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Expanding collaborative autoethnography into the world of natural science for transdisciplinary teams

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SUMMARY

Wicked problems such as climate change and the COVID-19 pandemic require authentically transdisciplinary approaches to achieving effective collaboration. There exist several research approaches for identifying the components and interactions of complex problems; however, collaborative autoethnography provides an empirical way to collect and analyze self-reflection that leads to transformative change. Here, we present a case study of collaborative autoethnography, applied as a tool to transform research practice among a group of natural and social scientists, by constructively revealing and resolving deep, often unseen, disciplinary divides. We ask, “How can natural and social scientists genuinely accept, respect, and share one another’s approaches to work on the wicked problems that need to be solved?” This study demonstrates how disciplinary divisions can be successfully bridged by open-minded and committed collaborators who are prepared to recognize the academic bias they bring to their research and use this as a platform of strength.

INTRODUCTION

The challenges that the global population currently face are truly “wicked” and require transdisciplinary research and action to address.1–4 However, diverse teams can have conflicting values, which, left unacknowledged, can complicate and impede productive outcomes. In a research context, disciplinary divides may run deep, for example, between those trained in the natural or social sciences, between quantitative and qualitative research, or between academics and practitioners. In this paper, we focus on the divide between natural and social sciences. Each may question how the other group identifies research questions; defines, collects, and categorizes data; and even challenges the value, validity, or aims of unfamiliar realms of research. Training in the scientific method emphasizes methodology, but rarely explicitly acknowledges the philosophical concepts of epistemology (what we know), ontology (what exists), or axiology (values). Throughout this piece we refer to natural and social sciences, covering a broad range of sciences, including technical sciences and the humanities as per Overland and So-vacool’s5 categorizations of the fields of research. Our aim in sharing this case study is to encourage reflection on the underlying epistemologies, methodologies, ontologies, and axiologies of scientific disciplines and how they differ and frame our way of knowing and experiencing place. Our research question is, How can natural and social scientists genuinely accept, respect, and share each other’s approaches in order to work on the wicked problems that need to be solved? Wicked problems are seemingly impossible to solve because the problems are ill formulated, with no single solution, high levels of uncertainty, and no determinable endpoint.6 Wicked problems can involve multiple forms of complexity: scientific, social, environmental, economic, and practical, and there are often various interconnections among these.7 Distinguished from multidisciplinarity (where researchers work independently) and interdisciplinarity (where researchers retain their disciplinary perspectives), transdisciplinarity has been defined as the “process by which researchers work jointly to develop and use a shared conceptual framework that draws together discipline-specific theories, concepts, and methods to address a common problem.”8 We expand this definition to include others who are part of the process but who may not identify as researchers. These innovations can generate new solutions to old, intractable problems and can accommodate multiple ways of knowing.

The current COVID-19 crisis is a wicked problem. This global pandemic connects social, health, and economic problems and involves enormous uncertainty.9,10 Efforts to solve one problem (for example, health impacts) have potential to worsen other impacts (e.g., social and economic). While science is critical to understand the nature of the spread of the virus, to identify
strains, and to develop vaccines, science alone is not equipped to tackle socially embedded wicked problems, such as behavior change or distribution and uptake of vaccines. Efforts to find sustainable solutions to these intersecting problems require input from diverse perspectives and a clear understanding and recognition of different values. Effective responses to the COVID-19 crisis will recognize the interconnectedness of diverse disciplines and ideas, and of people and nature, and will integrate knowledge, governance, and communities.11–13

Anthropogenic climate change, arguably the most wicked problem of our times, also requires a truly transdisciplinary approach, to implement the changes required to address both mitigation and adaptation to an uncertain future. Many suggested solutions involve those beyond technological solutions; they involve societal change. The Intergovernmental Panel on Climate Change (IPCC) exemplifies the whole gamut of science coming together to make projections on not only what our future climate may be, but also how that will affect food security, water availability, biodiversity, and society more broadly.14 However, the IPCC’s literature-based approach provides only the models and data, not the societal transformation that is required for timely action. For this we need input from economists, sociologists, and behavior-change practitioners as well as extensive community and industry engagement, from the individual to the multinational level.15,16 Unfortunately, the often siloed approach to scholarly training means that each of these disciplines speaks a different language and frequently fails to understand what the other can contribute.

Here we do not dispute the need for discipline-specific expertise, which remains critical to developing a deep understanding of how the various parts of our environment function and interact. However, bringing about change to implement the many and varied site-specific solutions necessary for humans to live in harmony with the other biophysical components of the earth system demands a holistic approach. There is a growing and pressing need to focus on and manage wicked problems such as COVID-19 and the climate crisis, particularly as their effects overlap and compound.17 We urgently need to overcome barriers to transdisciplinary approaches in a way that embraces the various parts of our environment and how they can contribute.

In this case study, we examine sensed perceptions of Antarctica through the lenses of six academic and government women scientists trained in a variety of scientific disciplines among the natural and social sciences—soil science, plant physiology, microbiology, ecology, geology, and environmental sociology. We do not represent every facet of transdisciplinarity, but we realized that we could use this experience to explore the disciplinary divide between the natural and the social sciences and between disciplines within the natural sciences. The study took place during the Homeward Bound leadership program in 2016 and involved written and oral data collection, followed by retroactive reflections and interpretation (Note S1).

FINDING A SHARED LANGUAGE THROUGH AUTOETHNOGRAPHY

In this case study, we examine sensed perceptions of Antarctica through the lenses of six academic and government women scientists trained in a variety of scientific disciplines among the natural and social sciences—soil science, plant physiology, microbiology, ecology, geology, and environmental sociology. We do not represent every facet of transdisciplinarity, but we realized that we could use this experience to explore the disciplinary divide between the natural and the social sciences and between disciplines within the natural sciences. The study took place during the Homeward Bound leadership program in 2016 and involved written and oral data collection, followed by retroactive reflections and interpretation (Note S1).

We share our application of collaborative autoethnography as a demonstration of a method that has the potential to shift paradigms to achieve shared goals in global environmental-change science. Autoethnography has been a popular method in the social sciences since Carolyn Ellis18 first introduced it in 1999 as a technique to unpack superficial beliefs and attitudes with the intention of coming together for “new negotiated understandings of their positions.”19 Autoethnography connects the personal experience (auto) to a wider cultural understanding (ethno) through systematic analysis (graphy).19 Both a theory and an empirical method,20,21 it has been used to inquire critically into myriad research questions.22–25 Autoethnography is conducted by a single researcher, using their own thoughts as data.

More recently, teams of social scientist collaboratives have been applying autoethnographies.26–29 Collaborative autoethnography centers expertise among peers to understand the same target from multiple self-observations to arrive at a shared understanding.30 However, most researchers who embark on collaborative autoethnography do so after having “agreed on the importance of ‘data of the self’ as relevant in social inquiry.”30 The present study flips this idea on its head, by using the research process to convince skeptical scientists that subjective observations can be considered legitimate data that can be rigorously analyzed.3 To our knowledge, this is the first study to use collaborative autoethnography with scientists who have not been specifically trained in qualitative research. The goal of this collaborative autoethnography is for participants to consider ideas outside of the disciplinary canon as a team building exercise.

The collaborative autoethnography process we took is detailed in the experimental procedures and consists of the following steps: preparation, fieldwork, reconvening, interpretation, iterative analysis, and writing and communicating findings (Table 1).

Epistemology: Is this data?

In collaborative autoethnography, co-researchers design the research questions and the data-collection materials together, so that ownership is shared equally. In our case study, the process began with the ecologist suggesting exploring a multi-sensory practice of noticing nature and the social scientist teaching the group the theory and approach to the collaborative autoethnography method.
An immediate question from the natural scientists participating in using self-reported reflections was the question, is this data? emphasizing the training the scientists undertook to see themselves as observers and not as subjects for consideration. The next question was, can this be replicated? Suggestions included selecting control groups by organizing male-only and co-ed groups to compare with our female-only group. The implication was that small-n, qualitative studies that did not follow the hypothesis-testing model through experimentation could not be considered valid or reliable. The social scientist later reflected on why she persisted to convince the group to embark in this direction: “I felt that scientists would be able to integrate social science and understand humanity’s role in global environmental systems better if they understood how to do it.” (M.H.) While the scientists agreed to participate, it was not without skepticism. One co-researcher later reflected on how she approached the idea of the project:

I have three sisters who are humanities scholars and use qualitative methods in their research. Their approaches have always struggled to understand how what they do can be justified as rigorous research.—M.B.

The co-researcher was candid and knowingly opening herself up to scrutiny by making this statement. When she applied her criteria for rigor to the humanities, they seemed to fall short, and she did not know any other criteria. She clearly realized that by articulating what most scientists would not say aloud she might be critiqued for things she did not understand, like “Othering” her own kin (sisters). And yet, it was authentic. She did this deliberately to force an explanation so that she could continue to grow and learn through the challenge. Having researchers in other disciplines in her family background made her aware that there was some discomfort in defining an unmeasured difference, something that other scientists might not be able to articulate. Using the word “alien” was not in and of itself suggesting a hierarchy, but divided two groups into Us (quantitative scientists) and Them (humanities); it is only if one group is justified as rigorous, while the other is not, that it can be considered Othering. Shifting the lens from object to subject in this way allowed space for us to examine our ingrained training as scientists, to hold it up to the light and consciously decide what to keep and what to question.

### Methodology: Blending approaches to build trust

Natural science methods traditionally start with a hypothesis and aim to test it, free of bias, with the findings supporting the hypothesis or providing a basis for an alternative hypothesis. This is very different from, if not diametrically opposed to, typical social science approaches. Many qualitative social scientists in fact refrain from using the term “hypothesis” altogether, to remain open to emerging data and limit bias introduced by the researcher as they design the study and interpret the results.

To assist in reconciling these seemingly opposed approaches, we initially altered the traditional collaborative autoethnography approach to be more structured and hence more familiar and comfortable to the natural scientists. Through this iterative process, we began to create a new shared language and worldview that incorporated several disciplines. It is not surprising then, that the true transdisciplinary work did not materialize until the final months of revising the manuscript. This was the point at which the team coalesced, more than before, around the shared main points that we wanted to emphasize.

### Ontology: What is real?

Science is the pursuit of knowledge about reality. In some of the natural sciences, historically, reality has been considered to exist outside of human experience; if humans were not here, the universe would continue on. Some social scientists may argue that we share assumptions about how we understand the world. Those assumptions are socially constructed and so ingrained that we often do not see them. Our group, for example, debated the applicability of gender in our research and therefore questioned its ability to have an impact.

We grappled with the appropriate attention to our identities as women. On the one hand, members of our group experienced undeniable gender discrimination in science. For example, one co-researcher shared that she had first become interested in Antarctica by studying algal samples her research supervisor

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### Table 1. Steps in the collaborative autoethnography process

| Collaborative activities | Purpose |
|--------------------------|---------|
| Preparation | remotely accessed online introductory calls, leadership development program in Antarctica, research design |
| Step 1: fieldwork | journaling, on-the-Ice interviews |
| Step 2: reconvene | two-week workshop to review the data and goals of the project |
| Step 3: interpretation | designed codebook, coded audio interviews |
| Step 4: iterative analysis | candid discussion allowed participants to clarify their original intentions and confirm or deny retroactive interpretation |

Adapted from Guba and Lincoln.31
had brought back. When she applied to become a field scientist in Antarctica herself in the early 1980s, her application was rejected, twice, “because there were no facilities for women” (F.H.). She changed her research field and career direction. Yet there seemed to be challenges to acknowledging the influence of gender on their approach to research. Indeed, one team member stated early on: “I am a scientist first and a woman second” (J.R.) in resisting the victim frame. Another co-researcher’s later reflection showed how differently she was now examining her own standpoint:

Of course, the biological fact that I am female has shaped my life experience, including my career as a scientist. And of course, people will have a range of ways to tackle an issue depending on their culture and background. This makes sense logically, but my years of scientific training scream at me that this can’t be right, that there must be an underlying truth, a correct and appropriate way to understand the world around us.—M.B.

Even though all the women in this study experienced the same trip to Antarctica and were selected because we were women, we each identified as “women in science” in differing degrees across a spectrum, and it would be unfair and inauthentic to present a universal narrative that suggested otherwise. The narratives demonstrate a willingness for the collaborative autoethnography process to be an impetus for personal and professional change. Through the exchanges, co-researchers devised outputs that would target scholars and practitioners to make sure our newfound knowledge had broader societal impacts. We found that the project did not coalesce around a single, coherent identity of what it means to be a woman in Antarctica. Instead, we experienced Antarctica through a lens of being a woman.

We also recognized that we saw Antarctica through a lens of privilege. Our self-reflections revealed ways in which we represented privilege while others have been marginalized. Although the participants of the wider Antarctica leadership program group (Homeward Bound 1) were diverse in scientific discipline, age, and seniority, fewer than 5% of participants of color were among the broader group and none within the subsample studied here. Class barriers—including a US$15,000 program fee—were additional barriers to candidates without financial resources or support. We were also able to organize childcare and other responsibilities, where needed, because of supportive sources or support. We were able to organize childcare and other responsibilities, where needed, because of supportive sources or support. The Homeward Bound program has been extensively evaluated and critiqued for diversity, equity, and inclusion elsewhere.32–35

It was with a jolt that we realized that our experiences of place were shaped by political and social lenses. Wicked problems, and approaches to their solutions, are strongly bound by their political and social context, and this work was no exception. Bookended by the global #MeToo and #BlackLivesMatter movements, the zeitgeist forced us to look deep within ourselves and our positionality: both real and perceived. We shifted our reflections on privilege from the theoretical to the experiential.

On reflecting on Antarctica, we wanted to describe a connection to this remote, icy, wild place in a sociogeographic context similar to “greenspace” (benefits of being in nature)36–38 and “bluespace” (the aquatic subset of greenspace)39–41 and explored introducing the term “whitespace.” The weight of this term and the perception of privilege it engendered almost caused a rift in the research team, as well as being unpalatable to reviewers. However, our commitment to hearing one another and working through the challenges respectfully has benefited both this work and each of us as individuals.

In addition to experiencing the consequences and influences of privilege, we also directly experienced the realities and consequences of our individual and group cultural lenses. One of the reasons we suggested the word “whitespace” to describe Antarctica’s icy wild places was not only the trajectory through “greenspace” and “bluespace,” but the recognition that visual descriptions dominated our responses to place: “I see white.” But our deliberate reflective practice widened our awareness. One team member reflected that, through the collaborative autoethnography process, she expanded and elaborated a sophisticated, cultural definition of sensory observations that became more inclusive:

If we were to start a new project exploring a multi-sensory approach to how people connect to nature today, I would now integrate wider definitions of “sense” and would like to include the additional senses recognised by some Victorian Aboriginal communities, such as imagination and intuition. That is, I would go wider.—F.H.

The repeated use of the word “wider” suggests the recognition that our original research design of five senses was narrowly determined by our group’s overlapping cultural orientation. As the quote above suggests, the co-researchers began to ask if sensory knowledge is indeed culturally influenced; then it follows that other cultures might have different ways, words, and meanings about senses.42 Indeed, we realized we had reinforced dominant colonized Western systems by examining five senses, sight, sound, touch, smell, and taste, and by listing sight first.42 Majid et al.42 coded 20 languages spoken around the world and found that different cultures emphasize different senses, only some prioritizing visual cues. For the co-researcher quoted above, the acknowledgment translated to real transformation in her research process.

Through this process we were able to recognize how our group members’ input was influenced by their different backgrounds, while acknowledging their somewhat limited cultural and socioeconomic diversity. By triangulating experience with familiar academic presentations of knowledge, we were able to make space to consider perspectives not expressed in the room. This allowed us to explore deep assumptions around language and cultural constructs and the dynamic nature of language and meaning.

Axiology: Is bias inevitable?
It is commonly taught in the natural sciences that bias should be minimized so that the researcher can remain objective—in other words, a researcher can and should be separate from their research. However, social scientists have argued across a spectrum, with many insisting that researchers are always a part of what they study and how they construct their studies. Bias, then, can never be eliminated, but only addressed.
Our collaborative autoethnography revealed scientist bias. We expected that our narratives would reflect our disciplinary training in content, but we were surprised to learn that it also influenced the shapes of our stories. For example, one respondent overlapped what she was sensing to describe her experience: the sharpness of the rocks, the laughter of people around her, and feeling uncoordinated on the slope. The team named this interview “layers,” and then connected this theme to the fact that the respondent was a geologist. The revelation sparked the team to review the notes to see if there were other connections. We laughed when we discovered that the interview we had described as “grounded” belonged to the soil scientist. In this way, co-researchers were able to connect the personal experience of observing their senses with the social structures that formed the ways in which they expressed their personal experience. This led to the realization that each respondent’s experience was (at least to a degree) also socially constructed, based on our social position. This interrogation of our own identity was an important trigger for the co-researchers in understanding, in a less abstract way, how perceptions influenced our philosophy and practice. Based on group discussions, one co-researcher connected the dots in this way:

Clearly, if any one of us shared our view of Antarctica with people who knew nothing about Antarctica, each would develop different expectations and feelings about the continent based on who they spoke to. In our own research, we study our subject of choice from this same discipline-specific lens. This means that each field of research is conducted with bias introduced by the authors.—G.P.

The quote above demonstrates how one co-researcher began to shift her axiological standpoint. Where her disciplinary training (in this case, microbiology) taught her to view objects of study as a neutral observer, she understood that her research outcomes would in fact always be biased by her choice, application, and interpretation of the observation method—all influenced by her training, collaborators, available resources, and cultural background.

In addition, we have had multiple people across humanities, social sciences, and natural sciences review our manuscript throughout its development. The feedback received was always colored by the respective reviewer’s discipline, some feeling not suitably qualified to comment given the transdisciplinary nature of the project, and some expressing the same resistances we experienced ourselves at the beginning. This is a challenge for similar work in the future.

**DISCUSSION: TOWARD APPROACHES TO WICKED PROBLEMS**

This study was born out of a recognition of the implications of the wide disciplinary gap between different ways of knowing: in this case between the natural and the social sciences. We also acknowledge the gaps between the scientific method and the approaches of practitioners, policy makers, and the wider community. These gaps are obstacles for the truly diverse teams needed to tackle wicked problems like climate change. We wanted to explore a process to help understand and bridge this divide, through direct practice in an unfamiliar discipline. As a group of predominantly natural scientists, we wanted to challenge ourselves to embrace more qualitative research methods, and other ways of knowing. Of the qualitative research methods that exist, we felt that the most foreign method would reveal starker contrasts and therefore be more transformative. However, we started off cautiously and allowed more unstructured processes to emerge organically as we became more and more familiar with the method. We learned how to better value and use “data of the self.”

Through this process, we began to create a new shared language and worldview that incorporated several disciplines, having deconstructed our language down to its underlying source. Our words echoed our cultures, our disciplines, our perspectives, and our privilege, and we carried these with us to the farthest reaches of the earth. These words went beyond language, to the very core of our worldviews. We found shared discourse a productive force that helped shape our thoughts, ideas, beliefs, and understanding of our positions as environmental researchers.

When dealing with uncertainty in topics like climate change, it is important to recognize and identify how bias obscures what we think we know. This study showed how collaborative autoethnography can be used to reveal subconscious or unconscious bias present in the building blocks of our worldviews.

**Shared purpose**

The personal challenges of transdisciplinarity are those of bringing our whole selves to the work. Transdisciplinary work requires all the ingredients of effective collaboration and more. Indeed, it brings together expertise and knowledge from different disciplines, governances, and processes, along with personal, individual, and societal values and behavior change.43–45 The difference between interdisciplinarity, multidisciplinarity or cross-disciplinarity, and transdisciplinarity is us; it is the personal perspectives we bring and our cultural contexts and how willing we are to engage authentically in collaboration.

These personal challenges mean that, to achieve the successful outcomes of transdisciplinary work, we must embrace discomfort, vulnerability, and change, and be willing to truly listen, learn, and share. In the context of listening and sharing, we embrace the term Ngapartji Ngapartji, an Australian Pitjantjatjara phrase describing reciprocal engagement, a process that honors everyone’s contribution and supports exchange and cross-cultural collaboration. Through our practice, we identified several elements we found important to support transdisciplinarity and relevant barriers to success. We list those supporting principles, barriers, and associated suggested mitigations in Table 2. These progress through the stages of identifying transdisciplinarity as a useful approach, building an effective collaboration, persisting through challenges, and sharing the stories of transdisciplinarity practice.

**Respect and humility**

This project and process was meant to disrupt prior sets of beliefs, and it was not always pleasant or easy, as this co-researcher describes:
I have realised with growing horror (existential dread) that science is not and can’t be the only way to ask and answer the really difficult questions like the future of earth. Joining the dots between disciplines seems to be the only way forward for Planetary Health. But this realisation is also personally very challenging. What am I left with if I no longer trust the scientific method? Have I wasted my life on an empty and futile quest using hopelessly inadequate and outdated approaches?—M.B.

In the quote above, the co-researcher struggles to integrate her new experiences in her identity, causing “existential dread.” This realization expands her thinking to consider different ontologies concerning global environmental research.

The extract below echoes the other narratives by noting uncertainty in the learning process, while expressing a different narrative arc than academic training tends to allow:

I remain highly uncertain about where my future knowledge contributions might lie. But I am certain that I have been changed forever since learning a qualitative research method.—G.P.

Since then, this co-researcher has found an avenue to combine approaches in the translation of natural and social science to influence climate change, as a consultant. By contrast, the co-researcher below reflects how she changed how she practices science, not as an epiphany, but a series of changes:

Taking part in this autoethnography project has had a transformational effect on both my personal and professional practice. The combination of theoretical and experiential learning around both “Affect” and “Autoethnography” have changed the way I relate to the world, to my family, to my colleagues and to my research. This change permeates my every day, my every interaction. It has not taken the form of an epiphany, an overnight transformation, but rather many small changes, many new insights grasped and deepened by regular practice.—S.G.

Autoethnography requires introspective self-reflection for many reasons. One is so the researcher can better understand how their attitude, position, and background may have introduced bias into the research. The point is not to try to erase all bias, because that is impossible, but to locate and be aware of where bias exists. This is part of the discovery that leads to transformation, as this quote addresses:

Reviewers wondered if we were proposing that all natural scientists should learn sociology. I personally began my career in sociology and now work in an environmental science department. What I understand now that I did not know going into it is that switching disciplines is switching careers. Asking scientists to train in another field might not be possible or even favorable. At the same time, bridging scientific divides is needed more than ever.—M.H.

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**Table 2. Transdisciplinarity: supporting principles, barriers, and ways to mitigate against and overcome these barriers**

| Principle     | Description                                      | Barriers to transdisciplinarity                                                                 | Overcoming barriers                                                                 |
|---------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Shared purpose| reason for working together                       | divergent aims at the start or that develop over time                                        | inclusive process to agree on aims development of plain-language description of purpose and aims regular review of purpose and clear communication about any agreed shifts |
| Respect and humility | commitment to the value of including different points of view and a willingness to: (1) be open-minded to new language and ideas and (2) question one’s own biases | collaborators maintain habits of bringing only disciplinary knowledge and expertise, including defensiveness over disciplinary norms; for example, natural scientists unable to consider political or cultural context as relevant to the work and social scientists impatient with natural scientists’ discomfort in engaging with political or cultural context | shared commitment to transdisciplinary principles of respect and humility deliberate allocation of sufficient time to: (1) build relationships and trust; (2) create a psychologically safe environment, and respect boundaries; (3) share knowledge and language; (4) understand unfamiliar methodologies; (5) shift into unfamiliar mental spaces; and (6) co-create research methods |
| Perseverance  | commitment to and trust in the process to deliver the outcome | giving up on the collaboration due to insufficient interpersonal skills and emotional intelligence to fully participate; lack of courage; dogmatic closed-mindedness; or impatience with others insufficient resources to participate effectively, including time and funding poor experience in publishing transdisciplinary practice and outcomes | shared understanding that development of transformative, disruptive ideas necessarily includes discomfort and takes time Employ “peloton” leadership identify and target funding providers that recognize the value of transdisciplinary collaborations shared stories of transdisciplinary practice in multiple forums |

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Perspective
Table 3. Metaphysical transformation of self and global environmental research design

| Definition            | Natural science | Qualitative social sciences | Participant self-transformation | Research transformation          |
|-----------------------|-----------------|----------------------------|--------------------------------|----------------------------------|
| Epistemology          | what we know and how we know it | positivism                | interpretivism, realism, pragmatism | “The biological fact that I am female has shaped my life experience, including my career as a scientist.” |
| Methodology           | how we measure it | highly structured, large-N, random samples, experiments, hypothesis testing, statistical significance | unstructured, semi-structured, or structured self-reflection, text as data, small-n purposive samples | “I have realized ... that science is not and cannot be the only way to ask and answer the really difficult questions, like the future of earth.” |
| Ontology              | what exists and how we categorize it | reality exists outside of human understanding | reality is socially constructed | “I have realized with growing horror (existential dread) .....” |
| Axiology              | values and aims of research | research can be value free explain and predict the world through replication, validity, reliability, generalizability | bias is inevitable understand the world through trustworthiness, authenticity, and transferability | “This means that each field of research is conducted with bias introduced by the authors.” |

Natural scientists did not become social scientists or vice versa; rather, we came to an embodied understanding of how each other sees the world. This has benefits for the transdisciplinary work that we do with stakeholders who hold different values, norms, and beliefs. We summarize these changes in Table 3. In our study, the social scientist leaned into a realist epistemology to appreciate which methods, whether large-N or small-n, would best answer the research question. In general, the natural scientists trended toward a pragmatist approach, in appreciating both objective and subjective points of view.

Since beginning to undertake this work together, all members of the team have honed their focus to leading transdisciplinary research and practice to tackle the wicked problems of climate change and the biodiversity crisis from various angles and with diverse stakeholders. Examples of this work are provided in Table 4.

Perseverance

While the qualitative data above demonstrate evidence of personal change, some of the co-researchers noted frustration with structural barriers to transdisciplinary work:

I feel like we’ve struggled and anguished and still fallen short of achieving a real breakthrough. I STILL can’t get funding for transdisciplinary research (zero from three), even though all the straight science projects I propose continue to be funded (three from three). It’s a bit depressing; we have all personally changed but we haven’t changed the system one iota.—M.B.

Another co-researcher shares other structural barriers that have prevented her from fully realizing transdisciplinary research goals:

The very process of this work has been a challenge and highlights many of the blockages facing transdisciplinary research. Personally, I have struggled to justify this work as important to my organisation, as it was criticized as being too “soft” and support for attendance at a transdisciplinary conference was hard won. Most of us have had to find time outside of regular work schedules, as this work is not considered by our employers to be core business. Likewise, seeking funding for further research is compromised by not having established centers with established track records or funding schemes that are targeted to mixed teams with experienced assessor panels. But we persisted.—J.R.

Toward successful transdisciplinary collaborations

Here, we reflect on the potential of collaborative autoethnography as an approach to facilitate transdisciplinary research practice, the broader applicability of this approach, and barriers to implementation. We recognize that the underlying epistemologies, methodologies, ontologies, and axiologies of scientific disciplines can get in the way of successful transdisciplinary collaborations. At first, we wanted to confront the differences between the social and the natural sciences, but because of the particular makeup of our team, we could use this experience to interrogate nuance between disciplines within the natural sciences. However, disciplinary divisions can most successfully be bridged and built upon by diverse, relevant, open-minded, and committed collaborators who are prepared to recognize their standpoint and the academic bias they bring to their research and to use this as a platform of strength. When this is achieved, it enables truly transdisciplinary work to take place, through critiquing our own expertise and embracing and learning from that of others. Looking forward, transdisciplinary work can support and accelerate the creation of new academic disciplines and ways of knowing.
For the next stage of climate change research, an “all-hands-on-deck” approach is needed to deepen our understanding of the actions the world must take to achieve food and climate security, as outlined in the 17 Sustainable Development Goals. We propose that this case study could be applicable and even transferable to other teams who struggle to reach across divides to tackle today’s wicked problems. Although applying collaborative autoethnography may not be possible in all transdisciplinary teams, due to time constraints or the differing nature of the gap to be bridged, we suggest that the basic principle applies more broadly. We encourage transdisciplinary teams to learn about, embrace, and contribute to a method used by their collaborators. This is ideally conducted in an initial phase of the project, while the overall methodology is still under construction, to allow the transformation of the participants to influence the evolving approach.

For example, Fiedler et al. recently advocated for “climate translators” to translate complex climate data for non-expert users, to assist with the push to integrate climate change risks into financial decision-making and disclosures (e.g., through the recommendations of the Task Force on Climate-Related Financial Disclosures). A basic approach to this role may involve collecting information on the company, advising them in return on risks to consider, and providing climate data alongside some key limitations. A truly transdisciplinary approach would seek to build internal capacity in the non-expert users, while looking to learn more deeply about how they operate, and to maintain oversight of and integrate risks into their decision-making. The two-way learning process would lay the platform for a collaboration and iterative approach to defining relevant climate-related risks, what they mean for the company in practice, and how resilient their current strategy is.

Table 4. Research transformation in practice

| Author | Transdisciplinary work | Stakeholders |
|--------|------------------------|--------------|
| Haeffner | leadership of a water justice lab assessing the resiliency of communities across different hydroclimates to respond to varying levels of water infrastructure investments | social scientists, environmental managers, applied linguistics scholars, community partners |
| Hames | leadership of a state government program aimed at connecting people with nature, including projects integrating science and art | biodiversity and climate-change policy makers, biodiversity and natural scientists, traditional owners, environmental agencies and partners, NGOs, community members, artists (visual, video, music) |
| Reeves | adaptation in agricultural communities of southern Gippsland (www.growingsoutherngippsland.org.au) | Farmers and land-care practitioners, soil scientists and agronomists, multimedia artists, economists, social scientists |
| Barbour | Development of an ethical understanding of the interactions between the human and the plant world in the framework of multispecies justice (https://aeon.co/essays/what-can-an-embodyed-history-of-trees-teach-us-about-life) | philosophers, humanities scholars, Indigenous studies scholars, creative practice academics, environmental planners, economics academics, law academics, education academics, government researchers, high-school teachers, iwi (tribal) representatives, regional councillors, NGOs, insurance companies, community members |
| Reeves | assisting major companies in understanding and publicly disclosing their risks from climate change and their opportunities to adapt and transition to a lower-carbon economy | consultants with diverse academic and professional backgrounds, corporate stakeholders, climate scientists |
| Grover | leadership of the Soil-Atmosphere-Anthroposphere Lab, exploring the interconnections between food, climate change, and people | farmers, natural scientists, social scientists, NGOs, industry, government |

NGO, non-governmental organization.
Our experience suggests that cultivating transdisciplinary skills requires certain preconditions for success. These include the participants’ open-mindedness, their ability to acknowledge and reflectively critique their own standpoint and its influence on their research, their openness to engaging in training outside of their field of expertise, and their capacity to explore this. We found that each of us can explain only the angle we choose to see; we recognize that as individuals, each of us is inadequate, or limited in our perspective, no matter the depth of our training. However, if we can bring those disparate visions together, we gain a far greater appreciation of the synergistic whole and therefore can actually begin to tackle a problem with a holistic approach.

The material that we were exposed to by participating in the academically diverse Homeward Bound Leadership program primed us to “weather the storms” (sometimes major, sometimes of the teacup variety) of multidisciplinary collaboration. The leadership program gave us the space and time to pursue ideas. As Homeward Bound primed us for working together, so can collaborative autoethnography prime other teams for transdisciplinary collaboration. In the initial year of our collaborative autoethnography project we explored our values, emotional intelligence, learning styles, self-awareness, and behavior change; we undertook an intensive course in personal development. This awareness of self and others, openness to change, shared experience, and understanding of our strengths and weaknesses equipped us with the internal resources to work through the difficult aspects of working across disciplines, the frustrations and misunderstandings, the differences in pace and style, and external commitments. These opportunities for personal development do not generally become part of professional development until the later stages of a career, be it professorial or managerial level and above. However, we suggest that they should be part of the training at all levels, given their value in enabling successful transdisciplinary research and teams, enabling the individual participants to express authenticity in what they bring to the table.

This case study is applicable to other teams who struggle to reach across divides to tackle today’s wicked problems. We found collaborative autoethnography to be approachable and valuable in addressing disciplinary divides. It was not expensive or resource intensive, but it did require several bursts of distraction-free time over a long period. Through learning a “foreign” method, natural and social scientists were able to genuinely accept, respect, and share one another’s approaches. We propose using collaborative autoethnography as a core part of transdisciplinary projects to arrive at a shared conceptual framework. It could be a part of initial team-building during the first stages of a transdisciplinary project and revisited throughout the project to refine the research questions.

We invite researchers and practitioners to leave their comfort zones; critically examine their epistemologies, methodologies, ontologies, and axiologies through collaborative autoethnography or some other process to identify what they bring to the table; actively strive to see the issue through a different disciplinary lens; and invite diverse members of the team to the planning stage. Each researcher needs to be receptive to critique of bias and to legitimize and explore other positions and methodologies. This is a critical step in achieving authentic transdisciplinary research and building the capacity of individual researchers and teams to create authentically shared and impactful outcomes. As we move toward transdisciplinary problem-solving in our research and practice, it is our hope that articles that are diverse in their disciplinary and paradigmatic perspectives appear in cross-disciplinary publications, that their formats are appropriately varied, and that they are embraced with curiosity and appetite by a variety of researchers and practitioners in our complex world.

**EXPERIMENTAL PROCEDURES**

**Resource availability**

**Lead contact**

All information and requests should be directed to and will be fulfilled by the lead author at melh32@pdx.edu.

**Materials availability**

No new materials were generated by this study.

**Data and code availability**

Principles and protocols are outlined in this paper and in Note S1. We will gladly provide support to research teams who wish to explore collaborative autoethnography as a tool to transform their research practice and build their capacity to generate solutions to the planet’s wicked problems. Additional extracts of the original data and coding from the case study in this paper are available in the supplemental information.

**Approach**

The collaborative autoethnography process is detailed in Table 1. Research design occurred over email in the months leading up to the Homeward Bound program Antarctic journey, and design refinement and data collection occurred in person on the ship and at landing sites on the Antarctic Peninsula throughout December 2016 (Table 1, Preparation, Note S1). Program participants were nominated to be involved in the research. Participants co-designed hard-copy field booklets with a series of questions. Participants provided written or drawn responses during their time in Antarctica. We documented sensory responses to the physical space during Antarctic landings in the written booklets and through audio-recorded walking interviews (Table 1, Step 1, Note S1).

The team set aside 14 days of method workshops in July 2018 in Germany (Table 1, Step 2). To assist in reconciling different disciplinary approaches, we initially altered the traditional collaborative autoethnography approach to be more structured and hence more familiar and comfortable to the natural scientists. To those experienced in collaborative autoethnography, the initial analysis approach may therefore seem a limitation of this study. However, the parallel thematic coding format allowed the researchers to compare notes and check their interpretations against the group, instilling a sense of reproducibility in the data. The group discussion after each note-taking session elicited rich reflection and analysis that also served to build trust among the group. After all, in each recording, one of the coders in the room was listening to her own interview, knowing that others were also listening, potentially judging under the ruse of “critique” and “analysis.” The format provided the space to remember and reflect on how the respondent was feeling at the time—to be simultaneously the researcher and the researched—an insider and an outsider. It was a vulnerable position to be in. And once one researcher revealed their vulnerability, each was subsequently allowed to and perhaps felt a sense of reciprocity to reveal their vulnerabilities as well. The domino effect of revelations led to increasingly greater authenticity in interpreting the data.

Co-authors and Rickard were also able to take the advanced step of analyzing each of the interviews as narrative wholes, and this occurred organically (Table 1, Step 4). Finally, as the non-social scientists became more experienced in working with personal data, they began to see new opportunities for data collection. We designed new questions to which each team member would spend 15 min of private time writing. These self-designed reflections examined change, memory, and connection to nature: What do you recognize now that you did not recognize before? Sitting in a vegetated green space (as opposed to the icy white space of Antarctica), for someone who is not here right now, how would you describe what you see, hear, taste, smell, touch, and feel? Newly self-assigned reflection questions became notable in that we no longer questioned the perspective bias of the scientist in the science or whether or not the respondent had changed from participating in this method—we now assumed we had. Through collaboratively writing this article, we have been able to refine our conclusions (Table 1, Step 9).
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The authors declare no competing interests.

DECLARATION OF INTERESTS
All authors were involved in the conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing of the original draft, review and editing, project administration, and funding acquisition.

AUTHOR CONTRIBUTIONS
All authors were involved in the conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing of the original draft, review and editing, project administration, and funding acquisition.

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