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Rethinking Psychology of Technology for Future Society: Exploring Subjectivity from Within More-Than-Human Everyday Life

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Two decades into the twenty-first century, the gap between techno-scientific progress and an understanding of its significance in human life seems wider than ever. Günther Anders, a philosopher of technology, wrote over 60 years ago about an increasing discrepancy, a "Promethean gap" (Anders, 2018a/1956, p. 29), between human creation and imagination. Through the development of modern technology, he realized, human activity had begun to surpass itself in a problematic way. Since human capacities such as emotion, perception, or even the ability to care are relatively limited when compared to our capacity of making, we are faced with a fundamental discrepancy between the world of technology and the human ability to meaningfully conceive it; a divide

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primarily attributable both to the accelerated pace of technological development, and to the enormous complexity of the things created and their effects. In this paradoxical situation, whereby "we are smaller than ourselves" (Anders, 2018b, p. 324, authors' translation), Anders sees the basic contradiction of our time and the decisive task to situate ourselves, our ways of thinking, our theories, interpretations and actions, within the horizon of the self-created world of high technology. "If we don't succeed", he underlines, "in matching the circumference of our imaginative abilities with our abilities of making, then we won't survive" (1992, p. 8, authors' translation).

Today, scientists around the globe are increasingly aware how the world is dangling on a string due to excessive human exploitation of the Earth's ecosystems, and are warning that the "time is running out … soon it will be too late to shift course away from our failing trajectory" (Ripple et al., 2017, p. 1028, in the declaration *Warning to Humanity: A Second Notice*, signed by over 15,000 scientists). Within Science and Technology Studies (STS) influential scholars realize this danger as well, and put it at the center of their thinking (e.g., Haraway, 2016; Latour, 2017; Papadopoulos, 2018; Stengers, 2015). As a recent response, a critical self-reflection has set in among scientists in various disciplines on how modern sciences have been part of the problem, as well as on how we have to fundamentally rethink our scientific conceptions and self-understandings—to be able to meaningfully work with these problems and thus become part of enabling a viable future society. With reference to the body of work of Günther Anders, Bruno Latour, for instance, explicates to his fellow scholars in the light of the threat of global warming: "You are interesting to me only if you situate yourselves *during* the end time, for then you know that you will not escape from the time that is passing. Remaining in the end time: this is all that matters" (2017, p. 187).

Likewise, psychologists are concerned and engage in a critical debate about their scientific apparatus and a renewal of psychological theory, methodology, and research practice. In this paper we expand this dialogue with STS to rethink the psychological study of technology. Our question is how the psychology of technology can fundamentally reformulate its scientific vision so it can help to analyze the discrepancy between creation and imagination, and thereby contribute to a profound understanding

of the significance of modern technology in human life. We are arguing for a conceptual shift along four lines: (1) From a disembodied, dissecting, and individualizing scientific vision of subjectivity toward an embodied conception of the internal relationship between humans and the more-than-human world; (2) from an external and artificially distancing "view from above", including a subduing research practice, toward restructuring research from a situated standpoint of the human subject; (3) from "methodolatry" (Bakan, 1967) and its quick-fix methodical recipes toward content-based methodologies enabling the exploration of the complexity and conflictuality of the internal relationship between humans and the world; and finally (4) from conceptualizing technology as neutral instruments for controlling world toward grasping technological artifacts as contradictory and political forms of everyday life.

Along and across these lines we unfold in the following the contours of a conceptual renewal and the perspective of a critical participatory psychology of technology from the standpoint of the human subject. Subjectivity, so we argue, needs to be decentered, by understanding it as not exclusively belonging to individual human beings. Rather, subjectivity is done from within its more-than-human relations. Here we build on posthumanist thought and STS scholars, who situate human action in the vision of "more-than-human worlds". We build on this term, because, as Maria Puig de la Bellacasa explains, "it speaks in one breath of nonhumans and other than humans such as things, objects, other animals, living beings, organisms, physical forces, spiritual entities, and humans" (2017, p. 1) and renders it possible to question

> the boundaries that pretend to define the human realm (against the other than human as well as otherized humans), to sanction humanity's separate and exceptional character and, purposely or not, to sanction the subjection of *everything else* to this purported superiority. The frontiers blurred through these ways of thinking and the sociomaterial moves that impel them are now commonly known: between nature and culture, society and science, technology and organism, humans and other living forms. (Puig de la Bellacasa, 2017, p. 12)

At the same time, this decentered relational human subject always already acts from a particular standpoint, from within its experience of

everyday life. Accordingly, all knowledge, including all psychological knowledge, emerges from acting from within this more-than-human everyday life.

Psychological concepts must be able to grasp subjectivity in this contradictory movement, as both being decentered and dependent on more-than-human worlds, and simultaneously as concretely situated within the embodied experiential realm of human everyday life. As will be shown, this is a crucial step toward overcoming psychology's disembodied, dissecting, and atomizing conception of the human–technology relation.

Building a Psychology of Technology for a Sustainable Human–World Relationship

The psychological study of technology can play its part in investigating the discrepancy between creation and imagination by rethinking a scientific culture that situates the study of the relationship between humans and technology within more-than-human everyday life experienced and lived. Such a psychology regards the crucial challenges of today's technological world, for instance social inequality or climate change, as inextricably entangled with how we conduct our everyday life, and with how we come to know about and understand this ontological, epistemological, and ethical entanglement. It questions a top–down, instrumentalist scientific gaze from outside and above, by systematically including the researcher's internal relatedness to the subject matter, given that her knowledge creation and subjectivity are just as much rooted in the researcher's everyday entanglement with the technological world as any other's. Psychological knowledge thus becomes dependent on the development of self-understanding, which is generalized via a collectivized, critical exchange of everyday experiences with technology across the shifting standpoints of people involved.

On the grounds of such a critical, self-critical, and participatory inquiry, psychology could be rendered able to meaningfully engage in current debates on how scientific knowledge can contribute to maintaining human life by building a human–world relationship that is worthwhile

sustaining for every organism inhabiting planet Earth. It could thus contribute to recent debates that seek to fundamentally reconceptualize humanity's inextricable relatedness to the world, debates that for instance draw on and develop concepts such as the Biosphere, Gaia, the Anthropocene, Terrapolis, the Chthulucene, etc. Such concepts invite explorations across STS, the natural or "zoe" sciences, as well as the (post-)humanities more broadly (as, for example, discussed in the *South Atlantic Quarterly* special issue 2017 on Climate Change and the Production of Knowledge, edited by literary scientists Ian Baucom and Matthew Omelsky). What role can psychology play in this transdisciplinary project of fabricating an alternative view of the human–world relationship, and in that context, of our relationship to technology?

Baucom and Omelsky describe science's current transdisciplinary challenge as follows:

> Is it possible to imagine a reinvention of feedforward possibilities, a reimagination and a new fabrication of some point of feedforward vitality from the conjoined perspectives of the human, social, and natural sciences? Can we fashion a perspective on the Anthropocene that is somehow both within it and at some (seeming) critical distance from it, a perspective through which we *can* "mobilize" our knowledge of having come to this point in the history of knowledge and, so, also mobilize the form that knowledge and the imagination can now take for the future of the planet? (2017, p. 15)

Psychology can be pivotal for addressing the consequences of our own creations to help us grasp the ambivalences and contradictions we see ourselves confronted with in today's scientific and technological world, and to concretize and develop feedforward vital possibilities for reimagining, fabricating, and mobilizing situated and yet self-critical knowledge of daily existence. However, this requires acknowledging that the human–science–technology relation is contradictory because we are not mere victims of our past technological decision-taking, of our former designs and current use. We are fabricators of our daily technological reality, and we embody technological artifacts because we hope they will improve our life circumstances, that artifacts will help us expand

our agency by rendering us able to grasp the world better—arguably at "a (seeming) critical distance", to paraphrase Baucom and Omelsky. Technology is never only detrimental, never only worsening our life circumstances: technology has also been co-constitutive for human development, for developing from primarily reactive organisms to active provision-producing, societally arranging beings—in order to create an alienating and simultaneously emancipating distance from vital daily necessities (Marvakis, 2013). Technology thus holds potentials for overcoming an immediacy-fixated reactivity to an individual's environment, by materially generalizing social possibilities for more purposefully acting in the world together; and it co-constitutes the core of human social self-understanding and the ways in which we think and act in everyday life.

Psychology's hitherto understanding of technology, in contrast, has been reproducing the common idea that technology is merely an external tool at the mercy of individuals' and cultures' will and hands. Its deeply contradictory and ambivalent nature has been ignored, in particular to what extent it is taken-for-granted, embodied, fully entangled in how we imagine and practice our daily existence—reciprocating all those societal contradictions the human-world relationship has historically come to produce. Currently, psychology's methodolatry de facto spurs an immediacy-fixated, instrumentalist, and individualistic understanding of science and technology, which promotes anthropocentrism and human (and Western) exceptionalism, and regards the world including human life as a mere resource for technological extraction and industrial exploitation through hegemonic political and economic forces (Zuboff, 2019). Instead of looking at the internal relatedness of the human–technology relationship, it detaches its study of the human and technology from everyday life lived, from the concrete everyday life contexts from within which it takes place. It atomizes its respective insights rather than considering them as entangled with and dependent of other aspects of daily human existence. It is this uncritical, detaching, anthropocentric understanding of science and technology that will not be able to tackle the Promethean gap that Günther Anders identified (on the contrary, it exactly creates it), and that we therefore suggest to replace with a psychology of technology situated in the standpoint of the human being and in its more-than-human practice of everyday living.

The Need for Overcoming Psychology's Disembodied Conception of the Human–Technology Relation

In the 1970s, a sensitivity emerged within psychology toward the more questionable and contradictory aspects of techno-scientific progress. Various voices within the field began to call for a *psychology of technology*. Actually, Günther Anders was one of the first to argue for a systematic psychology of technology. In a paper written in 1961, he reflects on the implications of technology in people's everyday life, articulating the "need for a special psychological discipline" focusing on material objects (2018b, p. 60, authors' translation). Referring to the work of his father, William Stern (one of the most influential German psychologists in the first part of the twentieth century), Anders notes:

> My father has coined the unfortunate term "psychotechnics", although he didn't boast, as did his colleagues, to have discovered that the mind can be treated technically. In contrast, if we talk about "psychology of technology" we mean the study and critique of the existing influence that technology has on humans. (Anders, 2018b, p. 464, authors' translation)

Moreover, arguments for a psychology of technology were also put forward from within psychology. Kenneth Gergen, for example, explains: "We rapidly assimilate new technologies into our lives; we welcome and embrace them. But too seldom do we ask questions about the ways they have changed our lives – sometimes irrevocably" (2000, p. xiii). Various voices explicitly argue for the need of a psychological study of technology, since there would be hardly any area within psychology in which technology is not involved; be it the psychology of development, psychology of personality, social psychology, educational psychology, or work and organizational psychology (e.g., Gordo-López & Parker, 1999; Turkle, 2015; Walkerdine, 1997). Psychologists however also realized how the study of technology would be a real challenge for the whole discipline. Regina Becker-Schmidt, for example, writes: "The influence of the technological revolution on the bodily, psychosocial and mental constitution of whole generations has been ignored"

(1989, p. 50), and she emphasizes that we must be prepared to "explore an unknown scientific continent" (p. 49, authors' translation).

Despite the challenges psychology faces in developing a psychology of technology, the necessity of such a program is now widely acknowledged. Furthermore, in recent years various approaches have been evolving more on the margins of dominant psychology—ranging from psychoanalysis, the cultural-historical activity theory, to cultural psychology, discursive psychology, social constructionism and critical psychology—to a quite substantial body of thought examining in-depth the significance of technological artifacts in human experience and action. Yet, in relation to the amplitude of academic psychology and its dominance in everyday societal discourse, these approaches remain the exception.

Reasons for why the psychology of technology has, as of yet, so tentatively developed in psychology can be found in modern psychology's proximity to discourses promoting techno-scientific progress, and, above all, in its one-sided conception of itself as a science mainly rooted in quantitative methodology. Since psychology detached itself from philosophy in the mid-nineteenth century and was institutionalized as an independent scientific discipline, major traditions of psychological thought adopted their theoretical language and methodology from the natural and computer sciences (using terms such as "input", "output", "storage", etc.). The methodological core of its scientific identity lies in the acquisition of knowledge through quantitative, experimental, and statistical procedures.

Such an approach brought forth two fundamental problems. The first is a problem situated in the realm of scientific theory. Rather than developing methodology according to the investigated subject matter—adequate to the psychological phenomena under scrutiny—the quantitative, experimental, and statistical methodology is assumed as valid in advance, independently of the content and context of research. Moreover, this is viewed as a universal method of acquiring knowledge—a methodological fallacy which by no means guarantees the desired scientific objectivity, and which has repeatedly been critically addressed, for example, as "methodolatry" (Bakan, 1967) or "methodologism" (Teo, 2009). This brings with it, second, a substantive problem

related to the subject matter of research. On the foundation of quantitative methods and a mechanistic scientific language adopted from natural and engineering sciences, psychological phenomena become reduced to simplistic cause and effect models. In such an approach, human experience, subjectivity, life contexts, and potential ways of realizing human agency can only be understood in abstract ways: as artificially dissociated variables that operationalize and thereby unduly reduce the complexity of a person's whole relations to the world. The internal relatedness and two-sidedness of the human–technology relationship becomes disembodied and dissected, while its phenomenal expressions are atomized by removing them from the everyday life and contexts in which they actually unfold, are lived and practiced.

The problem of methodologism and an ensuing lack of ecological validity has also been identified *within* classical psychology's few debates on the relevance of psychology of technology. For example, Walther Bungard and Jürgen Schultz-Gambard explain self-critically that in dealing with technology, psychology's quantitative methodology raises its own barriers. As they emphasize, an epistemology which reduces the reality under investigation to simple cause and effect models creates a "decontextualized psychology", where technology can hardly appear as a promising research object (Bungard & Schultz-Gambard, 1988, p. 161). This illustrates how the question of the psychological study of technology exposes the limits of a psychology that theoretically and methodologically reduces the notion of the psyche to mechanical and technical terms, and underscores the need for working on a fundamental renewal of psychology's understanding of itself as a science.

In this sense, not only is the critical analysis of technology and scientific technicism integral to the production of psychological knowledge and thereby developing the field of psychology of technology. In addition, efforts have to be made to develop new theoretical concepts and methodologies for conducting empirical research. These concepts are to transgress detached, isolating, and individualizing ways of understanding the psyche as a mechanical process, and which instead regard each person as a subject actively experiencing and acting *from within* a world co-constituted and mediated by technology (Schraube, 2019).

In this more dialectical line of theorizing the human–technology relationship, more recent psychological theories emphasize the efficacy of objects and the "materialized action" of technological artifacts (Schraube, 2009). This aspect is highlighted, for instance, in the notion of objects as "affordances" (Gibson, 1986), or the idea of conceptualizing technological things as "evocative objects" (Turkle, 1984), as "actors" (Latour, 2005) or as "political forms of life" (Feenberg, 2017; Winner, 1989). Even if the activities embodied in the things always contain an objectivized and generalized dimension—with Elaine Scarry, for instance, talking of manufactured artifacts as "compassion-bearing" objects (1985, p. 293)—the objectification movement, due to its specific, situated societal and historical character, cannot entirely avoid a one-sided, fractured, and partial character. Furthermore, an object can never be designed in a way that it can only be used for its originally intended purpose. Therefore, technological objects represent fundamentally contradictory and conflictual things. This inherent contradictoriness and relational-interpretive openness of technology—and herewith of psychological science, which necessarily relies on technology in the form of scientific objects and methods—must be integrated in psychology's understanding of science and technology as inextricably entangled part of human imagining and acting in more-than-human worlds. This encompasses the researcher's imagining and acting just as much as that of anyone else.

The Internal Relatedness of Science, Technology, and the Researcher

Sharing the commitment of developing theoretical and methodological frameworks that attempt to investigate human–technology relations from within the more-than-human world, a variety of psychological approaches have emerged (as mentioned above) that engage in unfolding a *psychology of technology*. Even if their points of discursive interaction still tend to be rather sporadic and unconnected, all are working on a range of common concerns: from a fundamental renewal of psychology's understanding of itself as a science, toward situated, qualitative

approaches driving psychology's production of knowledge and research practice in the exploration of the human–technology relationship from within the everyday life it takes place in.

The various approaches to psychology of technology build, on the one hand, on the wealth of diverse traditions of qualitative research within the social sciences and humanities, developing them in accordance with specific research topics and questions (at times including quantitative methods for particular issues). On the other hand, the psychological study of technology is closely related to and involved in the development of STS. STS is an inter- or rather transdisciplinary field of study, bringing together various traditions of thought including philosophy, sociology, history, anthropology, political science, and psychology. Over the past decades, STS has established itself at European and North-American universities as an independent field of research and teaching, systematically investigating and debating the relationship between science, technology and society.

On the basis of detailed analyses of the production of scientific knowledge (Knorr-Cetina, 1981; Latour & Woolgar, 1986), STS argues to move beyond a positivist, cause-effect-model seeking conception of scientific research practice. In addition, it calls for a notion of science and technology as socially situated processes that can only be adequately grasped through their material, cultural, and social entangledness. Accordingly, the empirical research into the relations between science, technology, human agency and life, builds especially on qualitative methodologies, which investigate human language and action as they are practiced in everyday life (Hasse, 2015; Hess, 2000; Schatzki, Knorr Cetina, & von Savigny, 2001). A constituting element of the formation of STS consists in an increasing awareness of a profound crisis in modern life and thought. As Langdon Winner explains in an analysis of basic concerns and projects that have inspired research and thinking in STS during the past several decades:

> A fourth collection of concerns in STS attracts philosophers and social theorists. Here the focus turns to what many thinkers have argued is a profound crisis in the underlying conditions of modern life and thought. The development of modernity has gone badly wrong, not only at the

level of specific, vexing social problems but in its fundamental core of ideas and institutions, especially those that involve science and technology. While attempts to fathom the nature of the crisis vary from writer to writer – from Marx to Mumford, from Heidegger to Ellul, from Habermas to Foucault – the point of inquiry is to locate philosophical, historical, and cultural origins of phenomena closer to hand. In its very nature, research of this kind is both radical and critical; it seeks to "look deeper", to probe what may be highly general sources of contemporary disorientation and to suggest change of the most fundamental kind. (Winner, 1996, p. 104)

Major traditions in STS realize that modernist understandings of science and technology need to be transgressed. Scientific modernism propels anthropocentrism and human exceptionalism, which puts human beings first in a presumed natural hierarchy, and the world and its resources at the extractable service of humanity. Implied is an artificial detachment of humanity from this very world that human beings are also a part of, which they are intra-dependently related with, or which, in Annemarie Mol's terminology, *transubstantiates* them (Mol, 2008).

While, for instance, the cultural-historical school of psychology represents a practice-based, dialectical approach that engages in the study of technology (we will discuss it in more detail below), its ontological framework seldom explicitly questions human exceptionality and supremacy. Here, technological things still tend to be conceptualized as either "tools" or "resources", both of which connote instrumentalist understandings of material objects—and may thereby overlook the complexity, contradictoriness, and politics of technological artifacts.

Dialectical approaches to the study of science and technology thus just as much require a rethinking of their ontological framework, for instance toward a dialectical psychology based on a *philosophy of internal relations* (Ollman, 2003, 2015). Ollman's proposition to study "contradictions" as an alternative to isolating essences and dichotomizing phenomena that are internally related, addresses concerns similar to those articulated by more posthumanist approaches, such as by the methodology of *diffraction*, which quantum physicist and feminist theorist Karen Barad developed further on the basis of Donna Haraway's work (Barad, 2007, 2014). In the words of Barad:

> Diffraction is not only a lively affair, but one that troubles dichotomies, including some of the most sedimented and stabilized/stabilizing binaries, such as organic/inorganic and animate/inanimate. Indeed, the quantum understanding of diffraction troubles the very notion of dichotomy – cutting into two – as a singular act of absolute differentiation, fracturing this from that, now from then. (Barad, 2014, p. 168)

According to our reading of Ollman's dialectics through Barad's diffractive methodology, scientific analysis and research practice is never a process which a subject individually engages in: she is always already internally related to (or entangled with) the more-than-human world, as part of an apparatus that consists of a multiplicity of forces that cogenerate the "result" of an analysis. Analysis always cuts together-apart in different ways, is inherently contradictory because it makes some things emerge while simultaneously shunning others—and it is in the difference of these analyses that the potential for purposeful collective action emerges. That which is temporarily shunned from the analysis is also part of its mutually dependent relations: what can be seen and researched, what is present in our analyses, can only be foregrounded because all else is *absenced* (Law, 2007). And yet, also the absenced background is present, and co-constitutes what can be researched. It is part of the whole subject matter under scrutiny, for instance of "subjectivity". Thus the whole is always already radically situated: only very particular and partial knowledge about it can be generated. Knowledge's radical situatedness must be rendered as explicit as possible, opening itself up for a critical inquiry by other apparatuses that analytically cut together-apart differently, presence and absence other aspects of the internal relationship of the whole phenomenon under scrutiny.

In order to grapple with the particularity and partiality of a researcher's analysis as situated in an entangled apparatus, the question of the *self-reflexivity of research in the psychology of technology* has become one key element in current debate, as the researcher also needs to situate her own inquiry in the internal relatedness and contradictoriness of human–technology relations. Svend Brinkmann underlines the need to take the everyday life of researchers, including their things and situatedness, as the starting point of qualitative research: "Everyday life *objects* are thus

those that the researcher in question appropriates and uses in her daily living (e.g., consumer products, technologies, pieces of art), and everyday *situations* and *events* are those that the researcher experiences in her life (e.g., conversations, parties, work, rituals)" (Brinkmann, 2012, p. 17). The central relevance of analyzing this self-involvement, something which various feminist theorists have explicitly put on the research agenda in the past decades, is also evident in the psychology of technology. As Barad has noted, ontologically we are not merely in the world, but *of* the world (Barad, 2007). Hence, we are also permeated by precisely that technology we have created and create, and which influences the everyday lives of all of us (Højgaard & Søndergaard, 2011; Ingold, 2013). Epistemologically, this implies that we cannot locate ourselves as researchers as detached from or instrumentally outside our subject matter, but instead inside the situatedness of human relations to technology. As Donna Haraway emphasizes, the view from outside, the "infinitive vision" of human relations to technology, is a fiction: "Only partial perspective promises objective vision" (1991, p. 190).

Meanwhile, it is precisely the individualizing optical metaphors of *reflection* and *self-reflexivity*, so ubiquitously used in the qualitatively working social sciences and humanities as criterion for ensuring validity and objectivity, that Haraway (1997) later questioned by offering the concept of *diffraction*. As Vivienne Bozalek and Michalinos Zembylas explain:

> Reflection remains fundamentally an inner mental activity in which the researcher supposedly takes a step back and reflects at a distance from the outside of the data … Reflection is thus based on the assumption of an 'I' who is different and exterior to that which is conceptualizing, an 'I' who is separate from the world … The slip into the subject 'I' is important in understanding reflection and diffraction, since in the latter there is no researcher as independent subject – in diffraction the intra-action and connections between human and non-human phenomena are foregrounded. Rather than pondering on the meaning of texts or events, a diffractive methodology focuses on what these phenomena do and what they are connected to. (2017, pp. 116–117)

In order to focus on what phenomena do and what they are connected to, the method of diffraction, as science philosopher Melanie

Seghal points out, "incorporates historicity and difference into the practice of theory itself" (2014, p. 188). This systematic incorporation of historicity and difference in the practical-performative act of analyzing and thus producing knowledge across human and more-than-human connections echoes, as we will in the last section argue, also a central tenet of dialectical, practice-based approaches to a psychology of technology. It aims at the transgression of particular and only partial perspectives on internal human-technology relatedness through the generalizing creation of knowledge, while its generalizations highlight connections alongside their contradictoriness and difference, thus remaining open to ongoing renegotiation.

As Seghal (2014) further points out, Barad develops Haraway's notion of diffraction by emphasizing its ontological implications and its internal relatedness (or entangledness) with epistemology, methodology, and ethics. Similarly, we will argue that a *diffracting dialectics* can only be developed on the ground of profound ontological reformulations and refinements, most importantly of the researcher-researched relationship—as the necessarily particular and partial, limited analysis of the internal relatedness of human–technology–world only becomes truly open to difference, becomes questionable and negotiable via everyday practice, if troubled in its most fundamental assumptions.

Simultaneously, the troubling also requires a counter-movement, an at least temporary agreement across diverse and necessarily limited perspectives and actions, in order to render collaboration and thus coexistence (across human and nonhuman, or more-than-human forces) possible. Temporary agreement in the form of conceptual generalizations that do not deadlock human–nonhuman–technology–world relations and intralink empirical findings, we argue, is what the psychology of technology from the standpoint of the subject particularly works toward. Subjectivity, as the most central of all concepts in this psychological tradition (Teo, 2017), is here understood as the conduct of everyday life, which necessarily bridges across and integrates the various practices, contexts, viewpoints, collectives that a human being contributes to. Collectively troubling this integration by creating difference, by critically inquiring into the taken-for-granted, is a vital part of everyday life. But also this troubling requires generalization, in order to be able to

"stay with the trouble", in paraphrasing Haraway (2016), to acknowledge but not merely reproduce Anders' Promethean gap, but to diffract it. It requires explicitly working toward expanding human experiencing and self-understanding, in terms of its internal relatedness with the technologized world, thereby rendering purposeful collaboration on the societal and ecological crises of our time with more-than-human forces increasingly possible.

Toward a Critical-Participatory Psychology of Technology from the Standpoint of the Human Subject

As part of the earlier mentioned special issue on *climate change and the production of knowledge*, feminist philosopher Rosi Braidotti (2017) writes about how knowledge creation must be understood as a deeply political endeavor, which challenges the fracturing of human–nonhuman relations via negative and deadlocking differentiation—a fracturing that, as we have argued, has been strongly propelled by modern psychology with its many disembodying, dissecting and atomizing conceptualizations of subjectivity that create an artificial distance to subjectivity's more-than-human world relations, including its technological relations. In its stead, a psychology that builds on the feminist and posthumanist critiques raised in the past few decades and that aims at overcoming instrumentalist-exploitative understandings of the world at the technological service of supreme human beings, must radically situate itself and its inquiries in the everyday practice of diverse and critical knowledge creation—a knowledge created together including all those missing humans that else are otherized, overlooked, differentiated away, in the collaborative actualization of possible (and vitally more sustainable) futures. Psychologists, along other scientists, need to acknowledge the partiality and particularity of their theorizing, thus becoming critical subjects of knowledge. Our claim resonates with Braidotti's perspective when she emphasizes:

> The task of critical subjects of knowledge is to pursue the posthuman, all-too-human praxis of speaking truth to power and working toward the composition of planes of immanence for missing peoples, respecting the complex singularities that constitute our respective locations. "We" is the product of a praxis, not a given. The dwellers of this planet at this point in time are interconnected but also internally fractured by the classical axes of negative differentiation: class, race, gender and sexual orientations, and age and able-bodiedness continue to index access to normal humanity. This rhizomic field of posthuman knowledges does not aspire to a consensus about a new humanity but labors to produce a workable frame for the actualization of the many missing people, whose "minor" or nomadic knowledge is the breeding ground for possible futures. (Braidotti, 2017, p. 93)

The critical-political knowledge practice that Braidotti argues for requires, in our understanding, what Baucom and Omelsky called "a perspective on the Anthropocene that is somehow both within it and at some (seeming) critical distance from it" (2017, p. 15)—a distancing that is however neither artificial nor abstract, but concrete in that it serves affirmative collaboration for "vital geocentrism" (Braidotti, 2017, p. 91) rather than for conceptually detrimental anthropocentrism. We consider such a move to be a deeply dialectical (and arguably dialectic-diffractive) endeavor: conceptual practice should make analytical distancing possible, but not for abstract and solipsist, artificially detached views of subjectivity, but rather for situated concretization of partial and particular knowledge claims that seek more general directionalities for fellow action without fixating them. Generalizing concepts serve to open up for difference, for negotiating what to move toward how—to get at a distance from one's own doings in order to open up for questions of others' doings (Langemeyer, 2019, in this volume). It is this immanent contradictoriness of relational knowledge, as both seeking particularity and generalization (Dreier, 2007), or diffraction and affirmation (Haraway, 2016; Thiele, 2014), that we consider to be deeply dialectical, and that a conceptualization of subjectivity must render possible to emerge in its concrete-empirical actualizations.

But how to strive for the dialectical contradictoriness and open-endedness, the posthuman uncertainty and indeterminacy of the analytical work of each particularly and partially analyzing apparatus? Can it only be acknowledged, or can we actively work with that as a productive point of departure for developing a vitally *geocentric* psychology of science and technology? The solution may be to radically situate psychological inquiry in concretely experienced, contradictory everyday life, and to collectively develop conceptual as well as technological artifacts that incorporate a generalized human standpoint from within more-than-human everyday life: a cross-apparatus subjectivity that truly can serve an intra-dependent, vitally geocentric practice. Ergo: concepts that enable a practice of mutual recognition in the processes of making and transforming the world, by challenging and developing everyday self-understandings in dialogue with more-than-human forces.

This is what dialectically grounded, action-oriented understandings underline, which regard the human being as actively constituting and simultaneously constituted by her more-than-human environment and therewith technology. As mentioned above, however, dialectical psychological traditions are not free from reproducing modernist-instrumentalist conceptualizations of technology and world, without explicitly questioning human exceptionalism and supremacy. Drawing on the discussion in STS and in particular feminist notion of *diffraction* can help to specify how a dialectical approach to human-technology inquiry could more clearly address the internal relatedness and entangledness of human and world. In consequence, dialectical practice approaches to a psychology of technology require a (self-)critical and inherently participatory stance due to their acknowledgment of one's analyses' unavoidable particularity and partiality. But what role can "subjectivity" as an integrating and yet troubling concept play in overcoming instrumentalist understandings of science and technology? A look into the history of dialectical theorizing in psychology that has been developing concepts for investigating technological practice will bring us here a step further on.

Emerging in the early twentieth century and still influential today, the *cultural-historical tradition of psychology* has systematically studied the significance of material objects in human subjectivity. Here, the focus is especially on the development of human activity (Stetsenko,

2005). This tradition of thought is based on the assumption that higher psychological processes emerged in phylogenesis simultaneously with the capacity to produce and modify material objects as a means of regulating human interactions with the world and one another, and that this development was a prerequisite for the formation of human personality. As Alexander Luria wrote in 1928, "Man differs from animal in that he can make and use tools … [Such tools] not only radically change his conditions of existence, they even react on him in that they effect a change in him and his psychic condition" (Luria, 1928, p. 493). Through the concept of objectification, the human production process is understood as a societal process of human externalization in the goods produced, into which flows the dimension of psychological content, such as human experience, needs and knowledge gained through involvement and conflicts with the natural and social world (Leontyev, 1981). For this reason, the phenomena are studied in situated ways both socially and historically, and issues of the democratization and the contradictory generalization processes inherent to objectivation processes are also a key theme in cultural-historical theory (Wartofsky, 1979). In particular, though, the central question in this approach is how the produced things are integrated as tools and means into goal-directed human action. On the grounds of the concept of objectification, the objects produced are understood as having both a material as well as an ideal dimension. Michael Cole has described this dual character of things as follows: "By virtue of the changes wrought in the process of their creation and use, artifacts are simultaneously *ideal* (conceptual) and *material*. They are ideal in that their material form has been shaped by their participation in the interaction of which they were previously a part and which they mediate in the present" (Cole, 1996, p. 117). In empirical research, one finds detailed models of how material objects co-constitute human activities, whereby the focus of such research is primarily on human development, learning and educational practices, as well work, design and organizational practice (Bang, 2012; Engeström, Miettinen, & Punamäki, 1999; Kaptelinin & Nardi, 2006; Kontopodis, Wulf, & Fichtner, 2011).

Critical psychology builds on ideas promoted in the cultural-historical approach in order to propose a psychology from the standpoint of

the subject, which also formulates a theoretical and methodological foundation of a dialectical psychology of technology. One of the most important achievements of critical psychology consists in developing a psychological vocabulary articulating in detail the internal relationship between humans and the world. Human beings are not regarded as abstract, isolated individuals, but understood as unfolding their everyday life in relation to nature, culture, technology, and society—an entanglement where the concepts of human subjectivity, agency and the conduct of everyday life are pivotal.

In his historical analysis of the psyche, Klaus Holzkamp takes Leontyev's work as a starting point to elaborate an understanding of the crucial role of the human capacity to produce things, as well as the utilization of the tools and means produced, in creating the potential for human social existence (Holzkamp, 1983). Moreover, in extensive analyses, he highlights the problem of an instrumentalist scientific language in psychology and engaged in a fundamental renewal of the epistemological foundation of psychology (Holzkamp, 1983, 2013a, 2013b). A key moment in this renewal came with the realization that instead of human subjectivity and agency being causally *determined* by social and technological conditions, they are *grounded* in each person's interest in gaining a degree of control over the societal conditions of their life and concerns. Hence, Holzkamp argues for a "reason discourse" (in contrast to the still widespread "conditioning discourse") as the scientific language adequate to the task of formulating psychological theory and methods. Since reasons for actions must always be expressed in the "first person" mode, as "my reasons" from each individual subject's standpoint, the view of others from the external standpoint (as adopted in the conditioning discourse) has to be replaced by the standpoint of the human subject as the (necessarily always limited, partial and particular) scientific standpoint of psychological research.

This tradition has provided the basis for a *psychology of technology from the standpoint of the human subject* (Schraube, 2013). Such an approach is developed in contrast to an anthropocentric vision of science and technology. Similar to other psychological and STS standpoint theories (Harding, 2004; Martín-Baró, 1994) it tries to overcome supremacist, subjugating, top-down approaches in the production

of scientific knowledge toward a bottom-up perspective rooted in the everyday problems, dilemmas, and concerns of people as well as the responsibility of humans for the self-created societal and technological relations. A central focus here is on the dialectics of technology and a critical analysis of both the potentiality as well as the power, constraints, one-sidedness, and discrepancies materialized in technological artifacts and systems. In this context, research has examined various arenas of everyday life such as, for instance, the significance of material artifacts in young children's conduct of everyday life (Chimirri, 2014), the automatization of work (Axel, 2002; Langemeyer, 2015), the digitalization of educational practice and learning (Schraube & Marvakis, 2016; Sørensen, 2009), questions of design and everyday practice (Costall & Dreier, 2006), or technoscience and the politics of experimental practice (Papadopoulos, 2018).

The subject-scientific concept *conduct of everyday life* (Holzkamp, 2013b; Schraube & Højholt, 2016) examines how, from their own situatedness, people relate to and act with technological artifacts, and seek, through those actions, to produce and sustain particular aspects of the world while changing others. This concept allows the psychology of technology to investigate how the subjective organization of everyday life and the socio-material situatedness of human agency are connected beyond the multiplicity of contexts of everyday action. This, in turn, makes it possible to seriously consider the complexity, dynamism and processual nature of the human relationship to technology.

The conduct of everyday life implies radically situating the analytic reflexivity of the psychology of technology simply because researchers are themselves actors within the relations under investigation. For this reason, such research employs collective and participatory methods. Here, then, the researchers are themselves regarded as part of their own psychological analysis of technology. Since such analyses also allow co-researchers to question each person's relations to the world, each participant researcher can negotiate, democratically (Nissen, 2012) and *teleogenetically* (Chimirri, 2015a), their own ideas and methods with the others, i.e., with regard to the impact which a (temporary) collective can hope for their ideas and methods to have on future societal action. As a result, the empirical researchers actively participate in

the technological actions and practices of others, co-researching them through own experiences, exchanging their ideas and views on their shared as well as differing notions of technology and its objectives, taking up the contradictions that emerge, critiquing them together with the co-researchers, and locating them in their socio-historic context. The aim here is to achieve a generalized, but non-determining, understanding of how and why certain material artifacts ought to be kept and others changed and, in this way, shape a more democratic negotiation of future collective possibilities for action (Chimirri, 2019, 2015b). Partial and particular perspectives, including the immediacy and radical situatedness of everyday life experienced, can thus be temporarily transgressed, put at a critical analytical distance together. The standpoint of the human subject thus becomes generalized across more-than-human perspectives, and at the same time actively invites for getting critically inquired into and troubled by other human forces acting from within highly different life circumstances.

While dialectical practice approaches to the psychology of technology and feminist-posthumanist STS may draw on different philosophical foundations, both share a similar ethical and in consequence also onto-epistemological and political commitment. In her discussion of Barad's, Haraway's and others' work, cultural theorist Kathrin Thiele (2014) terms this commitment an *ethos of diffraction* that implies an *affirmative politics of difference(s)*:

> Affirmation (worthy of its name) practiced: Affirming that there will never be an innocent starting point for any ethico-political quest, because 'we' are always/already entangled with-in everything; and yet that this primary implicatedness is not bound to melancholy or resignation, which for too long has been preventing us to think-practice difference(s) that really might make a difference. (Thiele, 2014, p. 213)

Thiele argues for this ethos to transgress the post/humanist binary in theorizing ethics. In our eyes, this represents a central element that a dialectical practice psychology of technology is striving for: the particularity, partiality and the ensuing contradictoriness of knowledge demands us to put our respective knowledges to the test of difference,

to have them explicitly challenged and troubled by more-than-human others. At the same time, however, it requires "staying with the trouble", as Haraway (2016) suggested: to take this troubling as a point of collective departure for affirmatively partaking in the critical inquiry and technological generalization of the internal, always already contradictory human–technology–world relatedness (in dialectical terms) or intra-active entangledness (in posthumanist terms). This ethico-onto-epistemo-methodological alliance across the post/humanist binary and differently attuned analytical apparatuses (with a conceptual emphasis on subjectivity and intra-acting more-than-human forces respectively), we hope, might help to substantiate a psychology of technology engaged in overcoming the Promethean gap identified by Günther Anders more than half a century ago.

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