Sustainability Science (2024) 19:555–574
https://doi.org/10.1007/s11625-023-01442-w

ORIGINAL ARTICLE

Directing personal sustainability science toward subjective experience: conceptual, methodological, and normative cornerstones for a first-person inquiry into inner worlds

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Received: 14 October 2022 / Accepted: 19 November 2023 / Published online: 5 January 2024

Abstract

Despite the rapid expansion of sustainability science in recent decades, sustainability crises have continued to grow. Sustainability researchers argue that this is partly the result of neglecting people's inner worlds and call for a stronger consideration of inner states and processes in sustainability scholarship. We argue that the advancement of *personal sustainability science*, i.e., the systematic inquiry of inner worlds in relation to sustainability, is currently impeded by at least two unresolved issues. First, attitudes, emotions, values, and the like have frequently been the object of sustainability-related research. It thus remains unclear to what exactly researchers should more closely look at when inquiring into people's inner worlds. Second, the epistemological and methodological foundations for conducting research on inner worlds remain underdeveloped. We illustrate that current research activities usually remain at a phenomenologically shallow level. In response to these issues, we provide conceptual, methodological, and normative cornerstones for a first-person inquiry within personal sustainability science, allowing for an in-depth understanding and potentially even a transformation of people's inner worlds with regard to sustainability. Overall, we suggest redirecting personal sustainability science more strongly toward the inquiry into people's subjective (i.e., first-person) experiences of inner states and processes unfolding in relation to sustainability.

Keywords Inner worlds · Inner dimensions · Inner transition · Inner transformation · Personal sustainability science · First-person methods · Phenomenology · Inner development goals

Introduction

Sustainability science has grown hugely in terms of interest and progress since its foundation at the beginning of this millennium. Set out as an agenda aiming at describing current unsustainability and transforming society toward a sustainable future (Clark 2007; Shrivastava et al. 2020), faculties and departments that focus on sustainability sciences have been founded, journals that cover research on the field have been established, and funding institutions have been created. Unsurprisingly, the number of scientific publications in the field has skyrocketed (Ávila et al. 2018), advancing the overall understanding of current unsustainability. Despite these efforts, anthropogenic sustainability-related problems have only been exacerbated (Alvaredo et al. 2018; IPBES 2019; IPCC 2023).

While reasons for this diametrical development are manifold, some researchers consider it at least partly the result of an incomplete understanding of and approach to sustainability. More specifically, they argue that sustainability science

Handled by Jasper O Kenter, Aberystwyth Business School, United Kingdom.

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primarily focuses on external (especially biophysical) manifestations of unsustainability, and it overemphasizes solutions through socio-economic structures, governance dynamics, and technology change. They claim that people's inner worlds—also called interiorities, inner, or personal dimensions—are a central cause of unsustainability, but they remain strongly neglected (e.g., Parodi and Tamm 2018; Frank and Stanszus 2019; Ives et al. 2020; Wamsler 2020; Hochachka 2021; Woiwode et al. 2021; Wamsler et al. 2021). Thus, the inner, personal level is described as the essential level of change and the deepest leverage point (Meadows 1999; Hochachka 2021; Wamsler et al. 2021; Woiwode et al. 2021; Ives et al. 2023) to promote a societal sustainability transformation. In line with these claims, political grassroot efforts have been launched to advance the idea of inner worlds in relation to sustainability, for example, in the form of "inner development goals" (http://www.innerdevelopmentgoals.org) or "SDG 18—Consciousness Change" (http://www.sdg18.de). Overall, this inward turn (Boda et al. 2022) has led to increasing efforts in *personal sustainability science*, i.e., the systematic inquiry of inner worlds in relation to sustainability (Wamsler et al. 2021; Woiwode et al. 2021; Boda et al. 2022; Ives et al. 2023).

In this article, we argue that these efforts are currently impeded by at least two unresolved issues. First, in light of an extensive body of research dealing with psychological factors like values, attitudes, emotions, or identities related to sustainability (e.g., Brosch 2021; Leichenko and O'Brien 2019; Passafaro et al. 2015; Udall et al. 2021; Lenoir-Improta et al. 2017), it seems somewhat surprising that researchers conceive of individuals' inner worlds as being neglected. We claim that there is conceptual vagueness in the literature revolving around terms like "inner worlds", "interiorities", or "inner dimensions". Consequently, it is not clear what exactly sustainability researchers should examine when inquiring into people's inner worlds. Second, and as a result of the first issue, we hold that the epistemological and methodological foundations of personal sustainability science remain underdeveloped. Current suggestions and approaches to studying inner worlds range from (predominant) statistical-quantitative methods (Wamsler et al. 2021), to qualitative deep interviewing (Hochachka 2021), to transdisciplinary research, and the inclusion of different forms of knowledge (Ives et al. 2023). While all these approaches are contributing to understanding inner worlds, we argue that a pivotal epistemological and methodological characteristic of inquiring into inner worlds has not been sufficiently extrapolated yet.

To address both issues, we suggest directing personal sustainability science more strongly toward an in-depth inquiry of subjective experience. Our argument is divided into three sections. First, we examine the literature arguing for the neglect of inner worlds within sustainability science. We argue that these claims hold true only insofar as the concept of inner worlds explicitly refers to individuals' mental states and processes in relation to sustainability, that is, states and processes exclusively unfolding in the subjective experience of individuals. We hold that much of the existing research dedicated to emotions, values, attitudes, and other 'inner' dimensions lacks width and depth concerning the reconstruction and recognition of the various facets of subjective experience. Second, we discuss first-person methodology for systematically accessing and deepening the understanding of individuals' subjective experiences while contributing to the transformative endeavors characterizing sustainability science. We argue that the vast majority of existing research that can be subsumed under personal sustainability science relies on phenomenologically thin methods, limiting the depth of accessing and understanding inner worlds a priori. Third, building on our argumentation, we provide conceptual, methodological, and normative cornerstones for a first-person inquiry within personal sustainability science, allowing for a deep and systematic examination, and possibly transformation of people's inner worlds with regard to the vision of sustainability.

Inner worlds and sustainability

The purpose of the following section is to shed light on the concept of inner worlds in relation to sustainability. For this purpose, we conducted a non-systematic review (Cook 2019) of the literature addressing this relationship. While this kind of review inevitably involves limitations and difficulties in terms of reproducibility and representativity, we consider this approach warranted with regard to our aims. A non-systematic review allows one to address more far-reaching questions and pursue insights beyond applying fixed terminologies (Cook 2019). As we illustrate below, this seems to be important to navigate the terminologically diverse, disciplinarily, and fragmented landscape of inner worlds literature.

Our argument proceeds along three steps. First, we show that the term "inner worlds" is used ambiguously in the current literature, referring to different understandings of inner worlds and their relation to sustainability (or lack thereof). Second, we point to a plethora of literature from different disciplines within the field of sustainability science that addresses facets of inner worlds. Third, we argue that these studies are usually rooted in a third-person, quantitative, or at least shallow-phenomenological interpretation of the often preconceptual and pre-reflective experience of inner states and processes. We infer that there is a need to more strongly direct personal sustainability science toward a first-person inquiry into individuals' lived experience of inner states and processes related to sustainability.

Three understandings of inner worlds and their relation to sustainability

Over the last decade, multiple sustainability researchers have repeatedly claimed in reputable journals that a stronger consideration and deeper understanding of inner worlds—also referred to as inner dimensions, personal, or human dimensions, or people's interiorities—are crucial "in order to inform transformative problems such as climate change" (O'Brien 2012, p. 673; see also Parodi and Tamm 2018; Frank and Stanszus 2019; Ives et al. 2020; Wamsler 2020; Woiwode et al. 2021; Wamsler et al. 2021; Fougères et al. 2022). They have also defined inner worlds as "subjective domains within the individual relating to people's mindsets, worldviews, beliefs, values, and emotions" (Wamsler and Brink 2018, p. 55), "people's values, beliefs, worldviews/paradigms and associated internal (i.e., cognitive/emotional and relational) qualities/capacities" (Wamsler et al. 2021, p. 2), or "our emotions, thoughts, identities and beliefs" (Ives et al. 2020, p. 208).

In terms of how these inner worlds relate to sustainability, the literature is often vague and ambiguous. At least three somewhat overlapping understandings of this relation seem to be promoted.

The first understanding is that of inner worlds as "root causes" (Maiteny 2005) of unsustainability, that is, how these inner worlds guide unsustainable action. This approach is commonly predicated upon Meadows' (1999) theory of leverage points. According to Meadows (1999), mindsets, understood as "the great big unstated assumptions" (p. 16) of a society, create the foundations of social systems. Meadows (1999) argues that individuals' mindsets are what essentially cause current unsustainability. While they remain widely unstated due to their ubiquity, she holds that it is possible to strengthen society's awareness of these mindsets. She considers a change of these mindsets to be the deepest leverage point for a societal transformation toward a sustainable future (see also Ives et al. 2020). Based on this perspective, O'Brien (2018) distinguished three spheres of transformation, namely the practical, the political, and the personal sphere. The practical sphere describes "specific actions, interventions, strategies and behaviors that directly contribute to a desired outcome" (p. 155), such as tackling climate change. This sphere is embedded in the political sphere, which represents "systems and structures that facilitate or constrain practical responses to climate change" (p. 156). The political sphere, in turn, is embedded in the outermost personal sphere, which describes individuals' beliefs, assumptions, values, worldviews, interests, and emotions. While the political and especially the practical sphere are most strongly represented in sustainability discourses, O'Brien argues with Meadows (1999) that the most powerful (albeit slowest) leverage points to initiate a societal transformation lie in the personal sphere, as it is from this sphere that socio-political structures, economic systems, individual, and societal action emerge. Building upon Meadows' and O'Brien's perspectives, several sustainability scholars have referred to inner worlds as the root causes of unsustainability (Ives et al. 2020; Wamsler et al. 2020, 2021; Woiwode et al. 2021). As such, they propose that sustainability science should focus more on how inner worlds affect individual sustainability-oriented behavior and outer change processes.

The second understanding of inner worlds refers to how individuals relate to and come to an understanding of the external world as sustainable, as well as to the inner reactions prompted by this perception. Being exposed to sustainability-related information is thought to prompt affective-motivational reactions among individuals, such as grief, worry, anxiety (Ojala et al. 2021), frustration (Verlie 2019), hopelessness (Grund and Brock 2019), and being overwhelmed (e.g., Frank 2021). These affective-motivational reactions are seen as important determinants of sustainability-related attitudes and action. According to this understanding, exposure to sustainability-related information is always accompanied by a subjective process of translating information into new knowledge representations (Strube and Wender 1993). Inner states and processes are thought to affect this translation process by determining the epistemic evaluation of the perceived information and by influencing how individuals will engage with new information in the future (Clayton and Manning 2018; Frank 2018; Ojala 2016; Verlie 2019). In particular, being exposed to sustainability-related information can activate psychological coping mechanisms, leading to biased perceptions, or the downplaying or denial of sustainability-related information. In this sense, inner worlds are considered to be directly relevant for various forms of knowledge exchange and knowledge generation related to sustainability, including interdisciplinary and transdisciplinary research (Page et al. 2016), sustainability communication (Fraude et al. 2021), education (Ojala 2016; Frank 2021), and policy making (Wamsler and Bristow 2022). Nevertheless, it has been argued that research into these inner worlds has been neglected too, and that sustainability-related knowledge exchange and generation activities remain largely uninformed by this kind of research (Frank 2021; Fraude et al. 2021; Trümper and Beck 2021).

The third understanding of inner worlds refers to the inner quality individuals experience within themselves. The idea here is that the vision of sustainability carries an inner dimension characterized by a specific quality, sharing similarities to concepts of health, well-being, or quality of life (Wamsler et al. 2021). While some scholars consider this inner quality as an "intermediary factor" that influences "outer change toward climate action and sustainability" (Wamsler et al. 2021, p. 7), others (Ives et al. 2020; Parodi

and Tamm 2018) conceive of this inner quality as an independent goal with intrinsic value of sustainable development and consider it as some sort of inner manifestation of sustainability. Parodi and Tamm (2018) establish "personal sustainability" as a (not only academic) research field and use the term to describe this quality, characterized by specific bodily experiences, emotions, thoughts, satisfaction of needs, and a sense of meaning in life (see also Parodi et al. 2023; Hunecke 2018). In this regard, the idea of personal sustainability also relates to the work of other sustainability researchers, considering wellbeing and the individual quality of life as important independent facets of sustainable development (e.g., MaschkowskiI et al. 2008; Di Giulio and Fuchs 2014; Grabs et al. 2016), and it links sustainability-related questions to perspectives of care (Lass 2018; Niehaus et al. 2018; Godin and Langlois 2021).

Cross-cutting all three understandings is the question of how inner worlds can be influenced so that they contribute to mitigating sustainability-related problems (e.g., climate change) and promoting a sustainable future. This interest is based on the premise that individuals can contribute to enabling sustainability transformations through their roles and actions within their private and professional lives (Scoones et al. 2020; Hunecke 2022; Ayers et al. 2023). In these roles, individuals can act as change agents in various sectors (e.g., entrepreneurs (Halberstadt et al. 2019), educators (Brandt et al. 2019), or researchers (Fazey et al. 2018)). Inner worlds are considered as being either supportive or detrimental to fulfilling this role (Giangrande et al. 2019; Wamsler et al. 2021; Wamsler and Bristow 2022). Expressed in the notion of inner transformation, the idea is that, through engaging in specific experiences (e.g., being exposed to nature) or practices (e.g., mindfulness meditation) and acquiring intrapersonal skills or qualities (e.g., connectedness to nature), individuals can change their inner worlds in relation to sustainability (Frank and Stanszus 2019; Sacks 2018; Veciana and Ottmar 2018; Wamsler et al. 2021; Woiwode et al. 2021; Ives et al. 2023). This is supposed to entail the dissolution of the inner root causes of unsustainability (Ives et al. 2020; Wamsler 2020), a different perception of and relation to nature (Barragan-Jason et al. 2022; Ives et al. 2017) and outer unsustainability (Frank 2021; Ojala 2021; Wendhack 2018), increased wellbeing (Brundiers and Wiek 2017; Frank and Stanszus 2019; Hunecke 2018), and an overall adequate preparation of individuals for fulfilling their roles as future change agents (Frank 2021; Wamsler et al. 2020).

A neglected field?

As mentioned, academics' appeals for the consideration of and research into inner worlds more intensively in relation to sustainability are commonly rooted in the assertion that people's mindsets, worldviews, beliefs, values, emotions, morality, and motivations are neglected within sustainability science (Wamsler and Brink 2018; Hochachka 2021). For example, Hochachka (2021) states that "the subjective, interior dimension of climate change is the least well-represented in current adaptation efforts and it is not equally weighted with the other strategies" (p. 2). Similarly, Ives et al. (2020) hold that "the inner life has evaded explicit analysis within mainstream sustainability science because it cannot be understood via traditional scientific tools, approaches and terminologies" (pp. 208–209).

However, are inner worlds really neglected in sustainability-related research? Wamsler et al. (2021) base their claim on a recent systematic literature review in which they identified 89 studies published between 2002 and 2020 that explicitly referred to aspects of inner dimensions. It comes as a result of applying a systematic review, however, that the applied search string is restrictive and necessarily limits the scope of identified literature (Cook 2019). Articles that refer to specific dimensions of sustainability (environmental, social, economic) instead of sustainability as a general concept, to specific emotions (e.g., fear, hope, anger) instead of emotions in general, or to specific sustainability-related behaviors (for example consumption, sustainability-related learning) instead of speaking of environmental behavior in general cannot be not found when applying their particular search strategy. Against this background, there is reason to assume that scholarship on inner worlds related to sustainability goes beyond the body of literature identified in the review.

The idea that inner worlds are relevant for identifying sustainability-related problems and promoting corresponding solutions certainly dates back to before 2002. It reaches back to the emergence of early environmental philosophies, such as "deep ecology" (Naess 1973), which emphasizes the importance of "a radical transformation of consciousness" (Rosenhek 2004, p. 46) to overcome the ecological crisis that the world faces. Educational efforts to cultivate "environmental literacy" (Carter and Simmons 2010, p. 13) and thereby influence people's inner worlds have been promoted in forms of environmental education (EE) and later Environmental and Sustainability Education (ESE) since the 1960s. Scientific research on the individual and their interaction with the natural environment has been conducted in environmental psychology since the 1970s (Saunders 2003). Sustainability-related, psychological research has particularly grown in popularity in recent decades (Roszak et al. 1995; Clayton and Manning 2018). While much of this research focuses on cognitive aspects (including thoughts and beliefs) (Brosch and Steg 2021), a plethora of studies have also investigated emotions (Kals and Maes 2002; Brosch and Steg 2021), identities (Udall et al. 2021), values (Passafaro et al. 2015), and other related constructs.

Empirical research has also been dedicated to the three domains of inner worlds outlined above. In what follows, we point to a series of purposefully selected studies that indicate the extensive research activity revolving around these domains.

Inner worlds as root causes have received broad attention within consumption research. Scholars have repeatedly emphasized that individual consumption patterns constitute a main contributor to current unsustainability (Alfredsson et al. 2018; Wiedmann et al. 2020), and that it is thus crucial to understand the drivers underlying individual consumption (Bamberg et al. 2021). Furthermore, there is a wealth of research (including meta-analytic models) concerning what constitutes the main predictors of pro-environmental behavior more generally. These include values, emotions, social norm, attitudes, habits, moral norms, nature connectedness, mindfulness, and self-efficacy (see Bamberg and Möser 2007; Barragan-Jason et al. 2022; Barth et al. 2016; Geiger et al. 2019; Grund and Brock 2020; Kasser 2011; Klöckner 2013; Brosch and Steg 2021; Verplanken and Whitmarsh 2021). Based on this research, a series of intervention studies have examined means to change behavior that is harmful to the climate and motivate climate mitigation behavior (Abrahamse et al. 2005; Bain et al. 2016; Nielsen et al. 2021), including the potential of spillover from one behavior to another (Geiger et al. 2021).

How individuals relate to sustainability, emotions, attitudes, and other inner dimensions have been subject to extensive research activities too. In general, research has repeatedly identified a variety of negative emotions (guilt, anxiety, despair) that can result from a confrontation with current unsustainability (Brosch and Steg 2021; Charlson et al. 2021; Tam 2019). Several scholars have also addressed psychological coping mechanisms (denial, rationalization, suppression) that are activated in order to regulate the emotions that influence the prospective perception of sustainability-related information and the perception of one's own behavior (Brosch and Steg 2021; Clayton and Manning 2018; Frank et al. 2022; Haltinner and Sarathchandra 2018). Researchers have investigated how emotions like fear and hope influence learning processes related to sustainability, especially in environmental and sustainability education (Grund and Brock 2019; Ojala 2016; Verlie 2019). Other researchers have studied how implicit beliefs and epistemic emotions influence sustainability-related learning (Muis et al. 2015, 2018; Thacker and Sinatra 2022). Another concept receiving more attention in sustainability-related scholarship is that of human–nature connectedness as a factor that influences the kind of inner states and processes stimulated through exposure to sustainability (e.g., Barragan-Jason et al. 2022; Ives et al. 2017; Zylstra et al. 2014). Again, these examples demonstrate research activity revolving around inner dimensions in terms of perceiving sustainability.

Finally, people's experienced inner quality is central in various disciplines, including medicine, psychology, and health and movement sciences. Research looking into the relation of personal wellbeing and sustainability-related problems has also gained momentum over the past decade (e.g., Lund et al. 2018), culminating in a new movement of conceiving of health as a concept that explicitly comprises personal, communal, national, regional, global, and planetary dimensions (Horton et al. 2014; Horton and Lo 2015). A number of studies have investigated how climate change and other threats resulting from unsustainable lifestyles affect aspects of inner dimensions (e.g., Grund and Brock 2019; Charlson et al. 2021).

Scholarly endeavors advancing the idea of inner sustainability transformations—or inner transitions—have gone in two different directions. First, they have looked at practices and interventions that have the potential to contribute to transforming people's inner worlds. Researchers have looked at a variety of these practices, including Yoga (Yüce and Günes 2021), Neuro-Linguistic Programming (Murray 2011), Motivational Interviewing (Costanza et al. 2017) or, most dominantly, mindfulness meditation practices (Frank et al. 2021; Thiermann and Sheate 2020a; Wamsler et al. 2021). Education is often considered a key enabler for sustainability transformations, as it is meant to help future change agents by developing the skills, abilities, and knowledge needed to face and overcome challenges connected to engaging with sustainability (Lambrechts et al. 2013). More recently, sustainability researchers have argued that such challenges are often of affective-motivational nature (Frank and Stanszus 2019; Giangrande et al. 2019; Brundiers et al. 2020; Frank 2021). In response, ESE scholars have suggested ways to address and transform inner dimensions in ESE practice (e.g., Brundiers and Wiek 2017; Frank and Stanszus 2019; Murray et al. 2014; Ojala 2013, 2016; Verlie 2021; Ayers et al. 2023; Libertson 2023). Sustainability researchers have also attempted to specify the intrapersonal skills, qualities, and dispositions that characterize inner transformation, that is, the outcomes the aforementioned practices are supposed to stimulate. Various labels have been used to describe these outcomes, including mindsets (Wamsler and Brink 2018; Brundiers et al. 2020), psychological resources (Hunecke 2018), virtues (Corral-Verdugo et al. 2014; Manstetten and Becker 2018), inner capacities (Ayers et al. 2023; Ives et al. 2023), (intra-) personal sustainability competencies (Giangrande et al. 2019; Brundiers et al. 2020; Frank 2021), and the previously mentioned Inner Development Goals and SDG 18 "Consciousness Change".

While this list is far from complete, it is not research on inner worlds in terms of specific psychological constructs (e.g., emotions, values, attitudes) that is lacking in current

scientific approaches to sustainability. So, what exactly is it that is considered neglected, incomplete, or inadequately addressed in the context of sustainability science?

One reason could be that studies on the different domains and aspects of inner worlds often remain within the confines of their own discipline and are not connected, or even perceived by researchers from other disciplines. Research endeavors from environmental psychology, social psychology, pedagogy, sociology, philosophy, anthropology, cultural studies, and management sciences investigate sustainability approaches into inner worlds from different perspectives and with different theoretical backgrounds, terminologies, goals, and mindsets. As a consequence, they often remain in their own disciplinary discourse. A single common and strong interdisciplinary discourse or, perhaps more importantly, a consistent theory of inner worlds related to sustainability as a common reference is still missing (although more recent approaches work toward this goal, e.g., Wamsler and Bristow 2022), but it would be necessary to study inner worlds in a more systematic and comprehensive way (Parodi and Tamm 2018; Parodi et al. 2018).

Another reason raised is that much of the existing body of literature is grounded in methodological reductionism (e.g., Ives et al. 2023). This perspective relies on analyzing isolated behaviors or neatly defined psychological constructs, thus falling short of providing an integrative and interrelated understanding of the various facets of inner worlds.

While we second both limitations with regard to existing research on inner worlds, we hold that the current use and definitions of inner worlds in itself underemphasizes an (if not *the*) essential characteristic of the term, resulting in an insufficient epistemological foundation to conduct a systematic, in-depth inquiry of inner worlds and hence develop a deeper understanding thereof.

A shift to first-person experience

In searching for a solution to this problem, as a first step, we want to deliberate on the term *inner worlds.* More specifically, we hold that the prevailing approaches to defining inner worlds conflate at least two epistemological perspectives on inner worlds, which in turn influences the object and how it is examined. For example, the Wamsler and Brink's (2018) definition discusses "subjective domains within the individual" that are related to "people's mindsets, worldviews, beliefs, values and emotions" (p. 55). Similarly, Hochachka (2021) considers people's inner worlds as the intangible, unseen domain of life that unfold "in both the individual and collective spheres, including beliefs, understanding, morality, motivations, values, and worldviews" (p. 2). While both definitions associate inner worlds with subjective experiences and situate them in a phenomenological sphere, at the same time, they describe inner worlds in terms of specific psychological, abstract concepts and qualities whose inquiry is not dependent on subjective experience (e.g., Burkhardt 2019).

In response, we suggest conceiving of inner worlds as individuals' mental states and processes in relation to sustainability, that is, states and processes exclusively unfolding in the subjective experience of individuals. In this sense, inner worlds should not primarily be defined by the objects associated with individuals' internalities (e.g., emotions, thoughts, mindsets), but first and foremost by the perspectives from which these internalities are examined. This distinction reflects the ambiguous use of the term "mental," which can either refer to aspects of the mind in a more general sense or specifically address the quality of conscious—or phenomenal—experience (APA Dictionary, n.d.). While the objects of inner worlds studied do not need to be phenomenally conscious to the subjects—and they often are not or are only to a limited extent—we shift the definitional focus to the perspective of explicitly first-person, subjective experience of mental states, and processing is done by the subjects themselves. "The term 'first-person' denotes empirical self-observations in contrast to third-person data, the observations of objects and processes external to the observer's mind" (Choifer 2018, p. 336).

This does not mean that individuals are necessarily able to instantly describe or verbalize their subjective experiences. Many facets of subjective experience remain on a pre-reflective level (Petitmengin 2006); individuals are not consciously aware of them, but they can be brought to consciousness and thus described, verbalized, and analyzed by appropriate methods. In this sense, inner worlds also unfold in a dynamic, preconceptual, or even paradoxical way. They should not be hastily interpreted into predefined terms and categories (e.g., differential emotional scale, thought impact scale), even though individuals might describe them in these terms if compelled.

If inner worlds are understood this way, it seems that personal sustainability science has yet to develop suitable methodological approaches to inquire into these worlds.

Accessing subjective experience in personal sustainability science

If sustainability not only includes desirable states and dynamics of material systems, but also those of the human mind that can experience and promote the former, then the latter should also be examined more closely. In the preceding section, we compiled and systematized approaches that either call for or have already carried out an inclusion of inner worlds in the context of sustainability. As we show in this section, the current approaches prioritize methods that (a) do not allow for a deep understanding of inner worlds,

and (b) tend to reduce inner worlds to abstract and externally measurable constructs that, as in the explicit or implicit behaviorist tradition, are in danger of being instrumentalized to control and steer human behavior. As a solution, we argue that sustainability science aiming at inquiring into both inner dimensions and the corresponding agency should more strongly develop and employ first-person methods for this purpose. Overall, we hold that inquiring into inner worlds is not only a matter of choosing a research object, but it requires a more fundamental epistemological, methodological, and normative shift in personal sustainability science.

First-person research—thin and thick phenomenology

Despite persistent skepticism (e.g., Dennett 1991, Nisbett and Wilson 1977; Schwitzgebel 2008; for an overview, see Ramm 2018), new ways of integrating first-person and introspective data into empirical research have been explored in the last decades. It should be noted, however, that after the failure of the first wave of introspectionism in psychology, and its replacement by behaviorism in the early twentieth century, introspection had a poor reputation but nonetheless continued to be used, albeit under the guise of "verbal reports" and other camouflaged references (Boring 1953). Recent developments should therefore not be suspected as a relapse into overcome aberrations, but rather seen as explicitly facing the inescapably subjective and qualitative dimension of conscious experience and its due reintegration into research and educational contexts. Considering critical analyses (e.g., Weger and Wagemann 2015; Trnka and Smelik 2020) and—to varying degrees—the incorporation of research standards like objectivity, replicability, validity, and reliability, multiple first-person methods have emerged since the 1980s, some of which will be presented in the following section and placed in a context with mainstream methods.

Against this background, researchers have attempted to map the methodological spectrum employed to understand subjective experience (Berkovich-Ohana et al. 2020; Masrour 2011; Lumma and Weger 2021). On one end of this spectrum, we find approaches that correspond to a maximally "thin" or indirect phenomenology of lived experience, while the other extreme represents a maximally "thick" or direct phenomenology. Here, phenomenology is not to be understood as a specialized philosophical sub-discipline but as an explorative attitude that stands at the beginning of any scientific research and ultimately of any acquisition of knowledge (Wagemann 2022a). In this pragmatic, empirical context, phenomenology is used to first approach, examine, and describe the objects of interest in an experiential and qualitative manner before subjecting them to more specific research procedures. Thus, "thick" phenomenology refers to rich and detailed situational description (e.g., an immediate and detailed description of bodily experiences when confronted with climate change). Comparatively, "thin" pertains to concise, possibly abstract information (e.g., answering a 5-point Likert scale concerning emotions about climate change). Unlike Berkovich-Ohana et al. (2020) who restrict the thin/thick polarity to first-person accounts, we extend this notion to include third-person methodology too. In this way, we embed first-person accounts into a more complete overview. We thus methodologically bridge from the natural sciences, which lack reference to conscious experience, to philosophical research, which lacks the empirical approach. This extension also allows a more precise explanation of the thin/thick distinction in terms of qualitative and quantitative methods and their combination (see Fig. 1).

At first sight, it might seem paradoxical to include a purely quantitative measurement of external behavior in this spectrum, as phenomenal consciousness is not incorporated in these data at all. Nonetheless, if quantitative behavioral data are recorded in the context of conscious experience or agency, they refer to this experience and agency, even though only in an indirect or maximally "thin" way. While, in this case, inferences must be drawn to assess the role and character of conscious experience, in standard survey methods (e.g., questionnaires or interviews), the first-person perspective is more directly included, depending on the specific data format used (nominal, ordinal, qualitative). In principle, interview methods can yield more complex ("thicker") experiential information due to social interaction and reactivity, albeit this is often not sufficiently considered. Compared to the following decidedly first-person methods, however, standard survey methods tend to remain on the third-person or "thin" side of the spectrum, as they mostly aim at measuring quantitative variables according to operationalized psychological constructs and thus quantify experiential dimensions at an early stage. Furthermore, standard survey methods neglect the possibility that individuals interpret and hence relate to specific items very differently, producing phenomenologically non-comparable results. For example, the Freiburg Mindfulness Inventory (FMI) questionnaire provides very similar levels of trait mindfulness for binge-drinking students in comparison to highly experienced mindfulness practitioners (Grossman 2008). This indicates that both groups might conceive of the specific items very differently despite their quantitative similarity.

In contrast to purely quantitative methods or early quantification of first-person experience, the lower or "thicker" half of the diagram covers approaches of "late" quantification and purely qualitative data collection. "Late" quantification means that first-person data are first recorded and analyzed qualitatively before being quantified and fed into statistical tests. In the following, without claiming to deliver a complete account, we outline some exemplary methods representing this part of the spectrum. Here, we start with

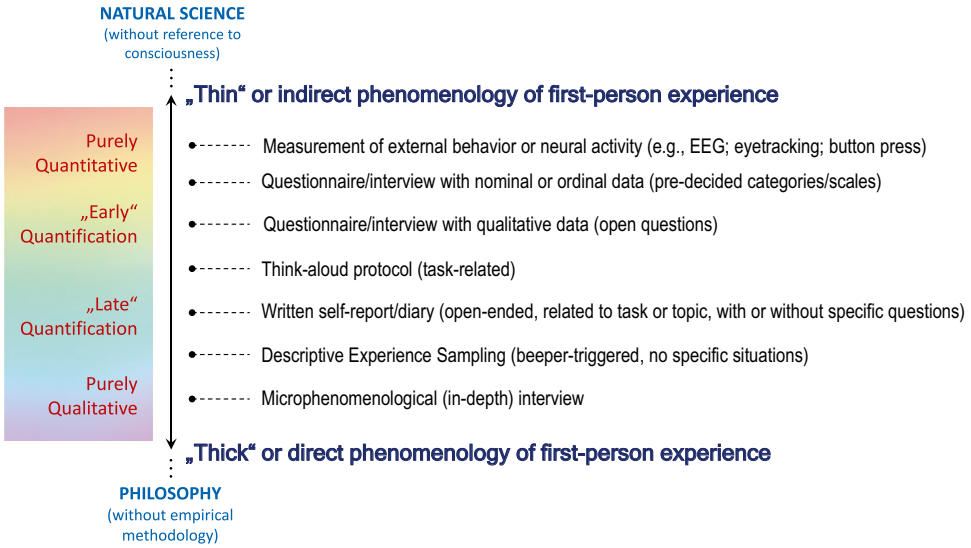

Fig. 1 Methodological spectrum between "thin" and "thick" phenomenology of first-person experience. The methodological varieties of an empirical access to first-person experience can be seen as an analogue to the spectrum of electromagnetic waves in physics, in which a small but significant range applies to the colors of visible light. Above, they connect to natural science without reference to consciousness, and below they run out into philosophy without empirical methodology. Between these boundaries, data acquisition methods incorporate a "thinner" and less direct or a "thicker" and more direct phenomenology, respectively. The extremes of this spectrum are purely quantitative and purely qualitative methods, mediated by "early" or "late" quantification of first-person experience. While "early" quantification is part of the empirical standard toolbox, "late" quantification means that first-person data are first recorded and analyzed qualitatively before being quantified and fed into statistical tests

the think-aloud protocol which is audio/video recorded during or shortly after completing an experimental task (e.g., a mathematical calculation). The participant is asked to spontaneously say everything that she thinks, feels, and experiences while doing a task without interpreting or explaining it (Ericsson and Simon 1993). Concurrent and retrospective think-aloud techniques have specific advantages and disadvantages. For example, for many people it is too demanding to verbalize their cognitive processes, but this provides more immediate and comprehensive data, whereas retrospective verbalization is easier to accomplish via memory but less reliable (Kuusela and Paul 2000). Think-aloud techniques have wide applications like, for instance, in psychology (e.g., Güss 2018; Malek et al. 2017), in research on education (e.g., Kesler et al. 2016), and in usability (Boren and Ramey 2000).

Next, we come to written self-reports, which do not seem to be as prevalent as oral accounts (interview, think-aloud), possibly due to formalized written questionnaires still dominating research (Handy and Ross 2005). Although digital text data are increasingly used in psychology to derive objectively measured features (e.g., Boyd 2017; Pennebaker et al. 2014), written accounts have traditionally been limited to sociology and anthropology. Nonetheless, in terms of first-person methodology, they provide some advantages over oral accounts as they are less time-consuming regarding data acquisition and analysis, and data tend to be more consciously organized and reflective (Handy and Ross 2005; Schellings and Hout-Wolters 2011). Examples are open-ended self-descriptions in personality psychology (Paulhus and Vazire 2007), written correspondence in gender studies (Letherby and Zdrodowski 1995), and various applicable diary techniques (Iida et al. 2012). More recently, written self-reports have been introduced into experimental cognitive research, which is described in more detail below.

While the latter two methods are framed within specific task contexts or topics, the Descriptive Experience Sampling method (DES) captures pristine inner experience in randomly assigned moments of everyday life. To this end, a beeper signal (e.g., six times over three hours) alerts participants in their everyday environments to attend to their inner experiences and record notes about them (Heavy and Hurlburt 2008; Hurlburt and Heavey 2015). Unlike similar approaches (e.g., Csikszentmihalyi and Larson 1984; Stone and Shiffman 1994), DES aims to explore inner experience as it naturally occurs and thus requires bracketing false beliefs and preconceptions. Participants are trained in preliminary trials, and extensive follow-up interviews are conducted to clarify the meaning of what the participants noted in the reflective moments. Since DES does not instruct subjects to report thoughts, feelings, or other specific aspects, but just their inner experience at a given moment, an unlimited number of aspects can emerge. They can be categorized into five frequent forms: inner speech,

imagery, unsymbolized thinking, feeling, and sensory awareness (Heavy and Hurlburt 2008). Since DES is a time and resource-consuming method, it is rarely applied with all of the features mentioned: instead, it is used for qualitative exploration or beeper-induced quantified data collection (Killingsworth and Gilbert 2010; McVay et al. 2009).

With the micro-phenomenological interview (MPI), further importance is given to the aspect of spoken language data and interactive in-depth explorations of inner experiences. However, MPI is not focused on isolated moments but rather on the dynamic aspects of inner life (Vermersch 1994; Petitmengin 2006). Moreover, in contrast to DES, MPI was developed to delve into the pre-reflective subtleties of inner experience that individuals are not naturally aware of. This can be achieved by stimulating the interviewee with iterative "how" questions to re-enact the original experience and examine it with increased accuracy. As a specific but unnecessary feature, the MPI method is often used in the contexts of embodied experience and cognition (e.g., Valenzuela-Moguillansky and Vásquez-Rosati 2019). Nevertheless, micro-phenomenology has been applied to various research fields like meditation (Petitmengin et al. 2019), decision-making (Sparby et al. 2021), and synesthetic perception (Gould et al. 2014).

As noted, these four methods serve as representative examples, without going into further detail about other approaches like Phenomenological Psychology (Giorgi 2009) and Interpretive Phenomenological Analysis (Smith et al. 2009), both of which are at the qualitative end of the spectrum, or Indirect Phenomenology (Braddock 2001) and Front-loaded Phenomenology (Gallagher 2003), which are more associated with quantitative or mixed-methods designs. However, although the order of the first-person methods on the thin/thick scale provides a rough orientation, that order is only valid to a limited extent, since all methods may be applied in different ways. Of course, methods in the upper range lend themselves to late quantification and nomothetic hypothesis testing, insofar as they are focused on specific experimental tasks and confined to non-interactive data recording. Complementarily, methods in the lower range are more suited to capture fine-grained aspects of experience in idiographic case studies. The different resources and efforts that need to be invested in each case (e.g., short text protocols versus transcription of large interview datasets) explain why the methods are used with higher or lower sample sizes. While these features justify the proposed classification of methods, they do not preclude atypical use. For example, micro-phenomenological interview data can also be coded, quantified, and subjected to statistical analyses, and written accounts can be extended by repeating the task over time or diversifying it with fine-grained conditions or questions. Together with their specific advantages and disadvantages, the flexibility of first-person methods invites the pushing of their limits. Ultimately, the decision to use a particular methodology must always be made in the context of the research or application.

In principle, all first-person methods can be combined with each other and external measurement methods. The most prominent example of such a mixed-methods triangulation is Neurophenomenology (Varela 1996), which combines neurophysiological and first-person data. Another example are written self-reports, which can be both analyzed qualitatively and quantitatively regarding the word count and frequencies of certain word types (Wagemann 2022a). Another example can be found in Wooffitt and Holt's work (2011), which proposes a discourse analysis to identify linguistic patterns in how people speak about subjective experiences (see Frank et al. 2021 for an application in the context of sustainable consumption). Moreover, first-person and third-person methods can be integrated into a circular research approach where they can be used alternately and thus stimulate each other (Wagemann 2023). This illustrates that we are not advocating deepening the antagonistic divide between third-person and first-person approaches. Rather, we are proposing the introduction of a continuous and dynamic spectrum ranging between the different perspectives and valuing their suitability to different contexts. In conclusion, in principle, it is not possible to map mental phenomena completely onto third-person data, so a more explicit inclusion of the first-person perspective would be appropriate for a serious examination of inner worlds.

Toward first-person inquiry within personal sustainability science

Our concern is that even existing research on inner dimensions related to sustainability is almost exclusively located at the top end of the presented spectrum (thin phenomenology). By far most studies in the field are based on quantitative research approaches (Wamsler et al. 2021). Some studies use semi-structured or open-ended interviews to collect data on people's subjective experiences in relation to sustainability (e.g., Verlie 2019; Ojala 2021); however, they also remain on a rather thin phenomenological level. Only a handful of studies rely on thick phenomenological methods to understand sustainability-related phenomena (compare, Petitmengin 2021; Candiotto 2022, or in parts Pöllänen et al. 2023).

In our opinion, the sparse adoption of first-person methods in personal sustainability science may be not only due to principled reservations against introspection, as mentioned above (3.1) but also to practical barriers in applying these methods. Most pressingly, first-person methods are hardly taught in current academic education, which is why they are largely unknown to many scholars. The implementation of phenomenologically thick approaches (e.g.,

micro-phenomenology) might also be difficult in the context of sustainability-related real-word issues and require more resources than standard approaches. However, there are also demanding statistical procedures that need expertise to be deployed, so the aforementioned challenges are not exclusive to first-person approaches.

An additional problem faced by both quantitative self-reports and qualitative interviews on sustainability-related topics is the potentially limited validity of the obtained data. Psychological research has provided extensive evidence that individuals often lack direct and unbiased access to their inner states and processes and even tend to suppress the latter (Wilson 2004; Kahneman 2011). In particular, sustainability-related topics are usually morally laden and hence influenced by individual conscience and social desirability, directly affecting people's responses in questionnaires and interviews (Small and Cook 2021). For this reason, several researchers have argued that individuals must be trained or systematically guided (by choosing thick phenomenological methods) when verbalizing subjective experiences (Petitmengin 2006; Petitmengin et al. 2019) or stimulated by appropriate tasks to direct attention to their own mental activities (Wagemann 2022a, 2023). In current empirical works on inner worlds related to sustainability, however, this is rare. Consequently, current research attempts to focus on inner worlds risk losing the phenomenal depth, precision, and scope in favor of abstract and quantifiable constructs. For the same reason, we also fear that "approaches to research that encompass co-creative and reflexive forms of knowledge creation (such as transdisciplinary, action-oriented and transformative research)" (Woiwode et al. 2021, p. 14; see also Ives et al. 2023) is not in itself "suitable for both the analysis and the (potential) engagement with inner dimensions" (Woiwode et al. 2021, p. 14), as they do not warrant unbiased and in-depth access to inner states and processes as such. Instead, these research activities could be enriched by first-person methods and practices that provide access to these dimensions.

Aside from its epistemological value, strengthening first-person methods in sustainability-related research is also rooted in normative considerations. As long as inner worlds are exclusively studied based on statistical data, abstract concepts, and shallow phenomenology, and their owners are not necessarily conscious or made conscious of them (having no direct (i.e., agentive and fully responsible) access to the formation of their judgments, feelings, attitudes, and motives), individuals remain exposed to psychological biases as well as interpretive sovereignty, manipulation, and possibly also deception by others. Hence, people are likely to remain objects whose inner lives and behaviors may be predicted and controlled by external authorities, but not intentionally observed and transformed, with the people themselves acting as responsible agents of change for sustainability. In terms of Habermas (1968), phenomenologically thin research on inner worlds in relation to the cause of sustainability is still situated in an instrumental research logic. Thin research risks removing the genuine quality of subjective experience and reducing it to externally measurable phenomena with the goal of influencing the latter toward sustainable development. In contrast, first-person methods can be developed, making researchers and laypersons aware, thus allowing them formative access to the determinants and processes of consciousness while complying with the quality criteria of empirical research (Corti et al. 2015; Weger and Wagemann 2015).

As a more concrete illustration of this, we refer to recent studies that explore mental micro-gestures performed in various perceptual change tasks and recorded by written self-reports. When participants are instructed to continually change their percept referring to a constant but ambiguous stimulus (e.g., the Necker cube or Rubin's vase), or to hold a particular percept faced with a continually changing stimulus; they not only reported that they were able to do so, but they also described how they succeeded by (a) intentionally averting the stimulus, (b) producing an alternative conceptual variant for perception, (c) turning toward the stimulus again with a changed concept, and (d) finally perceiving the intended content with full distinctness (Wagemann et al. 2018; Wagemann 2020). This dynamic structure of mental micro-activities has been replicated for different sensory modalities (Wagemann 2023) and thought processes (Wagemann 2022b). A similar structure of mental activities was found in nonverbal dyadic social interaction (Wagemann and Weger 2021; Wagemann et al. 2022). In our context, this line of research suggests that we can develop certain degrees of inner freedom and agency even in perceiving sustainability-related phenomena using first-person approaches, rather than blindly relying on our own cognitive habits or preconceived interpretations by others.

Frank and Stanszus (2019) provide an example of first-person inquiry directly stemming from sustainability-related research. They looked at students participating in a university seminar in which they ran a transformational project of their personal consumer behavior. Applying the concept of self-inquiry-based learning, students systematically documented their experiences with these projects and received introspective training during seminars. This systematic self-inquiry allowed them to deepen their awareness and improve their abilities in describing their lived experience. It also enabled them to transform their inner states and processes so they could pursue more sustainable consumption choices.

In terms of sustainability, it is important to note that the studies mentioned above were conducted in higher education contexts, and that the students benefited from the phenomenological insights into their own mental processes and recognized their potential to become aware of their agentive

and self-efficacious contributions to forming reality. In this sense, reality of mind is not a given fate imposed on us but rather something that we can deliberately build up in resonance with natural, cultural, and social environments.

Therefore, personal sustainability science oriented towards the first-person experience could contribute to a development that would enable people to become more self-aware and self-empowered agents whose insights and responsibility could also extend to external environments.

Exploring subjective experience within personal sustainability science

In the previous sections, we argued that inquiring into inner worlds within sustainability science is not primarily a matter of specifying a research object (e.g., emotions, values, or mindsets), but it requires a more fundamental shift towards an understanding of and approach to the individuals' subjective experiences. In this section, we provide the conceptual, normative, and methodological cornerstones for a first-person inquiry within personal sustainability science and propose an agenda for research undertaking this shift.

First, we provide a definition of first-person inquiry within personal sustainability science as a primarily deep-phenomenological inquiry of inner worlds. Second, we outline the normative facets of this kind of personal sustainability science. This is followed by the methodological principles we suggest for this kind of research. Finally, we provide exemplary pathways for conducting first-person sustainability science research.

What is sustainability-related first-person research concerned with?

If we understand personal sustainability science as the inquiry of inner worlds in relation to sustainability and consider inner worlds as essentially mental states and processes unfolding in the subjective experience of individuals, we propose to understand first-person research within sustainability science as the systematic inquiry of the subjective experience of inner states and processes occurring in relation to sustainability. Building on the previously presented literature (see "Inner worlds and sustainability"), we suggest distinguishing three experiential dimensions in which the subjective experience of individuals in relation to sustainability unfolds.

1. Root causes of sustainable action. This dimension encompasses subjective experiences unfolding from an active relation to sustainability. Outer manifestations of sustainability, such as climate change, biodiversity loss, and desertification, stem from aggregated individual behaviors (Alfredsson et al. 2018; Wiedmann et al. 2020; IPCC 2023). The drivers underlying such behaviors, commonly described in terms of needs, values, emotions, habits, and other motivations, are scrutinized with regard to their experiential quality.

2. Perceiving and processing sustainability. This dimension is concerned with the receptive relation the individual holds with sustainability. It comprises subjective experiences of how individuals perceive and come to an understanding of the external world as sustainable, as well as the internal processes prompted by these processes.

3. Inner manifestation of sustainability. This dimension is based on the premise that the subjectively experienced inner quality of an individual constitutes an independent manifestation of sustainability. In this sense, inner quality describes the experience of one's inner situation, for example, the experience of one's needs and their satisfaction or, more generally, the subjective experience of mental or physical wellbeing (or its absence), and quality of life.

Importantly, the suggested distinction between experiential dimensions is analytical. In practice, the three dimensions intersect and influence each other. For example, it might be possible that the experience of personal suffering as an expression of a poor inner quality constitutes an inner root cause for unsustainable actions (e.g., compulsive eating, Stanszus et al. 2019). From this perspective, changing an individual's inner quality might be considered essential for transforming inner root causes. However, studies on mindfulness have found that people can increase their inner quality at the expense of sustainable actions (Frank et al. 2021). Thus, while we acknowledge relationships between the three dimensions, we intend to map different access points and systematically guide research inquiring into people's inner worlds related to sustainability.

What we consider common to the three experiential dimensions is their systematic accessibility by first-person methodologies. In addition to the subject area of personal sustainability science (the three dimensions), studying inner worlds should thus be defined decisively by a methodological addition or reorientation.

Inner transformations toward sustainability, understood here as an acquired ability to alter inner states and processes in such a way that they support self-determined, sustainability-oriented action, constitute a cross-cutting facet concerning all three aforementioned dimensions. While we share the fundamental understanding of inner transformation as a process of unleashing an innate "human potential to care, commit to, and effect change for a better, more sustainable life across individual, collective and system scales" (Ives et al. 2023, p. 3), our proposed definition diverges from previous definitions of the term that rely more strongly on particular qualities that characterize inner transformation (Woiwode et al. 2021; Ives et al. 2023). Instead, given the proposed key characteristics of inner worlds and hence our understanding

of inner transformations as first-person phenomena, our definition more strongly emphasizes the unfolding of inner transformation in individuals' subjective experience. These states and processes can be experientially explored and made accessible to the subject for deliberate action. In this sense, inner transformation constitutes a revelation of an individual's agency with regard to their experienced inner worlds.

It follows that from the proposed phenomenological standpoint that the outcome of inner transformation cannot be predefined in the form of particular qualities, as this undermines the essential transformative potential of first-person inquiry to unleash an individual's agency (see also "The potential role of first-person methodology within sustainability-related research"). In a certain sense, deliberate mental action begins with classifying sustainability-related phenomena in one of two ways (transformed or not transformed) and, at best, agents are able to keep their perspectives flexible and to distinguish between what has already been transformed, what is still to be transformed, and what is in the process of transforming.

It is important to underline that subjective experience does not unfold independently of social context (Goffman 1959). Instead, individuals usually act in certain roles, such as in the role of a consumer or a professional actor. These roles provide different contexts in which subjective experiences related to sustainability unfold. For example, the manager of a multinational company engages in different actions in their professional context than a high school teacher. An African farmer will perceive climate change very differently from an upper-class consumer in a Western country. Finally, inner manifestations of sustainability differ between roles. Nevertheless, these initially seemingly incompatible contents of experience and perspectives on life can be brought into a relationship if the individuals become aware of the principles of their emergence and their own participation in it. Then, unfamiliar contents of experience can also be shared and grasped in terms of meaning, which may in itself represent a first step toward inner transformation. In this sense, first-person research within sustainability science can do justice to and help understand the specific influence of these contexts, such as by focusing on the subjective experiences of specific populations (e.g., entrepreneurs, politicians, sustainability professionals).

The potential role of first-person methodology within sustainability-related research

As we outlined in "Accessing subjective experience in personal sustainability science", methods that allow us to inquire into the thick phenomenology of lived experience constitute an important cornerstone of first-person research within personal sustainability science. This kind of approach does not rule out the possibility of complementing first-person perspectives with other methodological approaches. Nevertheless, in the words of Francisco Varela (1996), "lived experience is where we start from and where all must link back to" (p. 334). Complementary perspectives can serve as valuable corrective measures for making sense of subjective experience. However, they do not replace or devalue phenomenological approaches. To paraphrase Jack and Roepstorff's (2003) view on introspective research approaches, we believe that sustainability scientists should not "fear that introspective evidence will impugn the scientific credibility of their work. They should fear the Frankenstein science they will create without it" (p. xx). In particular, first-person research provides a means to systematically do justice to the claim for self-reflexivity in research activities (Fazey et al. 2018). It enriches scientific endeavors with the lived experience of the researchers and makes transparent how the researchers themselves are affected by their inner worlds in the process of inquiry (Weger and Wagemann 2015).

First-person research within personal sustainability science opens new pathways for inter and transdisciplinary collaboration, which are often considered essential for developing solutions for sustainability-related problems (von Wehrden et al. 2019; Caniglia et al. 2021). While psychology can play a role in this regard (Bruhn 2021), we think that more applied approaches stemming from coaching, psychotherapy, indigenous forms of knowledge, movement-based practices, and spiritual and contemplative practices could be of particular value for this kind of inquiry. In the words of Gustave Speth, "I used to think the top environmental problems were biodiversity loss, ecosystem collapse and climate change. I thought that within 30 years of good science we could address those problems. But I was wrong. The top environmental problems are selfishness, greed and apathy… And to deal with these we need a spiritual and cultural transformation—and we scientists don't know how to do that" (cited after Ives et al. 2020, p. 208). In this sense, first-person research can also establish a systematic foundation for integrating inner dimensions into "approaches to research that encompass co-creative and reflexive forms of knowledge creation" (Woiwode et al. 2021, p. 14; see also Ives et al. 2023).

Normative facets of sustainability-related first-person research

As evident in the context of inner transformations towards an expanded awareness and agency of individuals, sustainability-related first-person research as proposed here is deeply rooted in a humanistic-existential perspective. In the sense of Jean-Paul Sartre's famous quote "man is condemned to be free" (Sartre 1946), it is built upon the assumption that individuals can and must always choose an action. While

external circumstances affect our inner states and processes, it is the experience of these inner states and processes that triggers our behavior. First-person research aims to overcome "the unbearable automaticity of being" (Bargh and Chartrand 1999); it aims to replace unconscious, automatic reactions to these inner states and processes by self-determined, consciously chosen ones. As such, conducting first-person research within sustainability science also responds to what has been called individual "scapegoatism" (Akenji 2014; Schmitt et al. 2020), that is, laying the responsibility for a sustainability transformation on individuals while denying broader systemic causes of current unsustainability. It does not deny the need for addressing systemic causes or developing technical and political solutions. However, the first-person research paradigm emphasizes that individuals and their subjective experience also play an important role in understanding current unsustainability and advancing a sustainability transformation. Applying Habermas' (1968) terminology, first-person research within personal sustainability science is a form of emancipatory research, which enables radical changes in social conditions through developing individuals' response-ability (Perls 1969) with regard to inner worlds. It thus complements prevalent technical–instrumental and practical endeavors of sustainability science, which are often guided by the interest to control and steer future human development by informing top-down approaches. Furthermore, it can support individuals in engaging in collective action (Boda et al. 2022) by unleashing their agency and self-determination with regard to their inner states and processes occurring in action.

This kind of scientific endeavor directly contributes to both the descriptive and transformative purposes of sustainability science (Heinrichs et al. 2016). It is descriptive in the sense that it provides accounts of sustainability-related problems and their causes as they unfold in the subjective experience of the individual. It is transformative insofar as it allows the subject to explore their inner worlds in relation to sustainability in detail, as well as to discover and develop their inherent potential to change these inner worlds. As such, first-person research can also play an important role in developing what Thiermann and Sheate (2020b) have called experiential strategies, which "aim to physically, cognitively, and affectively stimulate meaningful experiences in relation to oneself, others and nature" (p. 7). In other words, first-person inquiry within sustainability science can help with the development and evaluation of specific practices suitable for initiating and supporting inner transformation. In this way, it can directly contribute to designing learning activities for environmental and sustainability education. Experiential learning has been considered a key pedagogical approach in this field (UNESCO 2017). As it is the systematic inquiry of people's subjective experience that characterizes first-person research, its research results can inform experiential learning activities by specifying the aspects of experience they intend to address, suggesting practices to systematically access these facets of experience and, eventually, enabling learners to deal with their inner states and processes in a self-determined way. At the same time, (experiential) learning settings related to sustainability can be excellent opportunities for conducting first-person research. These opportunities allow researchers and students—in a sense of a scholarship of teaching and learning (Hutchings and Shulman 1999)—to systematically explore subjective experience and evaluate the potential of specific learning activities to stimulate intrapersonal learning processes with regards to sustainability (see Frank and Stanszus 2019).

Another applicable feature of first-person research within sustainability science lies in its potential to start inquiring into our very own subjective experience as sustainability researchers. Without starting with and systematically including our very own inner worlds, we are concerned that voices criticizing the neglect of inner worlds when studying sustainability and calling for integrating people's inner worlds in sustainability science actually replicate the very externalization of sustainability-related problems and their solutions they intend to overcome ("others need inner transformations"). However, it is not only others (e.g., politicians, entrepreneurs, and consumers), but also we ourselves as sustainability scientists who perceive and process sustainability. In the same way, we incorporate the root causes and show inner manifestations related to sustainability. Against this background, first-person inquiry within sustainability science describes the practice of "walking the talk" and initiating a sustainability transformation by honestly facing and transforming our own inner worlds.

Possible applications of sustainability-related first-person research

We close this section by providing more specific examples of how personal sustainability science can be substantiated by applying first-person methodology to advance the understanding of and, eventually, transform people's subjective experience in relation to sustainability. For this purpose, we link back the principles characterizing this research paradigm to the dimensions of inner worlds outlined earlier and suggest possible applications of a first-personally founded personal sustainability science.

Root causes of sustainable action: several consumption scholars have argued that many consumer activities do not originate in choices based on thorough reflection and evaluation of their actual needs and values, but rather demonstrate habitualized behaviors triggered by situational cues (Klöckner and Matthies 2004). While the degree of reflection depends on the area of consumption (Zundel and Kaufmann-Hayoz 2011), ample evidence has been provided that

certain forms of consumption, for example eating, can be considered strongly habitual and automatic (e.g., van't Riet et al. 2011). Moreover, evidence shows consumptive acts can often be a reaction to impulses or serve as an emotional coping strategy for avoiding or suppressing negative thoughts and emotions, instead of being primarily based on physical needs (Mantzios and Wilson 2015). People are not necessarily aware of the causes behind their habitual consumer patterns, their underlying impulses, or the external triggers that activate them, restricting the control people have over their consumption and the entailed external consequences (Bahl et al. 2013). First-person research within sustainability science as proposed in this article could complement existing research by providing detailed first-person descriptions of individuals' inner states and processes preceding and accompanying consumptive acts. For this purpose, thick phenomenological research methods (e.g., micro-phenomenological interviewing) can be deployed to examine people's inner states and processes prior to consumption. A direct advantage of this kind of research is that it raises awareness for the unconscious events moving people toward detrimental and unsustainable consumptive behaviors. This kind of awareness also strengthens an individual's ability to deal with inner states and processes in a self-determined way and make conscious consumer choices instead of automatically activating consumptive coping strategies.

Perceiving and processing sustainability: As mentioned earlier, research on this dimension of inner worlds has looked at affective-motivational processes influencing the way individuals deal with sustainability-related information. It is argued, for example, that confronting unsustainability can trigger negative emotions like anxiety or guilt, which make individuals prone to engage in psychological coping mechanisms resulting in suppression, denial, or avoidance of sustainability-related problems depending on their abilities to deal with these emotions (Ojala 2016; Clayton and Manning 2018). These claims have far-reaching consequences for sustainability-related learning and knowledge exchange processes, as the very idea of obtaining new information and making informed decisions based on the latter can be undermined by these automatic coping mechanisms. However, research has not yet examined the subjective experience of sustainability-related learning and knowledge exchange in detail. A micro-phenomenology of sustainability-related learning and collaboration could shed light on this gap, analyzing learners' subjectively experienced, affective-motivational processes leading them to accept or refuse arguments. In particular, this kind of research would actively involve subjects in a learning process about their inner reactions to new information, allowing for a self-determined dealing with the inner states and processes prompted by these problems instead of automatically falling into emotional coping strategies and motivated reasoning processes.

Inner manifestation of sustainability: Consumption scholars have argued that individuals perform consumptive actions in pursuit of certain goals, and that these goals are individually felt needs (Di Giulio et al. 2011; Di Giulio & Fuchs 2014; Kaufmann-Hayoz et al. 2012). Following Max-Neef (1992), these authors argue that consumed things and services function as satisfiers for these felt needs: "As such, individuals intend consumptive acts to improve their lives in one way or another" (Di Giulio and Fuchs 2014, p. 187). They are "thus always linked to individual conceptions of a good life, even if these ideas may not be well thought out and may not be explicit" (ibid.). However, it remains very much an open question as to how we know that an experienced need is first of all adaptive (e.g., sugar cravings) and then actually satisfied. Thick phenomenological methods could shed light on the subjective experience of needs, as well as on the experience unfolding when attempting to address the latter. In this way, it can directly contribute to empowering individuals to make more conscious decisions in response to their individually felt needs.

We have suggested some starting points for the application of first-person methods in personal sustainability science. In terms of procedure, research could be initiated through (pilot or full-blown) qualitative studies using methods of first-person data collection, as described in "Accessing subjective experience in personal sustainability science", to explore the full range of experiential phenomena at a phenomenologically "thick" level. Having identified core phenomena and concretized research questions, qualitative and quantitative hypotheses could be developed on whether and how these phenomena depend on external or internal factors or conditions. Then, not to lose the connection to the experiential dimension due to incommensurability problems between qualitative and quantitative kinds of data (Small 2011), experimental mixed-methods approaches with qualitative data collection and late quantification could be implemented, for example, deploying again one of the outlined first-person methods. In terms of analysis, data would have to be coded according to qualitative research standards, before quantifying it in different ways, such as based on raw data (e.g., word frequency) or using code frequencies in the context of late quantification. The nominal or metrical variables obtained from this procedure could then be subjected to inferential statistics, in the same manner as in purely quantitative, phenomenologically "thin" research, to draw conclusions based on *p*-values, effect sizes, etc. (e.g., Wagemann 2023; Wagemann et al. 2022). The key difference, however, is that researchers are free to navigate between phenomenologically "thick" and "thin" approaches across the methodological scale, as the research questions require. They can proceed from phenomenologically "thin" to "thick" approaches, or vice versa, or integrate them into circular research procedures, as indicated in "First-person

research—thin and thick phenomenology". In this way, unexpected findings could emerge in the outlined research scenarios demonstrating differentiated aspects and effects of first-person experience and agency in sustainability science.

It is worth pointing out again, however, that the value of applying particularly thick phenomenological research methods is not exhausted through mere knowledge production. An in-depth understanding of subjective experience—as it unfolds prior to or after consumptive acts, for example, or when being confronted with sustainability-related information—also allows researchers and educators to build experiential strategies and learning spaces intentionally guiding learners through these kinds of experiences. Similarly, thick phenomenological methods can be applied to understand and evaluate learning experiences that are designed with the intention to stimulate intrapersonal learning processes (e.g., in the form of intrapersonal sustainability competencies (Frank 2021), inner capacities (Ayers et al. 2023), or Inner Development Goals (http://www.innerdevelopmentgoals.org). Against this background, we consider the emerging field of inner development within Environmental and Sustainability Education a particularly relevant area for the application of sustainability-related first-person research.

Conclusion

In the introduction of this article, we raised the concerns that there is conceptual vagueness regarding what sustainability researchers refer to when they discuss people's inner worlds and that there is ambiguity about how these inner worlds can be addressed.

To address the first concern, we suggest that inner worlds should not be characterized by specific objects, but in terms of their unfolding in subjective experience. We suggested three experiential dimensions in which these subjective experiences unfold in relation to sustainability, which we have labeled: (1) root causes of sustainable action, (2) perceiving and processing sustainability, and (3) inner manifestation of sustainability.

To address the second concern, we argued that existing research almost exclusively relies on phenomenologically thin or indirect methods when it comes to inquiring into individuals' subjective experiences. Consequently, a thorough understanding of inner worlds and how they can be transformed in such a way that they support self-determined, sustainability-oriented insight and action seems to be scarce. In response, we have suggested first-person—especially "thick" phenomenological—methods and their integration in mixed-methods approaches (with late quantification or different types of data) to access, deepen, and broaden the understanding of inner worlds in relation to sustainability.

In an attempt to redirect personal sustainability science—i.e. the systematic inquiry of inner worlds related to sustainability—toward the first-person experience of inner worlds, we developed conceptual, epistemological, and normative cornerstones of first-person research within sustainability science, that is, the systematic inquiry into the subjective experience of inner states and processes occurring in relation to sustainability. We believe that this kind of inquiry closes an important gap of current approaches within personal sustainability science and contains a significant potential for advancing and contributing to a transformation in the understanding of sustainability. It could be a means for overcoming the automaticity of our being that leads to reproducing the unsustainable reality many would like to change. Consequently, first-person research within personal sustainability science could contribute to replacing this automaticity with a more conscious, self-determined approach to dealing with inner states and processes. Furthermore, it could directly inform the development of experiential strategies by specifying the aspects of experience they intend to address, providing methods to systematically access these facets of experience, enabling learners to deal with their inner states and processes in a self-determined way. Finally, it describes a practice of initiating a sustainability transformation by honestly facing and transforming our personal inner worlds and supporting others in doing the same.

Acknowledgements We would like to express our gratitude to Karoline Pöggel, Jana Timm, and Kaidi Tamm, who made valuable contributions to the content of this article in its early stages. We would also like to thank Christoph Schönherr for his valuable feedback on the article.

Declarations

Conflict of interest The authors declare no conflicts of interest.

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