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EDITORIAL

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Critique in, for, with, and of responsible innovation

Mareike Smolka [a,b], Tess Doezema [c] and Lucien van Schomberg [d]

[a]Knowledge, Technology, & Innovation Chair Group, Wageningen University & Research, Wageningen, The Netherlands; [b]Human Technology Center, RWTH Aachen University, Aachen, Germany; [c]Faculty of Economics and Business, Autonomous University of Barcelona, Barcelona, Spain; [d]Faculty of Business, University of Greenwich, London, UK

ABSTRACT

Critique has been a central theme in Responsible Innovation and Responsible Research and Innovation (R(R)I). R(R)I promises to critique dominant technocratic and economic regimes by conducting critical analysis, promoting critical reflection, and launching critical interventions to democratize science, technology, and innovation. However, the sheer success of R(R)I as a policy concept promoted by influential international organizations, a measure to satisfy consumer demands in tech companies, and a pedagogical program advertised to students, suggests that its critical impetus has been curbed by the institutions it sought to confront. Tasked with enacting critique within the dominant regimes it aims to challenge, R(R)I finds itself in a double bind. This collection probes the role that critique has played and could play in R(R)I. Fourteen contributions shed light on the multiple ways in which critique has been conceptualized, performed, and debated in R(R)I, and they discuss how critique could be reclaimed and become more generative for the responsible governance of science, technology, and innovation. Taken together, the contributions indicate that critique is as flexible as R(R)I's scholarly styles, that it operates in different modes and across each of these styles, and that more consciously cultivating such difference provides generative responses to R(R)I's double bind.

KEYWORDS

Critique; reflexivity; power; responsibility; research; innovation

Reclaiming critique

Composing this collection has been accompanied by what Shanley et al. (2021) call the "discomforts" of working in Responsible Innovation. We are keenly aware that while critically engaging with hype-cycles, overstated study results, hidden politics, and Eurocentric biases underwriting research in the natural sciences and engineering, we may be less critical about our own activities. Especially those of us involved in transdisciplinary projects are familiar with the kinds of remarks by colleagues, reviewers, and collaborates which fuel the lurking worry that we are *not critical enough*. Recently, one of us

CONTACT Mareike Smolka mareike.smolka@wur.nl

was called out by a technoscientific collaborator because they did not want to participate in yet another workshop where scientists and business employees perform brainstorming exercises together with the general public that produce posters filled with drawings and post-its, rosy narratives of the future, and pretty images for social media, whilst actual decision-making would take place behind closed doors within the consultation rooms of large corporations. On one reading, such experiences are simply part of the 'high price' that engaged scholars must pay in exchange for their proximity to publics and policy makers (Rabinow and Bennett 2012). They are also among a recurrent set of thematic concerns accompanying engaged ethicists (e.g., Nordmann 2007) and Science & Technology Studies (STS) scholars (e.g., Jasanoff 2011). And yet, precisely because of the all too familiar tensions between criticality and engagement, it becomes all the more important to continually renew our critical sensibilities, both as individual scholars and as a scholarly community as a whole.

We recall the promises of Responsible Innovation and Responsible Research and Innovation, in short R(R)I, that attracted us to the concepts, practices, and community. R(R)I promised to be "critical of the dominant global economic paradigm" (von Schomberg and Hankins 2019, 7) by placing society, rather than financial gains, at the center of research and development. In their scholarly work, R(R)I researchers sought to adopt a "critical stance" (Owen and Pansera 2019, 42) towards the dynamics among research, technology, politics, and society, and "critical reflection" was identified as the core of many methods, techniques, and tools aiming to put R(R)I agendas into practice (van Hove and Wickson 2017, 215). We have dedicated significant portions of our careers to R(R)I for we too hoped that such scholarly and practical efforts could "provide an effective conduit for criticisms and the input of critical thinking and reflexivity into science and innovation" (Long and Blok 2017, 64; see also Blok et al. 2017; Lubberink et al. 2017).

While growing into the professional roles of R(R)I researchers, however, we became increasingly disillusioned with the criticality of our concepts and practices. The sheer success of R(R)I as an academic and policy concept reproduced across national and institutional contexts seems to have removed its critical edge. Elevated within powerful international institutions, R(R)I is leveraged in collaboration with agendas that sit uncomfortably with its lineage of scholarship concerned with science/power (Frahm, Doezema, and Pfotenhauer 2021). When appropriated by so-called "ethics owners" in Silicon Valley tech companies, R(R)I aligns more with revenue-generating metrics than with fundamental commitments to ethically robust digital platforms (Metcalf, Moss, and Boyd 2019, 449). Safely embedded in freshmen classes of business schools, natural science and engineering degrees, and extra-curricular certificate programs, R(R)I is another marketable competence taught in the neoliberal university. Universities have become skillful at turning R(R)I into a 'brand' to sell to an increasingly societally and environmentally aware student population. In light of this (self-)observation, we share the concern that the critical potential of R(R)I scholarship and practices may be limited by the new public management regime in academia (Felt 2017). The pressure to produce marketable knowledge and to contribute to societal problem-solving risks undermining efforts to create participatory spaces where problems can be seen in new ways, rather than being solved. In such a context, scholars worry that some approaches to R(R)I may close down public critique of science and innovation instead of opening it up (Pansera et al. 2020; Stirling 2008; Thoreau and Delvenne 2012).

Those criticizing the mainstreaming of R(R)I, however, make efforts to counter this trend. Some consider "collective self-criticism" (van Oudheusden 2014, 69) as a recursive application of R(R)I's core interest in critical reflexivity to itself (Conley and York 2020). For others, the remedy to R(R)I's purported instrumentalization lies in recovering the original visions articulated by its early protagonists (Owen, von Schomberg, and Macnaghten 2021). A case in point, the acronym R(R)I conflates the distinction between Responsible Innovation (RI), an intellectual movement with academic roots (Brundage and Guston 2019), and Responsible Research and Innovation (RRI), a public policy discourse originating in the European Commission's Science in Society program (Owen, Macnaghten, and Stilgoe 2012). Some RRI implementations instrumentally aim to advance and mainstream the action lines of that funding program, the so-called "RRI keys" (Novitzky et al. 2020, 40), and risk reducing ethical deliberation, stakeholder participation, and public engagement to post-hoc exercises in meeting performance indicators tethered to the keys. By returning to the intellectual vision of RI, scholars may be able to refocus their attention on critique and re-enter into "critical dialogue with dominant policy and institutional representations as a forum for mobilising political change" (Owen, von Schomberg, and Macnaghten 2021, 228). Yet, Owen, von Schomberg, and Macnaghten question whether a return is possible since the world has changed profoundly over the course of the last decade, for example with regards to public health, geopolitics, and digital connectivity.

Whether critique is possible and even desirable in contemporary times is a key question in recent debates on the reappraisal of critique in the social sciences and humanities more generally. Some social science and humanities scholars echo Latour's (2004) provocation that "critique has run out of steam." In an essay collection edited by Bargués-Pedreny et al. (2015) on the *Ends of Critique*, the editors play with Latour's phrase by proposing that although critique may have run out of steam, it is still running. They observe a crowded terrain of sociological and philosophical critique but without much traction in political struggles. In a double sense, "the ends of critique" refer to the *termination* of the political *purpose* of critique to move beyond interpreting the world and start changing it (e.g., Marx 1845). Others discern an increasing political influence of critique, but one divorced from progressive agendas. They accuse critical theories, such as constructivism, deconstruction, and postmodernism, of having paved the way to "post-truth" politics (McIntyre 2018), in which skepticism about the status of facts and the exposure of problematic motives of scientists drive arguments of the political Right (Fuller 2016; Whooley 2017). Acknowledging that critique has become the dominant ethos of political and academic discourses, Felski (2015) argues that it should be cut down to one among many other analytic endeavors. She views the critic as someone speaking from an elevated position of critical rationalism and thereby reproducing logics which have historically supported Northern hegemony over the Global South, male domination over women, the reign of reason over emotion, and the exploitation of more-than-humans. According to Felski, we must surpass critique and explore fresh ways of interpreting society, culture, and art, such as imagination, affective engagement, and translation (Anker and Felski 2017; cf. Fraser and Rothman 2017).

By contrast, Cressman's (2022) edited volume on Andrew Feenberg's philosophy of technology advances an argument for, as the volume's title proclaims, *The Necessity of Critique*. Cressman locates the heyday of critique after World War II when the terrors

of technological rationalism pervading the first half of the 20th century were utterly apparent. He argues that the irresponsibility and carelessness that persist in the governance of technology demand "a theoretically coherent, historically conscious, and empirically sound critique of technology" (3). Indebted to Feenberg, the contributions to Cressman's collection together insist that critique of technology is required for any sort of progressive social change. Similarly, Thiele, Kaiser, and O'Leary (2021) observe that Anglo-American academic discussions emphasize the necessity to stay with critique in view of present-day environmental, political, and health-related crises. These discussions consider how critique can be reclaimed today given that the term has been appropriated by "science conspiracists" (Popa and Blok 2022, 398), populists, and others who seem unwilling to critically examine their own assumptions. In fact, critical modalities are routinely drawn into and domesticated within the discourses and agendas that they seek to confront. Therefore, reclaiming critique requires us to examine the framing of critique and its parameters, established practices, methods, and dispositions of critique, the institutions in which it is operationalized, and the politics it might embed and speak for.

Despite its challenges, fostering critical perspectives remains an essential and ongoing task of social science and humanities scholarship, especially in light of the deepening entanglements among technoscientific change, social imaginaries, and governance. To this end, this collection assembles fourteen contributions that shed light on the multiple ways in which critique has been conceptualized, performed, and debated in R(R)I, while exploring how critique could be reclaimed and become more "generative" (Smolka 2020) for the responsible governance of science, technology, and innovation. These contributions were motivated by the following overarching questions: *Which multiple realizations, situated meanings, and normative commitments has critique acquired in R(R)I? How do these realizations, meanings, and commitments relate to one another? Which work does critique perform for different actors, institutions, and agendas? What kinds of investigations, collaborations, and practical impacts does it enable, and which ones does it close down? Who performs critique, how, and from which position(s)? How could individual, dialogic, and collective forms of critique be envisioned and enacted? How to assess the successes and failures of critical interventions?*

In addressing these questions, the contributions emphasize different modes of critique: critique in, for, with, and of R(R)I. This categorization does not present a historical reconstruction, for histories of critique and R(R)I are multiple (Shanley 2022) and, thus, better told by individual contributions than by a unifying editorial introduction. Neither is this categorization an exhaustive list of all the modes of critique in R(R)I. However, these modes of critique map onto the scholarly styles which Fisher et al. (2024) identify in an editorial review of the literature published in the *Journal of Responsible Innovation (JRI)* over the last ten years. Accordingly, *JRI* scholarship is characterized by four distinctly configured styles—*articulation, intervention, interpretation, assessment*—which researchers have employed robustly and often in combination with one another. Given *JRI's* position in the field, we take these four styles to be prevalent within the R(R)I research community as a whole.[1] The contributions to this collection show how

[1]For instance, a recent bibliometric analysis of R(R)I literature identifies *JRI* as the most influential journal in the field in terms of thematic focus, number of publications, and number of citations (Barlatier et al. 2024).

different modes of critique operate through the aforementioned styles. Taken together, they indicate that critique is both a steady and dynamic undercurrent of R(R)I, and that critique's generative potential lies in its very multiplicity.

Critique in R(R)I

Critique in R(R)I is a feature of the scholarly style of *articulation,* which engages in theoretical and conceptual inquiry and argumentation. Authors writing in this style formulate, extend, compare, and otherwise develop the analytical foundations of R(R)I. These foundations are descriptive and prescriptive, appearing in diverse manifestations such as frameworks, virtues, principles, and conditions. Critique can be embedded within these foundations, in particular in the normative frameworks meant to advance responsible innovation (Urueña 2024), the reflexive heuristics deployed by R(R)I scholars who work in the interventionist style (Stahl 2024), and the theory and philosophy of the politics, policy, and governance of science and technology (Doezema and Frahm 2023).

Urueña (2024) analyzes the critical-reflexive radicality of anticipation enabled and constrained by normative frameworks associated with R(R)I. He defines reflexivity as a necessary condition for critique. Whereas reflexivity enhances awareness of tacit assumptions, feelings, values, and motives, critique problematizes their foundations, and foregrounds strengths and constraints so as to advocate for change. He further characterizes normative frameworks of Anticipatory Governance, RI, RRI, and Technology Assessment based on their foundational literature and suggests that these frameworks provide guidance for anticipation in concrete projects. Accordingly, the earlier that anticipation takes place in a project, the more societal actors who are included, and the deeper anticipation probes underlying assumptions, the higher is its degree of critical-reflexive radicality. With this conceptual analysis, Urueña urges us to relate assessments of the critical potential of R(R)I back to the family of normative frameworks undergirding its discourses and practices.

Similarly, Stahl (2024) locates critique in the theoretical underpinning of R(R)I, exploring how researchers can adopt various aspects of critical theory in their practices, in particular the motivation to improve society through emancipation from dominant patterns of social reality. Based on his experiences as a leading figure of R(R)I activities in the Human Brain Project, Stahl illustrates how R(R)I researchers draw on critical theory as a reflexive heuristic to situate their activities on the following continua: acceptance and rejection of the status quo, observation and intervention, positivism and anti-positivism. By reflecting on these continua, Stahl argues that R(R)I scholars can gain clarity about the assumptions guiding their actions. He further emphasizes that such clarity may help them communicate more effectively among themselves, with their technoscientific collaborators, as well as with policy-makers and funding bodies structuring the broader research landscape which R(R)I inhabits.

Doezema and Frahm (2023) are concerned with governance rationalities in technoscientific innovation. They observe a shift away from models by which scientific credibility is situated in relation to its independence and insularity toward a new governance rationality that positions society at the service of science and technology development—as an essential "fix" for innovation to steer it in the right direction. The authors warn that, within this new rationality, R(R)I is often uncritically positioned as a delivery device

for 'democracy' to technoscientific projects. They advocate for taking a critical view of not only how technoscience is constructed, but equally how democracy is produced in such settings. According to Doezema and Frahm, preserving critique in R(R)I calls for symmetrical attention to technoscience and democracy, enabling examination of the expressions of democracy that R(R)I delivers, and helping to make visible the ways in which power is exerted and stabilized in different configurations of technoscience and public participation. Hence, the contribution by Doezema and Frahm, similar to those by Urueña and Stahl, examines the assumptions underpinning R(R)I practices so as to draw conclusions about how critique shapes the dynamics and outcomes of these practices.

Critique for R(R)I

While critique in R(R)I focuses on theoretical foundations, critique for R(R)I is performed through critical interventions that enhance an ethos of responsibility in science and engineering. The scholarly style of *intervention* is geared toward building capacities of different actors in the research and innovation system to engage with their roles and responsibilities. Such engagement is critical if it destabilizes cultural norms, taken-for-granted assumptions, and perceived boundaries between science and society. For this purpose, R(R)I researchers play a central role in designing, curating, and performing inter- and transdisciplinary interactions. In these interactions, critique is performed for R(R)I in the sense that the cultivation of critical capacities of local actors is considered as a condition for advancing ideals of responsible innovation more broadly. Capacity-building can take place within diverse educational settings (Orchard and O'Gorman 2024; Perez Comisso, Gansky, and Smith 2024) and at scientific, engineering, or other expert sites (Domínguez Hernández and Owen 2024).

In a pedagogy piece, Orchard and O'Gorman (2024) introduce critical design methods to STEM education in order to cultivate capacities for responsible innovation in future technology developers. Unlike other design methods that seek to develop a final product, critical design methods are process-oriented. They help create objects that communicate a provocative viewpoint on the potential societal implications of science and technology. For example, to foster critical reflection on techno-fix solutions for food waste, a group of English students supervised by O'Gorman was tasked to design a critical context for an Engineering capstone project (a smartphone application that logs perishable food and predicts food waste). The group created a fictional commercial about an energy-intensive and costly household appliance shrinking any amount of food waste to the size of a pea to reduce the volume of waste sent to the landfill. Orchard and O'Gorman find that this opened up a reflexive space for English and Engineering students to engage in a conversation about issues of socioeconomic privilege related to food waste. By supporting students in designing objects-to-think-with, critical design methods offer a novel pedagogical approach to building R(R)I capacities.

For Perez Comisso, Gansky, and Smith (2024), building R(R)I capacities through education depends on teachers fostering "critical self-reflexivity," calling into question their own epistemic authority. They introduce design practices and principles to bring R(R)I pedagogy in line with the plural meanings and practices that emerge as R(R)I travels across borders. They further describe their experiences in implementing these practices

and principles in a multilingual and intercultural digital learning approach. These experiences highlight how teachers can collaborate with students in reflecting on and undoing the ways in which Anglophone hegemony pervades the methodological and epistemological assumptions on which their teaching rests. The authors claim that, in this way, teachers can both perform and teach critique at the same time.

Domínguez Hernández and Owen (2024) enacted critique for R(R)I in an interdisciplinary project with data scientists developing a machine learning-enabled tool to assist humans in the moderation of misinformation on social media. The social scientists sought to bring insights from STS about the social construction of facts into conversation with the algorithmic construction of facts with the aim to facilitate responsible innovation. They find that the collaboration elevated reflexive awareness of the societal dimension of technology development in all participants, leading the authors to conclude that critique initially articulated by social science researchers can become an interdisciplinary outcome co-owned by all collaborators. Critique for R(R)I is thus not an intervention launched by a critical outsider into a technoscientific space but emerges through mutual learning in interdisciplinary research teams (Domínguez Hernández and Owen 2024), cross-disciplinary education (Orchard and O'Gorman 2024), and among teachers and students from different cultural backgrounds (Perez Comisso, Gansky, and Smith 2024).

Critique with R(R)I

Whereas critique for R(R)I depends on interaction across disciplinary and cultural divides, critique with R(R)I refers to a mode of critique that is endemic to technoscientific spaces or other professional environments. Our use of the preposition 'with' is inspired by a method of reflexive connectivity that is also known in anthropology as "studying sideways" (Hannerz 1998 cited in Boyer 2015). In studying sideways, anthropologists recognize the reflexive awareness of ways of knowing that exist within expert communities and that could help inform the ethnographic research process. Experts' reflexivity is not stimulated *by* ethnographic interventions or collaborations, but already exists in expert practices and is connected *with* the ethnographic project, for example by stimulating new research questions or analytical concepts.

To recognize and connect with already existing practices of critique at specific sites, R(R)I researchers adopt the scholarly style of *interpretation*. This style is characterized by empirical observation and analysis of actors, institutions, discourses, affects, and practices. Observation encompasses empirical research with a range of qualitative methods (here: co-creative workshops, ethnography, and interviews) whose raw material is refracted through various interpretive lenses (here: sociology, STS, feminism, communication science, and multispecies studies). Contributions to this collection ground theory-informed interpretation in observations within an R(R)I project on healthcare policy (Amanatidis and Børsen 2024), an epigenetics laboratory and a nephrology department (Mann and Chiapperino 2023), and the field of synthetic biology (Hey 2024) to highlight how R(R)I scholars can connect with critiques of technoscientific practices articulated and performed by practitioners themselves.

Amanatidis and Børsen (2024) attend to critique enacted by Swedish healthcare actors collaborating with Dutch R(R)I researchers to inform policies for demand-driven

innovation in a regional healthcare setting. The Dutch researchers organized a collaborative mapping exercise to capture regional techno-specific strengths for their economic development. The Swedish partners, however, criticized this approach for reproducing economic disparities instead of strengthening weaker regions to promote equality. Subsequently, the Dutch researchers let go of the mapping exercise and adjusted the research trajectory so as to connect their R(R)I activities with the healthcare actors' critique.

By contrast, Mann and Chiapperino (2023) were not involved in a collaborative project, but traced critique emerging in biomedical expert practices from an ethnographic perspective. Chiapperino's study allows us to peak into the laboratory of the renowned epigenetics scientist Marie Dupont. He recognizes Dupont's experimental designs as a critique of the dominant focus on pharmacological treatments of trauma-related disorders in epigenetics, as they run experiments with mice to test how enriched environments (not drugs) can remedy trauma and prevent its transmission to offspring. Meanwhile, Mann takes us into Eva Doblinger's nephrology department. Mann observes how Doblinger critiques the immense suffering inflicted on dying patients by the standard use of dialysis technology. Doblinger has developed an alternative therapy enabling dying patients to experience the highest quality of life instead of solely focusing on the prolongation of life. While this novel therapy improves patient care, it also puts patients in the sometimes difficult and ethically loaded position to make a choice between quality and quantity of life. Mann and Chiapperino recommend that R(R)I researchers seek out already existing forms of critical practice and study the normative effects—the "collateral goods and bads"—that these practices engender.

Similar to Mann and Chiapperino, Hey (2024) reminds us that scientists' *de facto* responsibilities (Glerup, Davies, and Horst 2017; Randles et al. 2016) can be productively engaged with to promote R(R)I. Against the backdrop of Ethical, Legal, and Social Implications (ELSI) programs in the United States, Hey studies how synthetic biotechnologists make sense of their responsibilities. She finds that biotechnologists criticize ELSI for being poorly aligned with the responsibilities important to them: responding to grand challenges, supporting nationalist agendas, and fostering relationships with colleagues as well as research organisms. Hey warns that, if left unaddressed, the misalignment between 'top-down' ELSI and responsibility 'on the ground' perpetuates a bifurcation between policy and practice. Therefore, she suggests paying attention to biotechnologists' critiques of ELSI and prioritizing situated practices of responsible research. Critique with R(R)I is thus a generative mode for R(R)I researchers to critically engage with policy programs (Hey 2024), scientific and medical standards (Mann and Chiapperino 2023), and R(R)I practices (Amanatidis and Børsen 2024).

Critique of R(R)I

The contributions to critique in, for, and with R(R)I are optimistic that R(R)I can effectively enhance or engage with critique in science, technology, and innovation. However, continuing with R(R)I and developing it further necessarily involves its own critique, highlighting the limits of different modes of critique and providing suggestions for improvement. Critique of R(R)I is a theme in the scholarly style of *assessment.* According to Fisher et al. (2024), critique of responsible innovation foundations and practices is the most prominent form of assessment in *JRI* and is often combined with other scholarly

styles. For example, an R(R)I *intervention* can be critically assessed with regards to its effects (Felt et al. 2023), and the *interpretation* of different meanings that R(R)I engenders in Global South contexts can inform a critical assessment of R(R)I's local reconfigurations (Pandey 2024). Along these lines, assessment as critique aims to develop and advance scholarly standpoints, approaches, and perspectives.

Under this theme, contributions to this collection expand scholarly discourses on the politics of R(R)I (e.g., Frahm, Doezema, and Pfotenhauer 2021; Ludwig et al. 2021; van Oudheusden 2014; von Schomberg and Blok 2023). Building upon these discourses, Penttilä (2024) criticizes R(R)I activities for not paying sufficient attention to the power dynamics structuring public and stakeholder participation and its outcomes, for framing global challenges as 'tame problems' whose solutions appeal to the expertise of dominant actors and thus circumvent public participation, and for turning participation into an overly standardized practice that advances interests of international organizations in maintaining the global political, economic, and social order. As all these critiques entail a concern with power, Penttilä suggests analyzing the social norms, relations, and structures that create and maintain hegemonic forms of power and using such analysis for changing these norms, relations, and structures. She sees potential for change in the critiques articulated by individuals and communities who do not yet have a 'real' seat at the table.

In an attempt to unleash this potential, Felt et al. (2023) trace the critiques of citizens in a European project seeking to develop a digital health platform. The vision for the project was to empower citizens to become active managers of their own health and to take part in platform development. For this purpose, Felt et al. organized citizen co-creation processes. In these processes, the social scientists encountered different modes of critique put forward by citizens, including frictions, resistance, and demands for clarification. However, possibilities for integrating such critiques in the technological design of the project were limited, Felt et al. point out. The authors analyze how the discursive framing and format of the project allowed for minor adaptations in response to citizens' critiques, but eliminated profound questioning and potential disruptions. Despite their efforts to empower citizens through co-creation, Felt et al. conclude that "both empowerment and co-creation run the danger of remaining empty signifiers that allow for the (re-)inscription and perpetuation of unequal power relations."

Lysen and Wyatt (2024) are similarly critical of R(R)I practices promising to promote participation and emancipation. Their creative contribution combines a conventional academic synthesis of literature with an e-mail dialogue between the authors, exhibiting their unfolding concerns about facilitating patient participation in a project on Artificial Intelligence (AI) developments in the domain of medical imaging. To be responsive to long-standing critiques of patient participation, the authors decide to express critique in the form of refusal and present a checklist of "refusal as action and method" as an alternative to the growing stock of R(R)I engagement methods.

Braun (2024) seeks to theoretically reorient scholarly efforts to facilitate public and stakeholder engagement. He argues that, to politicize R(R)I, its empirical practices should be reflexive of and experiment with more-than-human ontologies. By following the "turn to ontology" (Woolgar and Lezaun 2013) in STS, R(R)I could overcome its modernist worldview in which, according to Braun, the corruption of its implementation praxis is rooted. He stresses that such a turn to ontology is aligned with a turn to the

multiple meanings, formats, and practices to which R(R)I becomes attached in the Global South (cf. Doezema et al. 2019).

Pandey's (2024) critique of R(R)I's troubled trajectory across India's political and scientific controversies reveals the paradoxical dynamics of 'othering' that R(R)I can produce in Global South contexts. On the one hand, she observed how R(R)I was othered within Indian science policy discourses as a European concept with little use for Indian research and innovation. On the other hand, R(R)I othered Indian contexts, by framing frugal innovation as its Indian variant 'catching up' with the European original. Pandey does not restrict her analysis to exposing oppression and power asymmetries. Following a feminist approach to care, her contribution aims at fostering a commitment to care for neglected and marginalized concerns.

Across these critiques of R(R)I and its mobilizations in various contexts, we can trace critical impetuses that are both deconstructive and constructive in nature. The authors uncover and deconstruct the ways in which R(R)I perpetuates social, epistemic, and global power asymmetries, while also making constructive proposals for how to work against unjust power relations. These proposals include but are not limited to refusal (Lysen and Wyatt 2024), frictions (Felt et al. 2023), more-than-human ontologies (Braun 2024), and a commitment to care (Pandey 2024).

Double bind of critique

A cross-cutting theme in the contributions summarized above is a concern with the relation between critique and power, which as noted brings R(R)I into a double bind: it is tasked with critiquing and challenging powerful regimes of technocratic rationality and public management, whilst also being curtailed and sometimes undermined by operating within these same regimes. Based on a literature review, Lysen and Wyatt (2024) find that a dominant response to this double bind is to study and reflexively engage with power dynamics as they unfold in attempts at democratizing scientific research and technology development, a response that Conley and York (2020) refer to as "recursive reflexivity." Recursive reflexivity entails, first, a reflection on how the assumptions and practices of R(R)I are entangled with power, and, second, how the recognition of and active responses to this entanglement shape the successes and failures of R(R)I projects. Hence, recursive reflexivity results in a second-order reflexivity that reveals the effects of reflexive activity itself. R(R)I can steer these effects by adjusting its practices not only to the local power imbalances in which it becomes enmeshed, but also to those asymmetries which R(R)I researchers themselves produce.

Several contributions to this collection take up forms of recursive reflexivity to enhance or restore the critical potential of R(R)I. Braun suggests that R(R)I can reappropriate its critical agenda if it engages in what ethnomethodologists call "radical reflexivity," that is, spelling out and questioning the ontological assumptions on which any researcher's own reflexive activity is based. Stahl points to the importance of reflecting on the assumptions behind projects and the positions that R(R)I researchers (can) take within these projects to uncover and possibly avoid purely instrumental approaches to R(R)I. Perez Comisso, Gansky, and Smith urge R(R)I to turn its foundational principle of reflexivity back onto itself to recognize its Western biases and create space for a plurality of values and epistemologies. Domínguez Hernández and Owen draw on Bieler

et al.'s (2020) concept of "distributed reflexivity" to emphasize that interdisciplinary collaborations require all collaborators to reflexively engage with their conceptual, methodological and normative commitments for "moving from critique to action" in R(R)I pursuits.

For Lysen and Wyatt, however, practicing recursive reflexivity while executing R(R)I interventions does not dissolve their discomforts: "Even if we demonstrate reflexivity about our positionality in the process of intervening, it doesn't erase the fact that our project compels us to explore participation in medical AI with a set of problematic pre-established problem definitions." As an alternative to recursive reflexivity, they introduce strategies of refusal, ranging from 'saying no' to organizing a public participation event, to supporting the abandonment of specific innovations altogether (cf. Williams 2020). Although refusal is commonly judged as paralyzing and non-productive, Lysen and Wyatt consider these strategies as a generative form of critique. They are generative of new relational configurations, in which groups, infrastructures, and discourses in support of refusal emerge. In a similar vein, Felt et al. interpret the refusal of citizens to participate in the co-creation or use of a digital health platform as a "productive critique." Refusal was productive because it sparked fundamental questioning of the platform infrastructure and caused frictions with its vision of empowerment. Throwing frictions into relief through refusal can counteract the tendency to work towards harmony and alignment in stakeholder engagement and thus uncover fundamental value conflicts (cf. Blok 2014). Despite this generative turn to refusal, we acknowledge that it may not be viable for everyone. Citizens may feel forced to use specific infrastructures to access support for satisfying basic needs. R(R)I researchers working under precarious employment conditions may consider recursive reflexivity as safer than refusal, because it allows them to exhibit critical competences without endangering good relations with their employers or funders.

By comparing recursive reflexivity with refusal, we point to the "collateral goods and bads" (Mann and Chiapperino 2023) that different modes of critique engender. Refusal may be a potentially powerful way to stop harmful innovations from materializing, but it can come at the expense of job security. Causing frictions may unsettle techno-solutionist logics, but it may alienate technoscientific collaborators. Interdisciplinary collaborations that aim to inject critique into technoscience or support *de facto* critiques within technoscientific communities may augment critical capacities, but modulations of dominant patterns of practice may fail to provoke significant or lasting change. Caught up within a double bind, all modes of critique are subject to such 'overflows.' As it is impossible to predetermine and prejudge the productions of critique's qualities, the challenge is to render the specific closures and openings precipitated by modes of critique as matters of study, interrogation, and anticipation. Research on how 'goods and bads' of critique are produced somewhere, as well as the conditions and commitments from which they emerge, can help interrogate and anticipate the qualities of critique elsewhere (cf. Pols 2015). To foster learning across contexts, an objective we have pursued in this collection, we make a case for practicing, maintaining, and experimenting with diverse modes of critique across the R(R)I community.

As the contributions indicate, critique can play intellectually insightful and politically salient roles in philosophical conceptual analysis, interdisciplinary projects, ethnographic inquiries, pedagogical approaches, and public engagement activities. It operates in

different modes within the scholarly styles that characterize R(R)I research. The *articulation* of theoretical inquiry and argumentation molds critique inside the foundations of R(R)I, which pre-structure the critical potential of its practices. Through *intervention*, researchers perform critique for R(R)I by building capacities that enable students, technoscientific practitioners, and themselves to critically reflect on roles, responsibilities, and assumptions. *Interpretation* can foreground the forms of critique enacted by various actors at different sites and, thus, make researchers recognize how they can connect endemic critiques with R(R)I agendas and practices. Finally, critique of R(R)I is a dominant theme of *assessment*, which unveils the power imbalances reproduced in and through responsible innovation projects and settings so as to provide suggestions for how the community could move forward.

The presence of critique within all scholarly styles suggests that, far from having run out of steam, it is a strong engine driving R(R)I research. The scholarly styles do not only rely on, apply, and otherwise perform critique, they can also be seen as channels through which critique travels to different sites, actors, and academic communities. Moreover, the fact that critique has found its way into all these styles indicates that it is a flexible concept with the capacity for assimilation to remarkably different forms of inquiry. Critique, and more specifically critique in relation to R(R)I, is multiple and follows diverse pathways to navigate through its own impasses. By highlighting multiplicity, we move from a situated understanding of successes and failures in loosening the double bind of critique towards a more systemic understanding of their contingencies and distribution. We thus consider the exploration and creation of opportunities, practices, and collectives for generatively unsettling the dominant forces that curtail critique in different research projects, national, cultural, and political contexts, and career trajectories as a responsibility shared within the R(R)I community.

As there is no one way to make sure that our research is *critical enough*, just as there is no standardized approach to performing R(R)I (Doezema et al. 2019), we conclude that maintaining a rich diversity of different modes of critique—such as those identified here—is essential to R(R)I research and engagement work. Accordingly, we encourage the R(R)I scholarly community to critically appraise, debate, extend, and advance both particular modes of critique and their robust pluralities.

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ORCID

Mareike Smolka http://orcid.org/0000-0002-0343-0888
Tess Doezema http://orcid.org/0000-0003-0191-7032
Lucien van Schomberg http://orcid.org/0000-0003-2299-8812

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