to scientists' and engineers' reflective interactions with broader contexts. The alterations are traced in a modulation sequence that may pass sequentially from *de facto* over *reflexive* to *deliberate* modulation. The three types of modulation are only distinct in theory and for analytical purposes; in practice, while they can unfold sequentially at separate points in time, they can also overlap, be nested into one another, and even occur simultaneously (ibid.).

De facto modulation is any instance in a STIR dialogue when contextual dimensions play an implicit role in technoscientific practices. Pre-determined problem definitions, underlying desires, affective substrates, or conceptions of society, the public, and ethics may inform the framing of an impending work-related decision. In reflexive modulation, the technoscientific practitioner becomes aware of the ways in which such assumptions, expectations, and effects influence the research process, thereby rendering them modifiable. For example, dilemmas between values in decision-making often appear as either/or choices if the perspective on a given situation is narrow in focus and temporality. While narrative analyses have substantiated that scientists draw a discursive boundary between science and society [22, 80, 81], STIR prods them to take a wider perspective, probing how these cultural categories are nevertheless tacitly integrated in practice and how they could be integrated differently. In this way, "changes in thinking" ([27], p. 108) may generate a shift from binary either/or to integrative both/and thinking. In response to reflexive modulation, a practical change may occur, which can be identified as a deliberate modulation.

To put R(R)I agendas into practice, deliberate modulation may seem particularly important [27]. However, changes in logics of thought can support long-term cultural changes in technoscientific communities so that scientists and engineers may ultimately consider socio-ethical reflection as "part of their work" ([70], p. 1154; see also [27]). Moreover, reflexive modulation is a necessary but not sufficient condition for deliberate modulation. This raises the question under what conditions reflexive modulation occurs and gives rise to deliberate modulation. To explore this question, we shed light on the micro-level interpersonal dynamics that facilitate modulation sequences by analyzing them through the theoretical lens of "value exnovators."

Analytical Concept of Value Exnovators

A wide body of literature on therapy, counseling, and coaching provides theoretical approaches and concepts to analyze the interpersonal dynamics of dialogic processes [82–85]. Although STIR may be thought to have effects on stress levels and well-being, any such therapeutic outcomes are only secondary effects of the method and must not be conflated with its primary objective: to study the capacities of technoscientific experts to reflexively engage with socio-technical integration. To avoid confusion about the objective of STIR, we do not draw on literature from psychological and clinical fields, but combine concepts from R(R)I expert engagement studies and practice improvement research to illuminate the micro-level carriers of reflexive practitioner dialogues. In this regard, Shilton's concept of "values levers" [86] and Mesman's definition of "exnovation" [28] prove informative for our analysis.

Values levers are practices that pry open discussions about values in technical work, encourage consensus around those values, and result in values-based modifications of technologies. Values are flexible criteria used to evaluate events and behaviors because they subsume what people consider important in particular situations and contexts [87]. Embedding collaborative reflections on values in research and design processes is thought to encourage the development of socially desirable technologies [44]. This approach informed Shilton's ethnographic research in a computer science laboratory where she paid attention to

already existing practices that stimulated reflections on values questions so as to articulate and amplify these practices for explicit use in research and design groups [86].

Shilton and other scholars identified a variety of values levers, for example, interdisciplinary teamwork, value advocacy, affective and visceral reactions to designs, and interactions with users [86, 88, 89]. Such levers have been shown to emerge in several modes of values-oriented collaboration [90]. These modes include participatory approaches to technology development that involve users and other stakeholders [91], technoscientific trainings that emphasize ethics alongside procedural education [89, 92], collaborations between a values-oriented team member (usually from the social sciences and humanities) and scientists or engineers [86, 93], and "embedded values conversations" ([90], p. 72) in which technical research teams discover values to be part of their work [88]. Inspired by embedded values conversations in research teams, we investigate whether reflexive practitioner dialogues give rise to practices akin to values levers.

The term "lever," however, suggests a rather predictable mechanism and sometimes even an exertion of social power or manipulation in the form of nudging [94]. To avoid such associations and to emphasize the focus of our analysis on exnovation, we introduce the concept of "value exnovators." Value exnovators are not related to the concept of exnovation in the literature on technology life cycles, where it denotes destabilization, phasing-out, and dismantling of technologies [95–97]. Instead, our understanding of exnovation is derived from Mesman's studies on patient safety [28, 98, 99]. According to Mesman and Carroll, exnovation amalgamates "excavation"—digging out and exposing what is already there—and "innovation from within"—using what is already there as resources for improvement ([32], p. 157). Exnovation has guided a variety of practice improvement studies in healthcare settings [29, 31, 100–102], which acknowledge the abilities of healthcare practitioners to order their day-to-day practices and creatively respond to tensions, conflicts, and unexpected disruptions. In explicating these oft-hidden competencies of ordering and alignment, they capitalize on the strengths embedded in healthcare practices to make these practices even more smooth, adaptable, and efficient.

Inspired by this research, we develop the concept of value exnovators, which refers to relational practices between technoscientific peers that stimulate reflections on values. The concept approaches these relational practices as hidden competencies of technoscientific experts for collaborative reflection on values. These practices are theorized to generate a heightened awareness of value conflicts and possibilities to resolve them through socio-technical integration. Integration is accomplished by experts on their own, but can be enhanced by dialogic inquiries in which value exnovators "open up" [103] neglected issues, marginalized perspectives, and possibilities for performing integration differently. Hence, the concept foregrounds the strengths of collaborative socio-technical integration processes. An analysis of value exnovators sheds light on hitherto unexamined interactive dynamics in STIR dialogues and related integrative approaches [7, 104, 105] that facilitate gradual alterations in technoscientific practices.

Pilot Study Design

The analysis of value exnovators draws on empirical material from a pilot study, which puts reflexive practitioner dialogues to the test. The pilot study is part of a larger dissertation project on ethics in the neuroscientific and clinical study of mindfulness meditation [106]. While the dissertation investigates the kinds of value conflicts and socio-ethical issues related to this field of research, we are not interested in meditation research as such. Instead, the pilot study uses the empirical material gathered in the context of the dissertation research to examine the potential of reflexive practitioner dialogues to elucidate socio-technical integration and to exnovate this method by analyzing its carriers. The empirical material was gathered from a sample of researchers from different countries and disciplinary backgrounds who are involved in meditation research to varying degrees as evidenced by their diverging career stages (Table 1).

The sample raises several implications for the interpretation of our results. First, whereas STIR was used previously to explicate common repertoires and patterns pertaining to the negotiation and management of value conflicts in research and engineering [107, 108], the value conflicts experienced by meditation researchers may be specific to this scientific

Table 1 Overview of participants in online workshops

	Career stage	Field of research	Male/female	Country of residence
Workshop 1	Assistant professor	Cognitive neuroscience	Female	Netherlands
	Professor Emeritus	Statistics	Male	Netherlands
	PhD researcher	Psychology	Male	Germany
	Postdoctoral researcher	Cognitive neuroscience	Male	Netherlands
	PhD researcher	Cognitive neuroscience	Male	France
	Professor Emeritus	Mathematics	Male	Netherlands
	MSc graduate[a]	Science & Technology Studies	Male	Scotland
	MSc graduate	Clinical psychology	Male	Scotland
Workshop 2	Postdoctoral researcher	Cognitive neuroscience	Male	France
	PhD researcher	Cognitive neuroscience	Male	Belgium
	PhD researcher	Neurophysiology	Female	Germany
	Assistant professor[a]	Philosophy of mind & science	Male	Slovenia
	PhD graduate	Psychology	Female	Netherlands
	PhD researcher	Psychology	Female	Germany
	Assistant professor	Cognitive neuroscience	Female	Netherlands
	PhD researcher	Cognitive neuroscience	Male	Germany
	Professor Emeritus	Mathematics	Male	Netherlands
	BSc student	Psychology	Male	Netherlands
	Postdoctoral researcher[b]	Cognitive neuroscience	Male	France
	PhD researcher[b]	Psychology	Male	Germany
	PhD graduate[a]	Psychology	Female	United States
	PhD graduate	Physics	Male	Austria
	MSc graduate	Cognitive science	Female	Netherlands
	PhD researcher	Psychology	Female	United Kingdom
	Professor Emeritus[a]	Statistics	Male	Netherlands

Workshop 1: 8 participants, 8 interviews, 7 practitioner dialogues. Workshop 2: 17 participants, 12 interviews, 12 practitioner dialogues

[a]No data on opportunity

[b]No data

community. Meditation researchers commonly pursue a personal practice of contemplation. While contemplation is an umbrella term for multiple forms of meditation and reflection (e.g., prayer, dream yoga, mindfulness meditation), it is often embedded in a Buddhist worldview and value system in meditation research [109, 110]. Ethnographic inquiries show that meditation researchers experience tensions between the values cultivated in meditation (being in the present, non-attachment to material possessions and social reputation, interdependence, and benevolence, etc.) and the values intrinsic to being a "successful scientist" (performing career-centered ambitions, accumulating honors and resources, competing against others, etc.) ([111]; see also [112]). Even if

STIR facilitates reflections on these tensions and possibilities to resolve them, the generalizability of our results to other groups of researchers may be limited (as discussed further below).

Second, study participants were recruited through an already existing network of researchers who regularly attend Mind-Brain-Mindfulness Seminars, advertisements disseminated by the European Mind & Life Institute which supports the scientific study of contemplative practices, and through personal invitations. Personal invitations were sent to scientists who Smolka had become acquainted with during ethnographic fieldwork at meditation research conferences and in a European project on mindfulness meditation (www.silversantestudy.edu).

Ultimately, mainly scientists who already had an affinity to Smolka's work and, possibly, a predisposition for socio-ethical reflection agreed to take part in the pilot study. Hence, the sample may likely be skewed towards individuals with heightened pre-existing capabilities and awareness.

Third, the sample size is relatively small. The reason is that this study is a pilot project meant to expound rather than to validate our newly developed research method. Although we discuss and problematize whether reflexive practitioner dialogues can facilitate reflexive forms of socio-technical integration, the empirical analysis does not provide robust evidence for the effectiveness of the method. Instead, it contributes to methodological development and serves illustrative purposes. Developing methodological tools in this way is not uncommon in academic research and R(R)I communities in particular. With a total number of 25 participants, our study falls within the precedent [37, 48, 113, 114].

Study participation entailed one online workshop and a qualitative interview. We administered reflexive practitioner dialogues in two equally designed online workshops, which took place in June and October 2020. After being introduced to the use of the STIR protocol, workshop participants were grouped in pairs to engage with one another in two 20-min practitioner dialogues. In each pair, one dialogue partner asked questions following the protocol, while the other reflected on a work-related impending decision; roles were then reversed in a second dialogue. During the dialogue, participants completed the STIR decision-making grid collaboratively. Participants were afterwards invited individually to semi-structured interviews about their experiences of the dialogues. The interviews were conducted via video call, lasted between 45 and 90 min, and took place in the subsequent week after the workshop. The purpose of the interviews was to trace the effects of the dialogues on reflection processes, choices, and ensuing actions. Audio-recordings of 19 practitioner dialogues and 20 interviews as well as decision-making grids were transcribed and subsequently analyzed. For the sake of openness and data sharing, the pseudomized transcriptions are available for download upon request on dataverse.nl (data identifier: https://doi.org/10.34894/ZG5GMB). The dataset also includes a data documentation freely available for download, which describes the design of the workshops and the interview topic guide in more detail.

Empirical Analysis

As this is a qualitative pilot instead of an experimental control study, we use coding to indicate the effects of reflexive practitioner dialogues on experts' reflection processes. We coded the material in three steps. We first performed deductive coding, applying the midstream modulation concepts (de facto, reflexive, deliberate modulation) to the empirical material to trace modulation sequences. We then engaged in inductive coding to identify relational practices that supported these modulation sequences (value exonovators). In the third step, we transformed our inductively identified codes into overarching themes, which are more general and could be applied across multiple instances in the empirical data corpus. The coding process went through several rounds of iteration to maximize internal consistency. In addition, we discussed the results with study participants during an online meeting in June 2021 to ensure that they agreed with our accounts of their experiences, decision-making processes, and alterations of practices.

The value exonovators that we identified through thematic coding are (1) extending STIR questions, (2) recognizing shared epistemic living spaces, (3) attending to embodied ethics, (4) attentive listening, and (5) completing the STIR grid. Attentive listening (paying careful attention to words and phrases, repeating them, and seeking assent that this is what is meant) and completing the STIR grid (creating a communication and documentation device that moves iteratively through decision-making components) are established and integral parts of the STIR method (unpublished 2018 STIR manual by Erik Fisher). The first three value exonovators listed here, by contrast, are newly identified features of STIR, which we analyze in the following. An overview of the results is presented in Table 2. To illustrate our results, we present some modulation sequences in a narrative form and analyze the role of value exonovators in reflecting upon and redirecting socio-technical integration.

Table 2 Overview of reflexive practitioner dialogues

	Opportunity	Midstream modulations	Value exnovators
A	Which career should I pursue?	De facto: Ambiguous feeling about what would be the "right" course of action Reflexive: "It was the first time that I addressed this issue without feeling that it was a constraint for me to assess if it's right or not what I do... When I said this [outcome], there was a feeling about what is right to do now." Deliberate: "I will take time for myself, meditate and be with nature for a while. This will anchor something deep inside me."	Attending to embodied ethics, Attentive listening
B	How do I balance science, life and contemplation?	De facto: Tradeoff among work, life and contemplation Reflexive: Bringing contemplation into work and life i	Extending STIR questions, Attentive listening
C	Which research grant should I apply for?	De facto: Applying for either a large or a small grant Reflexive: Realizing that it is within the bounds of time and energy to apply for the small and the large grant Deliberate: Writing applications for the small and the large grant ii De facto: Dichotomy between mind (pursuing "intellectual curiosities") and heart ("inner desire" for contemplation) Reflexive: Balance between mind and heart Deliberate: Changing the relationship to work by approaching work as an opportunity to practice contemplation	Extending STIR questions, Attentive listening
D	Which career should I pursue?	De facto: Doing either PhD research on a topic of intellectual interest or an applied training in clinical psychology with more social relevance Reflexive: Doing PhD research and an applied training in clinical psychology	Recognizing shared epistemic living spaces
E	How do I study the mechanism of "falling apart" in meditation?	No modulations	
F	What do I do in the evening?	De facto: Either doing statistical work or having a glass of wine Reflexive: Doing statistical work and having a glass of wine Deliberate: "[The dialogue] pushed me to do the virtuous thing, which was to have one small glass of wine and do some quite interesting statistical work in the evening."	Extending STIR questions

Table 2 (continued)

	Opportunity	Midstream modulations	Value exnovators
G	Should I complete my current research project?	De facto: I experience a tension between contemplative life and science Reflexive: We experience a tension between contemplative life and science Deliberate: Mutual support in further conversations after the workshop	Recognizing shared epistemic living spaces
H	What do I do after completing the PhD program?	De facto: Applying for either a research grant or a research position Reflexive: Applying for a research grant and a research position	Extending STIR questions
I	Should I apply for an academic position outside of my discipline?	De facto: Intention to do research that is more socially relevant Reflexive: Establishing connections to researchers and practitioners outside the own discipline may create opportunities for increasing the social relevance of research	Recognizing shared epistemic living spaces
J	Who will analyze the EEG hyperscanning data?	De facto: Ambiguous feeling about selecting a course of action Reflexive: "I realized that I was quite clear on what I wanted to do... I felt seen in how I think about the situation, what drives me, what is important for me in this situation."	Attentive listening, Completing the STIR grid
K	Which career should I pursue?	De facto: Doing either scientific research or applied work with social impact Reflexive: Applying for grants to do scientific research with social impact	Extending STIR questions
L	How do I make a scientific manuscript ready for publication?	De facto: I experience a tension between life and science Reflexive: We experience a tension between life and science, and we also have a shared scientific interest Deliberate: Mutual support in further conversations after the workshop	Recognizing shared epistemic living spaces, Attentive listening
M	What will I present during the next research group meeting?	De facto: "I wasn't aware of how I was responding emotionally [to the alternatives]." Reflexive: Recognizing the affective qualities of alternatives Deliberate: "I presented what we agreed upon, so the ideas for the grant... After [the dialogue] it was crystal clear and I did not have to worry about it anymore."	Attending to embodied ethics

Table 2 (continued)

	Opportunity	Midstream modulations	Value exnovators
N	What kind of research should I do in the future?	De facto: Ambiguous feeling about selecting a course of action Reflexive: "[After the dialogue] I felt like I had to do what I am passionate about and do research on that."	Attending to embodied ethics
O	Which career should I pursue?	De facto: Weighing alternatives to make a rational decision Reflexive: Recognizing the possibility to "filter alternatives based on my feelings."	Attending to embodied ethics, Extending STIR questions, Attentive listening
P	How do I publish my doctoral thesis as a book?	No modulations	
Q	How do I structure the conference presentation?	De facto: Engaging in "ambitious," "wishful thinking" to give a presentation with multiple speakers involved Reflexive: Engaging in "realistic" thinking to see what is "feasible." "I selected an easy course, something that's not so much effort for the people involved, that's not too difficult to plan or practice." Deliberate: Giving a single-speaker presentation based on collaborative preparation	Recognizing shared epistemic living spaces, Completing the STIR grid
R	How should I analyze the survey data?	No modulations	
S	Which career should I pursue?	No modulations	

Analysis of value exnovators that enhanced midstream modulations pertaining to socio-technical integration

Extending STIR Questions

An essential element of STIR is the decision protocol whose boundary nature creates a platform for semi-structured dialogue [115]. According to Star and Griesemer, "the boundary nature [of objects] is reflected by the fact that they are simultaneously concrete and abstract, specific and general, conventionalized and customized" ([116], p. 408). They "are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (p. 393). A map is a type of boundary object that omits local contingencies and is, thus, fairly vague. Due to its vagueness, it serves as a means of communication between different parties. Similarly, the STIR protocol enables dialogue partners to map a decision by guiding them through a set of questions that are general enough to be applicable to diverse fields and groups of research, while being so flexible that they allow for local adaptations.

Meditation researchers elaborated upon protocol questions with unique extensions of the evolving dialogic inquiry. These "extended questions" intuitively arose from the protocol's structure and served as value exonovators in reflexive practitioner dialogues. Reflecting on the impact that the dialogue had on his decision-making process, one researcher pointed out:

> There is so much value in having a wise person guiding the discussion and integrating your input, making sense of it, and then asking the next logical but also intuitive question that comes from him or her. That can be surprising and insightful.

The researcher gained a new insight after his dialogue partner had asked him: "What would an older version of yourself do?"—a variation of the protocol question: "What would somebody else do?" He had been thinking about whether to apply for a large grant that would fund the upcoming years of his research, or a small grant which would allow him to finish his current project and then opt for a "sabbatical, close to nature, to do something more contemplative" (Table 2: Ci). While he had been operating in a mode of either/or thinking (de facto modulation), the intervention of his partner was "enlightening" since it allowed him to gain "a sense of seeing what is possible to do" by moving to both/and thinking (reflexive

modulation). He decided that it was within the bounds of time and energy to apply for both grants (deliberate modulation).

This modulation sequence was nested within a wider reflection on how to combine contemplative life with science (Table 2: Cii). For the researcher, applying for the large or the small grant was a choice between "the mind and the heart," between pursuing "intellectual curiosities" in science and his "inner desire" for contemplation. His dialogue partner probed into whether these pursuits were mutually exclusive by asking: "Have you found it possible to maintain the heart in doing research?" After pondering on this question, the researcher explained in the interview after the workshop:

> I think that carrying around the belief that the dichotomy [between mind and heart] exists is itself a problem. There is a middle way where, for example, I could continue to do the work that I am doing but in a different way. There is a possibility to have a balance between these two things by changing the relationship to work.

Stimulated by an opportunity for research grants, this reflexive practitioner dialogue thus also resulted in a second modulation sequence, moving from a dichotomy between mind and heart (de facto modulation), to an awareness of their potential coalescence (reflexive modulation), and a practical attempt to bring the heart into research by changing the relationship to work (deliberate modulation).

Both modulation sequences were facilitated by the questions that intuitively extended the dialogic inquiry guided by the STIR protocol. While scientists used the protocol questions to complete the four decision components (opportunity, considerations, alternatives, outcomes), they intuitively formulated variations and extensions of the component questions to move from one component to another (from alternatives to outcomes in the abovementioned examples). Following the ethos of engagement in STIR, these questions refrained from value advocacy. Shilton finds that her role as a "values advocate" ([93], p. 177) promoting anti-surveillance values in a computer science laboratory leveraged discussions on values in design choices. We observe, by contrast, that open, probing questions single out value conflicts, activate alternative lines of reflection, and advance decision-making processes towards integrative thought and action.

Recognizing Shared Epistemic Living Spaces

By following the STIR protocol in reflexive practitioner dialogues, meditation researchers recognized that they inhabited shared "epistemic living spaces" ([117], p. 19). The concept draws attention to "the room for maneuvering researchers perceive that they have in performing research, following their ideas and reflecting on them, arranging the private and the professional realms and engaging with societal issues—all aspects that researchers often implicitly equate with their quality of life in research" ([22], p. 54). As scientific environments cannot be strictly separated from non-scientific social positions (e.g., in a political party, enterprise, or religious community), epistemic living spaces hybridize and may involve tensions, contradictions, and value conflicts [118]. The exact forms of epistemic living spaces differ according to career stage, institutional context, and participation in social networks. Therefore, epistemic living spaces of researchers who are at a similar career stage and work in the same field can be assumed to overlap to a large extent.

Whereas shared epistemic living spaces were pre-given by the characteristics of the participants in reflexive practitioner dialogues, the recognition of these spaces was elicited by the decision protocol. In the consideration component of the protocol, dialogue partners unravel a diverse array of potential social, historical, cultural, organizational, institutional, political, and material conditions that mediate or are mediated by human agency in midstream modulation. By shedding light on these conditions, they reposition their attention to the wider contexts in which a decision is situated, part of which is their epistemic living space. As epistemic living spaces became visible in reflexive practitioner dialogues among meditation researchers, they recognized each other's problems and noticed them to be shaped by a similarly contoured maneuvering room. Their problems cannot be reduced to matters of "work-life balance," since the notion conceals the complexities of working in science while also pursuing a dedicated meditation practice that fosters a contemplative worldview. In recognizing shared epistemic living spaces, these oft-latent complexities surface and researchers can more easily understand each other's struggles "because they experienced [them] in their own skin," a researcher explained.

The recognition of shared epistemic living spaces served as a value exonovator because it emphasized the collaborative nature of reflexive socio-technical integration:

> If you are very close to the position of the other, then it's not just a reflection. It is a common search. It's not him answering me, but it's like sharing answers.

The researcher engaged with his dialogue partner in a common search for alternative ways to complete his PhD research without neglecting contemplation (Table 2: G). "How do I increase my [meditation] practice and am fit to be in this fast-moving publishing world, and does it make sense for me?" was the question that he discussed in the practitioner dialogue with his dialogue partner, who remarked: "We are speaking about your decision, but, in a sense, it is also mine." The dialogue partner was at the start of his PhD trajectory and was worried about the prospect of losing contemplative aspects of his life by becoming socialized in an academic environment. Over the course of the STIR dialogue, both scientists moved from an individual experience of a tension between contemplation and science (de facto modulation) to a heightened awareness that this experience was shared (reflexive modulation).

The recognition of previously unattended shared epistemic living spaces functioned as a value exonovator, for it encouraged the researcher who deliberated on a decision to express and more deeply explore his considerations. In the interview, he explained how his dialogue partner had assisted him in his reflection process,

> not in terms of giving solutions, but in terms of sharing that he himself had such difficulties. That was very reassuring and gave me a good playing field to be free in my views.

Moreover, awareness of shared difficulties facilitated an exploration of possibilities for finding solutions in further conversations after the workshop (deliberate modulation).

This modulation sequence appears counterintuitive in light of Shilton's [86] and Darling et al.'s [119] research on value levers in interdisciplinary teams. They identified interdisciplinary dialogue and work practices as levers that cracked open spaces for discussions on differing epistemological and ethical

approaches to research and design objects. Working across disciplinary boundaries often entails productive frictions that reveal assumptions, norms, and values embedded in research paradigms and enables researchers to question and rethink them in a collaborative process. Therefore, the original format of STIR was conceptualized as a "trading zone" ([120] cited in [115]) in which a social science or humanities scholar and a scientist or engineer communicate regularly across disciplinary divides.

Although a trading zone can be a productive space for midstream modulation, so also can the discovery of shared epistemic living spaces, at least among the participants in our workshops. We interpret this finding as a result of the widely shared experience of meditation researchers constantly working in trading zones at their home institutions, where they find it difficult to communicate with colleagues about their interests in meditation. Revealing these interests is often described as "coming out of the closet" ([111], p. 56) in the neurosciences and psychology. Therefore, researchers tend to seek out meditation conferences, symposia, and meeting points to talk with like-minded others about the challenges of working in science while living a contemplative life. Commenting on the reflexive practitioner dialogues, a researcher appreciated inquiring into the "trade-off between contemplation and academic work." She elaborated:

> I wouldn't say that that is a new question, but taking the time to actually reflect on that is something you rarely get to do . . . If I am talking about it at work, people don't really understand the contemplation part, and if I am talking about it at the meditation center, then they have no idea about the work.

The researcher considers shared epistemic living spaces as an enabling condition for a joint inquiry into decision-making processes that help take into account wider contextual dimensions in everyday work practices.

Attending to Embodied Ethics

Decision-making in science and engineering is often associated with intellectually articulated principles and cognitive deliberation. A meditation researcher, however, acknowledged: "I try to feel my decision intuitively. This sounds very non-scientific, but this is very important for me." Given the sovereign perspective of reason in which Western science grounds its claim to authority, it is not surprising that he apologetically inserted that his bodily approach to decision-making could be perceived as "non-scientific." Yet, research in Science & Technology Studies (STS) has demonstrated that scientists and engineers dispose of bodily affective sensitivities that are often hidden or latent, albeit constitutive of their work practices [121–123]. Similarly, research on values in design focuses on affective reactions [89, 124] because they often involve a visceral sense of what is "right" or "wrong" to do [125].

This visceral sense of "rightness" or "wrongness" is called "moral intuition" [126] in psychology. Individuals intuit moral judgments and make practical choices accordingly; only *ex post facto* do they rationalize their judgment and decision. Although critics argue that moral intuition is biased and should be corrected by reason [127, 128], it is uncontroversial that the body plays an important role in moral judgment and ethical reflection. Informed by this insight, the concept "embodied ethics" ([25], p. 9; see also [129]) has been taken up in STS to highlight the affective charge and bodily experience of ethics. It stresses that values, preferences, ideals, or strivings, as well as conflicts between them, stimulate bodily responses which can serve as moral guidance in decision-making.

Embodied ethics became more pronounced through reflexive practitioner dialogues. The dialogues enabled meditation researchers to detect bodily feelings that influenced how they valued alternative courses of action and ultimately directed their decision-making processes. For example, a researcher who deliberated on his career trajectory (Table 2: A) noticed about the practitioner dialogue:

> It was the first time that I addressed this issue without feeling that it was a constraint for me to assess if it's right or not what I do . . . there was a feeling about what is right to do now.

He explained that he had experienced an unpleasant dissonance between his desire to dedicate more time to meditation in a calm environment on the countryside and the need to work in a city where he introduced contemplative practices to businesses and healthcare organizations. His experience of

dissonance transformed into a moral intuition of "what is right to do now" through the process of articulating considerations, working out tensions between them, and exploring possibilities to dissolve them. He dissolved an embodied experience of conflicting values (de facto modulation) by detecting a moral intuition of the "right" course of action (reflexive modulation), which guided him in making a decision that included a period of meditation in his career trajectory (deliberate modulation). He decided to spend time in nature focusing on meditation for some time so as to feel grounded even if he returned to an urban environment in the future.

Although the modulation sequence sheds light on an inner affective transformation, we do not conceive of embodied ethics as an individual, private experience. Instead, our understanding of embodied ethics is inspired by relational analyses of affect, which draw attention to how affective relations shape materiality, practices, and bodies, how they mediate between subjects and objects, and how they bind subjects together [130, 131]. Embodied ethics took shape in between STIR dialogue partners concerning the opportunity to give a presentation at an upcoming research meeting (Table 2: M). While reflecting together on alternatives—presenting work-in-progress, sharing ideas for a grant application, or summarizing previous research findings—the following exchange occurred:

> Y: When you explained that option [sharing ideas about a grant application], I saw more excitement in your face . . .
> Z: That's an interesting observation because those things I obviously don't see myself.

As Y attended to the facial expression of Z and reflected his observation back to her, embodied ethics emerged in their interaction. Z had initially considered all articulated alternatives as equally worthwhile (de facto modulation), but receiving feedback on her facial expression generated reflexive awareness of her differing embodied evaluations of these alternative courses of action (reflexive modulation). After gaining a visceral sense of her priorities that might otherwise have remained unnoticed, she decided to present a grant application to her research group (deliberate modulation). By relating to each other in a face-to-face encounter through careful observation, feedback, and its embrace, dialogue partners co-created the experience of embodied ethics, which shaped the unfolding decision-making process and its practical outcome.

Discussion

The analysis indicates that reflexive practitioner dialogues can elucidate and modulate socio-technical integration. Although the analysis above foregrounds inflections of human and material work practices related to personal preferences and life choices, we also observed enhanced reflexive awareness of broader social value considerations: meditation researchers' perceived relevance to do research with social impact (Table 2: D, I, K). In line with previous research, we further found instances of both first- and second-order reflective learning [73]. While first-order reflective learning remains within the boundaries of existing (technoscientific) value systems and background theories, second-order reflective learning involves reflection on wider socio-ethical aspects and value-based premises of research. The latter enables researchers to recognize and step out of their taken-for-granted disciplinary logics, cultural norms, and research paradigms so as to widen their horizon of values that could direct their practices. Frost et al. suppose that second-order reflective learning is barely possible in academic fields and professional practices governed by techno-economic paradigms. Their STIR study in architecture and civil engineering indicates that practitioners see fulfilling market requirements as a precondition to address any other values. In a similar vein, our empirical analysis highlights that meditation researchers feel constrained by demands for efficiency, measurable outputs, and economic targets that constitute the "new public management" (NPM) regime ([22], p. 10; see also [132–134]) in academia.

Yet, in contrast to Frost et al. [107], our results are ambiguous. We found that reflexive practitioner dialogues enabled scientists to resist, unsettle, and cope with NPM. Some examples of socio-technical integration could be interpreted as instances of first-order learning, which stabilized the NPM regime. By moving from binary to integrative thinking in practitioner dialogues, a few meditation researchers came to see their work as an occasion to practice contemplation (Table 2: B, C). In these cases, it could be argued that sociotechnical integration became a matter of personal transformation while the effects of NPM

imperatives on individuals (e.g., demands for productivity, long working days, stress-inducing work environments) remained unchallenged. Other cases, however, demonstrate that reflexive practitioner dialogues enhanced capacities to detect, imagine, and enact an "alter-ontology" [135] in concrete, ordinary actions that stir up and put into motion what is usually regarded as sedimented. Meditation researchers unsettled the effects of strictly timed career structures [22] and publishing imperatives [80] on their lives and research by putting their work on hold to dedicate time to meditation (Table 2: A), by orienting their research to what appeared meaningful to them (N), and by engaging in further joint imaginations of alternative futures (G). These examples of second-order reflective learning indicate that scientists engaged in activities reminiscent of "practices of freedom" [136, 137], which emphasize human agency to resist and redefine dominant logics and norms.

Given that NPM logics have become pervasive and dominant across academic disciplines, one may wonder why our results diverge from the findings by Frost et al. [107]. We suggest that meditation researchers are different from other researchers in that they have a predisposition for second-order reflection. Felt and Stöckelová propose that scientists with multiple identities and attachments to non-academic but research-related institutions, such as consultancies and NGOs, have a "capacity to merge in an inseparable way with the context of application" ([138], p. 116). This capacity is arguably developed through continuous efforts to preserve "hybrid role identities" ([139], p. 923) in which scientists combine academic with non-academic selves or persona. Meditation researchers often portray themselves as experiencing contradictions between their scientific and contemplative selves, which stems from their dedication to both practice and study of meditation [109, 111, 140]. As they are continuously engaged in activities to preserve their hybrid role identity, we assume that meditation researchers have enhanced resident capacities for inquiry and reflection on societal and applied dimensions of research. The reflexive practitioner dialogues in our study could thus be considered as an enabling factor that tapped into these resident capacities by establishing a space where distinct role identities, their attachments, and values could be attended to. Although the "modern epistemological contract" ([138], p. 111) externalizes researchers' non-scientific

selves and values from the realm of science, some of our study participants addressed these values in reflexive practitioner dialogues. As hybrid role identities are not uncommon in technoscience [141–146], we assume that our findings could be reproduced in other academic fields or professional domains. Future research needs to investigate whether reflexive practitioner dialogues are equally effective in facilitating second-order reflective learning in scientific communities with other kinds of hybrid role identities.

The empirical analysis further examines the enabling conditions for modulations in reflexive practitioner dialogues, which we identify as value exnovators. Although the empirical analysis highlights how value exnovator function as carriers of reflexive and deliberate modulations, we acknowledge that they could become barriers if their deployment does not follow the ethos of engagement in STIR. For example, if listening is attentive but neither empathetic nor careful, the practitioner whose decision is mapped in the dialogue may feel inhibited—or worse, managed and manipulated [94]—in expressing thoughts and feelings. Moreover, if extended STIR questions are formulated so that they advocate for or against specific responses, they similarly risk steering the exploration of considerations and alternatives, which may close them down instead of opening them up [103]. Likewise, taken-for-granted shared epistemic living spaces could narrow down inquiries because shared considerations may go unrecognized [147] and what is known may be privileged over discovery [148].

Reflection and inquiry may also be inhibited by attending to embodied effects in reflexive practitioner dialogues. Some participants were prone to use the dialogue as an "affective balm" so as to feel less stressed about an impending decision. They reported that it had a soothing effect on them: "it was a gut-level discomfort, fear, apprehension that went away when I did the exercise." This report makes practitioner dialogues resemble "caring interventions" ([149], p. 71), such as resilience courses and wellness programs that universities offer to respond to increasing rates of stress, anxiety, and illness amongst academics [150]. Such interventions can tune down unruly effects, instead of tapping into them as resources to productively disrupt thinking and behavior as structured by hegemonic practices and perspectives [151, 152]. By likening reflexive practitioner dialogues to caring interventions, we

acknowledge that care is ambivalent for it has "conservative and generative sides" ([153], p. 154). It can keep scientists locked in first-order thinking but also generate openings for second-order reflection. A full consideration of the conditions under which reflexive practitioner dialogues enable conservative or generative care is beyond the scope of this article. It would require a situated approach that compares local care practices with one another and incorporates the normative appraisal of those who give and receive care within their contextual circumstances [154].

Conclusion

This study makes four contributions to the development of R(R)I expert engagement methods. First, the study provides initial evidence that reflexive practitioner dialogues can facilitate science governance in line with R(R)I agendas. The results indicate that reflexive practitioner dialogues can enable technoscientific practitioners to reflect on the broader values and social settings implicated in their routine specialized work practices and career-related decision-making. This is remarkable given the tendency of technoscientific practitioners to deflect rather than embrace normative inquiry [79, 155, 156]. Recognizing alternative values and courses of action, rather than confirming existing ones, is a condition for destabilizing taken-for-granted, hegemonic practices and structures, not only those pertaining to technoscientific paradigms but also to NPM regimes in academia. Although our findings are ambiguous—some participants found it easier to cope with these regimes, while others unsettled them by taking greater agency in steering their research projects, career trajectories, and rhythms of work—these observations stand in contrast to literature which presents NPM as a solid impediment to R(R)I [22, 24, 80, 157]. We show that reflexive dialogues can support technoscientific practitioners in becoming reflexively aware of dominant structures, logics, and norms, and to engage in practices that aim to unsettle—however, modestly—what is usually considered as fixed and hegemonic.

Second, reflexive practitioner dialogues widen the repertoire of approaches that seek to illuminate and redirect socio-technical integration. Studies have shown consistently that dialogues across socio-technical divides led by social science or humanity scholars influence the social shaping of technoscience [9, 25, 70, 71, 73]. We demonstrate that dialogues led by technoscientific practitioners can also facilitate reflexive and deliberate modulations. This finding suggests an opportunity for institutionalizing the regular use of the STIR protocol for something that has proven to be challenging: deepening reflection on the contextual dimensions of research and development [158]. Although tools for self-use have been developed to support reflexive socio-technical integration on a larger scale (e.g., web-based platforms to share R(R)I practices, ethical reflection toolkits, e-learning DVDs), little is known about their effectiveness in engaging technoscientific practitioners' situated thinking about the socio-ethical dimensions of their work. Our study provides initial empirical evidence that reflexive practitioner dialogues can elucidate and modulate socio-technical integration in work-related decision-making.

While practitioner dialogues may be a more scalable and less time-consuming route to the social steering of technoscience than those facilitated by embedded social science or humanities scholars [17], we emphasize that those studied here took place within workshops curated and organized by social scholars. To examine the potential of reflexive practitioner dialogues to become an institutionalized practice in technoscience, future research needs to follow their regular use in diverse research groups over time. Informed by the classic STIR study design [9], future research could investigate the effects of conducting reflexive practitioner dialogues on a weekly basis over a period of twelve weeks. As productive STIR dialogues depend on establishing trust between dialogue partners (ibid.), we recommend that partner constellations of reflexive practitioners remain unchanged over the course of the study. Future research could also implement Smolka and Böschen's suggestions for incorporating reflexive practitioner dialogues in a multimethod study design to investigate the conditions of their institutionalization in large research consortia and innovation ecosystems [159].

Third, the analysis of value exnovators is the first sustained attempt at identifying the conditions in dialogues guided by the STIR protocol that give rise to midstream modulation. Whereas a number of studies have pinned down the cultural, institutional, and practical obstacles to collaborative integration [16, 17, 21, 58], much less is known about how such approaches

engage with technoscientific practitioners' situated reflection processes. Our micro-analysis reveals that relational practices which involve bodily, intersubjective, and improvisational skills play an important but often unacknowledged role in dialogic reflection. While we find that the potential of these practices to support reflexive engagement with socio-technical integration is contingent on the methodology of STIR, future research could explore whether and how other approaches to collaborative integration give rise to similar or alternative value exnovators.

Fourth, shedding light on the strengths of reflexive practitioner dialogues can help innovate the method. Such "innovation from within" [160] social science methodology is a form of exnovation. By exposing what is already there, exnovation acknowledges that latent strengths within research practices are not only crucial resources to successfully accomplish a study, but also for its improvement. The value exnovators identified here suggest that reflexive practitioner dialogues could be further improved by teaching practitioners to develop improvisational skills for extending STIR questions [161], to borrow competencies from "deliberative practitioners" ([67], p. 177) who open up an inclusive space to facilitate dialogue, and to attend to embodied ethics through movement or body practices [25]. While proposals for improving reflexive practitioner dialogues need to be fleshed out in future research, our study performs a first step to exnovate reflexive practitioner dialogues by identifying value exnovators. This finding suggests that exnovation could be a useful approach to improve social science methodology, in particular R(R)I engagement methods.

Declarations

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