TU Delft OPEN

JHTR

Journal of Human-Technology Relations

OBSERVING THE TELEPRESENT

The School Absent Child and Mediating Technologies

Mads Lund Andersen MLUA@edu.au.dk
Aarhus University, Department of Educational Psychology - Denmark, ORCiD 0000-0001-5081-2347

Article type: Research article

Review process: Double-blind peer review

DOI: 10.59490/jhtr.2024.2.7482

ISSN: 2773-2266

Submitted: 22 March 2024 Revised: 16 September 2024 Accepted: 10 October 2024
Published: 5 December 2024

How to cite (APA): Andersen, M.L. (2024). Observing the Telepresent: The School Absent Child and Mediating Technologies. *Journal of Human-Technology Relations*, *2*(1), pp. 1-23. https://doi.org/10.59490/jhtr.2024.2.7482.

Corresponding author: Mads Lund Andersen

Keywords

Technological mediation; intra-action; Telepresence; Human Robot Interaction; Postphenomenology; New materialism

Abstract

The use of telepresence avatars in schools to facilitate attendance among persistently absent pupils is becoming increasingly common worldwide. Despite its prevalence, research on this topic lacks theoretical development. This article addresses such a potential gap by employing poststructural, new materialist, and postphenomenological theoretical frameworks to explore analytical potentials in combining insights from all three. To further situate this exploration, an empirical case example is employed throughout. Through diffractive readings, the article navigates concepts such as intra-action and mediation to provide nuanced understandings of the dynamics between humans and technology as well as humans through technology.

By integrating postphenomenological perspectives on mediation and new materialist notions of intra-action, it offers insights into the intricate relationships between pupils, telepresence avatars, and social, educational environments. This article explores how researchers might better conceptualize some of the complexities of human-technology interactions by engaging with diverse theoretical perspectives, paving the way for more informed and ethically grounded research practices in the field of educational technology. Lastly, by integrating these theoretical frameworks diffractively, this article attempts to uncover some of the complex and heterogeneous interplay between human subjects and mediating technologies, while simultaneously pointing towards future platforms for further exploration.

1 INTRODUCTION

The use of telepresence avatars, robots, or systems is increasingly prevalent in efforts to raise school attendance rates among children and young people around the world (Page et al., 2020; Weibel et al., 2023). Currently, these technologies are primarily used to accommodate children with long-term illness. However, target groups vary and may also include children with persistent school absence; children experiencing so-called school refusal; or children with developmental or learning disabilities, or emotional, behavioral, or somatic disorders.

Some countries (e.g., Belgium) have had systematic solutions in place involving telepresence technologies for several years, where a specific technological response is triggered more or less automatically (Turner et al., 2022); other countries are still exploring the potential of telepresence as a way of reducing school absence. However, despite these differences in the level and maturity of implementation, the use of telepresence technologies is largely based on common-sense pedagogical approaches that draw on previous experiences across a diverse range of settings and scenarios, with few studies exploring the field and little or no focus on theoretical development (See: Fletcher et al., 2023; Johannessen et al., 2023; Newhart, 2018). Literature on the subject also seems to be relatively homogeneous in its interpretation of how telepresence works within the school's social settings. To some extent, the technological avatar functions as a surrogate for the absent child, with the expectation that the social and academic consequences will remain relatively uniform across different settings and for different children (i.e.: Leoste et al., 2023; Lungeforeningen, 2022; Perifanou et al., 2022; Powell et al., 2021). The apparent lack of ambiguity within both the hypotheses and conclusions of prior studies may reflect the combination of a nascent field of technology and a demand from schools for solutions that allow them to take action to support absentee pupils here and now.

Some contemporary research has argued that persistent school absence is a highly complex and heterogeneous field of study where there are no one-size-fits-all solutions or a single monolithic cause (Knage, 2023). Furthermore, the usage of technology, especially in a setting as socially saturated as the classroom, can likewise not be viewed as a homogeneous or uniform phenomenon. Rather, implementations of technology in settings where human-to-human interactions are prevalent tend to be highly complex, ambiguous and heterogeneous phenomena (Blond & Olesen, 2020; Hasse, 2020b; Ihde, 2002; Rosenberger, 2018; Søndergaard, 2021; Verbeek, 2011).

While others have pointed to the potential ambiguity in perceptions, experiences, causes, and reception (Besmer, 2015; Edwards et al., 2016; Newhart, 2019; Weibel et al., 2023), the theoretical foundation for engaging with human–technology interactions as phenomena might still gain from more heterogeneous and non-dichotomized perspectives, especially in the case of telepresence, where the technology is meant to represent the human. A simplified view risks leaving researchers without the necessary means for conducting such research in a way that engages with the fields and subjects in what Karen Barad calls an ethico-onto-epistem-ologically (Barad, 2007) adequate manner, referring to research that explores and accounts for the interrelation between ethical, ontological and epistemological perspectives. I return to this concept later, where I explain what it means and its potential in relation to research on human engagement with technology. For now, I want to highlight the need for further development of methodologies and accompanying theoretical frameworks that include subjective processes of becoming and social and cultural perspectives on human and non-human interactions. Furthermore, there is a need for frameworks that also explore the ways in which human perceptions and relations are mediated through and with technology where the emphasis is on specific rather than general examples, in the interest of knowledge creation.

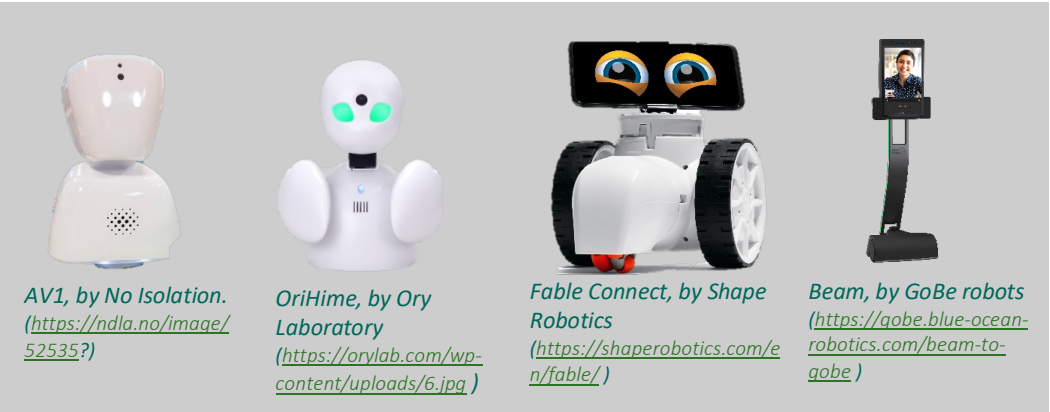
In the following, I make use of poststructural, new materialist and postphenomenological theories to explore potential cracks and missing links in the existing research, hereby mapping

the theoretical landscape and asking whether there is a need for further exploration of this still emerging use of technology and its consequences. The ambition is not to provide a theoretical or methodological guide for conducting research into such phenomena but to explore and re-examine theoretical perspectives that share a relational ontology, reading them through and with each other, while following Donna Haraway's advice to "stay with the trouble" (Haraway, 2016). My intention is to hereby provide a framework for reflection that enables researchers to engage with the diversity and heterogeneity of their respective fields. For the sake of exemplification, I engage with disciplines within the social sciences and develop a theoretical framework that will enable me to ask and answer further questions in the future and better understand the potential social implications of using telepresence avatars.

Firstly, the article introduces the technology of telepresence, briefly delving into definitions and the relevance of terminology and its potential impact on subjects and phenomena. Afterwards, the empirical case-example is introduced, including the methodology behind it. In the third part, the article introduces the concept of diffraction from new materialism and employs it in a reading of agency and intra-action with and through postphenomenological concepts such as mediation and multistability. The fourth section of the article attempts to dive deeper into the integration (and diffraction) of theories through and with the empirical material, before finishing up with concluding remarks that point to future theoretical, methodological and empirical work to be done based on the main themes of the current article.

1.1 TELEPRESENCE DEFINED

Telepresence technologies can be defined in a variety of ways. As such, several different names and classifications that share defining traits are used. Besides the popular use of "telepresence robots," these include "telepresence systems", "telepresence avatars" and, less frequently, "telepresence technologies". There are furthermore variations that exclude the "tele-"prefix, instead simply referring to remote or virtual presence robots or systems (Chang, 2019; Takayama et al., 2011; Zhang & Hansen, 2022). While there may be slight variations across the different classifications, they share very similar characteristics. Firstly, they all define a type of technology that allows a user to remotely engage in a physical environment through and with technology. Secondly, such engagement entails the user having access to visual and audio feedback from the location in which the avatar is positioned through the technology. Thirdly, the person in control must be able to move and/or look around the location, enabling active and in situ user engagement. Fourthly, the technology often furthers such engagement by giving the user the ability to simulate human characteristics or emotions through the avatar using anthropomorphic imitations of human engagement, such as LED "eyes" that elicit emotional reactions or other forms of human-to-human interaction, actively chosen by the user (Newhart et al., 2016; Schouten et al., 2022).



AV1, by No Isolation. (https://ndla.no/image/52535?)

OriHime, by Ory Laboratory (https://orylab.com/wp-content/uploads/6.jpg)

Fable Connect, by Shape Robotics (https://shaperobotics.com/en/fable/)

Beam, by GoBe robots (https://gobe.blue-ocean-robotics.com/beam-to-gobe)

Figure 1. Iterations of telepresence avatars

When defining emerging fields such as the use of telepresence avatars, it is both relevant and interesting to consider the choice of terminology. For example, using the term "robot" to denote such technology differentiates it from other technologies such as video conferencing systems and software (e.g., Zoom, Teams or Google Meet) and may instill expectations of autonomy—a point I will return to later. Iterations of telepresence avatars include techno-anthropomorph examples (e.g. the OriHime and AV1 robots) that have "faces" of their own, and tablets or smartphones that have been outfitted with wheels (e.g. Fable Connect or Beam); these are often referred to as "screens on wheels" or an "iPad on a stick" by practitioners (see Figure 1). Interestingly, such "call-it-like-you-see-it" terminology seems to reflect more direct interpretations of the physical materiality of the technologies than monikers with scientific (and science fiction) connotations, such as stereotypical technomorph "robots". One of the main material differences when dealing with telepresence avatars is whether the user is directly depicted (e.g. Beam) or not (e.g. the OriHime and AV1 robots), with some technologies offering both options (e.g. Fable Connect).

1.2 COINING A TERM

When dealing with a rapidly evolving field such as the use of telepresence for children and adolescents in schools, terminology might seem a tedious or uninteresting perspective compared to ostensibly much more pertinent topics of well-being and social connectedness. However, it can be argued that the development of language and concepts as a way for humans to understand the technologies with which they engage is closely linked to what those same technologies later become (Hasse, 2020a; Søndergaard, 2020). As such, whether we refer to the technology as a *robot*, *avatar* or simply a *system* becomes paramount in relation to its expected usage. As underlined by Schouten et al. (2022), robomorphism (i.e. "looking like a robot") strongly correlates with the ability of human subjects to relate to the technology. In the same sense, the rhetoric around the word "robot" may connote specific forms of technological autonomy within the technology, as is the case with AI-powered robotics and many pop culture examples of robots (e.g.: Bird, 1999; Garland, 2015; Lucas, 1977; Stanton, 2008). This risks diminishing the agency and autonomy of the user (in the current case, the child) through terminology alone. Of course, this becomes especially relevant when a potential increase in autonomy and agency is among the key reasons for using such technology in the first place (Fletcher et al., 2023).

On the other hand, referring to telepresence "systems" might detach the technology from all forms of agency, rendering the technology a "cold" object with little agency whatsoever, thus taking away agency from the absent child through the potential objectification of the technology, and conversely the child participating through it.

Deriving from Sanskrit, a third popular term associated with telepresence is "avatar", which according to Merriam Webster, has several meanings, from the physical representation of a deity to "an electronic image that represents and may be manipulated by a computer user" (Merriam-Webster, n.d.). One would have to stretch the definition of an "image" for the term to encompass all telepresence technologies mentioned in the literature on the topic, but even so, the concept of *representation* contained within the dictionary definition might become a key aspect of a potential theoretical consensus regarding terminology. The term *Avatar* might further connote imaginings of pop-cultural references to James Cameron's extremely popular movie series of the same name, where users transmit (and later transfer) their very existence into lab-grown bodies based on blue aliens (Cameron, 2009, 2023). Meanwhile, children tend to be far more familiar with the concept of avatars than adults: they engage as avatars when they play computer games (Chimirri et al., 2018); they create avatars of themselves on their smartphones or tablets, such as Apple's Memoji; or they produce virtual representations of themselves through video manipulation filters on social media such as Snapchat. As such, digital or virtual representations may come far more naturally to children and young people than to

researchers and educational practitioners. It might therefore be prudent to employ a definition of telepresence that engages with *representation* as a key marker of the capabilities of the included technologies. In this regard, avatar might not be the perfect terminology but is nonetheless closer than the various alternatives to the empirical field and, more importantly, the subjects and phenomena within it. For these reasons I employ the term avatar throughout this paper.

2 AN EMPIRICAL PERSPECTIVE: DESCRIBING THE TELEPRESENT

To underline what we might learn from the different terms in use below, and to point towards key differences and potential shortcomings within new materialism and postphenomenology, I will now present a brief case-based example concerning the use of a telepresence avatar. This example, I argue, highlights the need for a diffractive reading (that is, a reading through and with all the mentioned theoretical frameworks). The following descriptive case was produced based on a semi-structured interview conducted with a Danish mother and her 11-year-old child, as well as four earlier field observations of the use of telepresence avatars in two different primary school classrooms in Denmark. I also incorporate anecdotal evidence from engaging with the field for several years, conducting workshops and discussions with practitioners. The case is inspired by Robert Yin (2018), Bent Flyvbjerg (1988) and Sarah Crowe et al. (2011), but without adhering to a strict methodological template as the main objective is to provide insight into and reflect on specific theoretical terms. Furthermore, the case is used to ask questions rather than to provide answers. There is a need for further empirically based studies that can then address these questions later. The avatar in use was the AV1, shown above1. Pseudonyms are used to represent all human participants. The material from the observations and the interview has been condensed into a single descriptive case in the interest of coherency. In reality, this case represents several experiences, all of which share collective themes across settings. Below, I present this case in general terms. Text boxes will then be employed throughout the rest of the article to illustrate further points from the same case so as to better situate and inform the theoretical perspectives.

> Julie is an 11-year-old girl in grade 5 at a Danish school. However, she has a chronic intestinal disease that sometimes prevents in-person school attendance, such as when she is in hospital for various medical procedures, recuperating at home after such procedures or in quarantine due to the risk of infection. On such occasions, she instead participates in lessons by way of a telepresence avatar, in the form of an early version of AV1. Normally, this entails Julie's mother texting Julie's class teacher, informing him that Julie will be participating through the avatar today. The teacher then retrieves the avatar from a cupboard in the classroom and places it on Julie's desk. Before lessons start, the teacher turns the avatar on and its shoulders light up, awaiting a connection. Julie then logs into her account for the AV1 on her tablet and establishes a virtual connection to the classroom. Once Julie is connected, the top of the AV1 lights up as it lifts its head and white LED eyes switch on. Julie now has full control of her avatar, able to move its head from side to side and up and down. She also has direct two-sided auditory and one-sided visual connection to the classroom. This means that she can hear audio from the classroom, and that her voice can be heard in class, but the classroom does not have a visual connection to Julie, other than seeing the avatar.

[1] Several of AV1's settings have changed since this usage scenario, including the need to log in in the way described. This is now done in a simpler fashion, with end-to-end encryption from a specific tablet to a specific avatar. A 4G internet connection has also been added. These changes are not included in the analysis.

3 DIFFRACTIVE READING: AGENCY, INTRA-ACTION AND TECHNOLOGICAL MEDIATION

I find that the case of Julie, representative of so many other children (Turner et al., 2022), enables reflections on whether there might be a transdisciplinary need to refocus concepts and further develop theoretical perspectives in which heterogeneous human engagement with technology can be adequately examined. Such a need has already been pointed out within the broader field of psychology by Prof. Dorte Marie Søndergaard (2021), who argues that concepts must enable researchers to address challenges raised by phenomena such as technology and that such theoretical frameworks:

> (…) need to embrace complexity and heterogeneity at multiple levels and through many dimensions. The theorizing must enable and assist empirical analyses addressing all sorts of elements and entanglements involved in such processes of becoming and enactment – which may include subject-formative agencies entangling the material-technological, social, economic, discursive, and many other sorts of potentially enacting agencies. (Søndergaard, 2021, p. 7)

The current article aims to initiate such conceptual development through the diffractive reading of two primary concepts rooted in parallel yet different theoretical approaches: the new materialist concept of intra-action and the postphenomenological concept of mediation. Both approaches are further viewed through a poststructuralist analytical lens. As such, poststructural concepts are intended to underpin my empirical points and maintain a primary focus on children's processes of becoming. Specific concepts such as subjectification, originally defined as the simultaneous subordination as a subject formed by discursive practices and coming to agency through those same discursive practices (Butler, 1997; Foucault, 1982), and positioning, defined as the ongoing, socially constituted and diverse production of self-identity (Davies & Harré, 2007), will thus be analytically supportive notions. These notions will also be further developed based on the diffractive reading itself. As many readers will already have noticed, these concepts stem from different theoretical frameworks and even different disciplinary perspectives and have received quite different responses within the academic community. Let us start with the concept of diffraction, which enables us to re-read and co-read a number of theoretical insights.

The term diffraction stems from Karen Barad's now iconic reworkings of the terminology from theoretical physics, where diffraction is defined as the physical phenomenon where waves—such as light- and soundwaves—blend, interconnect and reemerge as they intersect, overlap or encounter each other or other obstacles (Barad, 2007). Barad reworks concepts first developed by Donna J. Haraway (1997) and Trinh Minh-ha (1997/1988) to further refine the notion of diffraction, initially as a description of their (Barad's) own methodological approach (Barad, 2007). In short, applying diffraction as a methodology entails a certain critical engagement with texts and theories from various disciplines to (co)create new concepts or understandings (Ceder, 2018).

Thus, in the Baradian sense, diffraction offers us ways of reading theory, methodology and indeed ways of analyzing, which potentially enable alternative perspectives on different ways of being in the world (or worldings, a new materialist term emphasizing that this is an active ontological process of embodying, enacting and engaging with the world), as well as providing insight into how such different perspectives come to matter. The concept hereby permeates relevance into highly qualitative fields of study, such as areas of psychology, sociology and anthropology. In relation to the primary theoretical traditions at play here, diffraction may be employed as a methodological means to consider and (re)read the analytical potentials of not only Barad's own new materialist perspective, nor only its foundations in poststructuralism, but also the potentials of other traditions and perspectives, here represented by

postphenomenology. When applying diffraction in this way, the differences in epistemology, ontology and terminology become a collision of waves within which we might find interesting nuances enabling the development of new perspectives that can be applied to the specific field of study that constitutes the focus of the current article. However, this first necessitates understanding the differences in conceptualizations and terminology, locating potentials and limitations before finally being able to perform meaningful critique and combine different theoretical stances. Prof. Cathrine Hasse, who has priorly navigated and contributed to the intricate landscapes of both postphenomenology and new materialism (Hasse, 2018, 2020b), argues that in such cases, the researcher becomes a diffraction apparatus "(…) moving into the bigger apparatus of already established phenomena emerging with words and meaningful materials" (Hasse, 2015, p. 15).

The most prominent example of diffractive reading performed by Barad was to read social sciences through and with quantum physics (Barad, 2007). Meanwhile, this article's ambitions are more modest: I read concepts from new materialism through and with postphenomenological concepts that were developed almost concurrently (Ihde, 1993b). Such a reading is not necessarily a novel concept—the two approaches have been combined before, with Barad sending a few choice words in the direction of postphenomenology (I will return to this later). What I find lacking, however, is proper consideration of the methodological and analytical novelty and usefulness of the terms that have so far been developed through such a combination. In terms of the current case of telepresence avatars, these terms seem to offer different and perhaps differing views on concepts related to the usage of such technology. As such, simply combining new materialist and postphenomenological concepts might not suffice; the two might more prudently be read through and with one another to enable full engagement with their collective analytical applications.

First, however, to neither oversimplify nor add unnecessarily to the existing complexity, we must engage with terminology from each of the two perspectives. I will therefore start by exploring concepts pertaining to another of Barad's key theoretical terms, closely linked to that of diffraction, namely intra-action. This will be followed by an exploration of postphenomenological concepts of mediation (specifically, technological mediation) and multistability, where I further explore how we might understand and make use of such terminology and whether there might be potential linkages to be explored through diffractive exercises. Do the different theoretical terms fill the same or overlapping gaps? Are they completely incompatible? What might we learn from reading them diffractively, that is, reading them through and with one another in the interest of critiquing and learning, rather than criticizing? As alluded to earlier, one of this article's analytical ambitions is to address the proverbial elephant in the room of how to theoretically conceptualize engagement through and with(in) technological means that directly "impersonate" (or at least represent) humans, illustrated by telepresence avatars. So far, neither new materialism, postphenomenology, nor poststructuralism (nor any other theoretical framework, for that matter) seems to have filled such gaps. To somewhat premeditate this point of this, in my analysis below, I will show that, in some cases, such "impersonation" by technology extends beyond representation. There are situations where the absent human is no longer directly part of the equation and the interaction is solely between the avatar and the classroom and its inhabitants. As I will show, this is the case when others sometimes refer to the AV1 as "Julie" when she is not logged in and, on other occasions, ask Julie about events where she was logged out and only the AV1 was present. Such cases call for theoretical perspectives that simultaneously acknowledge the mess of engagements in their complex multitudes while also enabling a "freezing" of specific engagements with/through multistable technologies as mediations occur.

3.1 NEW MATERIALISM: AGENCY AND INTRA-ACTION

New materialism includes a range of both theoretical and cross-disciplinary perspectives, enabling a mosaic of approaches, all of which have developed theoretical frameworks that merge the natural and social sciences with the humanities. Such frameworks therefore also include many different interpretations, some of which do not necessarily cohere with one another, internally (See: Alaimo & Hekman, 2008; Bühlmann et al., 2017; Tuin & Verhoeff, 2022). However, engaging in such discussions is beyond the scope of the current article, so let us for now stay with the "matter" at hand, and the Baradian, new materialist concepts of agency and intra-action.

To Barad, "matter" is not a reference to any "(…) inherent, fixed property of abstract, independently existing objects; rather, 'matter' refers to phenomena in their ongoing materialization" (Barad, 2007, p. 151). Matter, in this sense, includes organisms and bodies; human or otherwise, virtual, physical or ethereal artifacts, settings and contexts; including political, economic and ecological circumstances as well as temporal factors as all of the latter develop, evolve, devolve and come to matter. Phenomena are referred to as the primary ontological unit, and best explained as the entanglement of intra-acting "agencies". Agency is defined as the capacity to act upon, be acted upon by and act through the world, in specific settings or practices. In short, "Agency is 'doing' or 'being' in its intra-activity" (Barad, 2007, p. 178). However, agency is not a reference to any human-centered understanding of the ability to act or of any kind of subjective intentionality. In agential realist terms, agency goes beyond physical, subjective, or even virtual characteristics in order to recognize the non-deterministic, mutual entanglement of all agency, and that neither human agency nor any other form of agency is granted inherent hegemony in the enactment of particular practices (Barad, 2007; Bühlmann et al., 2017; Juelskjær et al., 2020; Murris & Bozalek, 2022). This emphasis on a pluralistic, non-dichotomized and heterogeneous understanding of agency and phenomena is precisely why we need new materialism's theoretical concepts, particularly when trying to understand human engagement with technology. It enables the presence of a sort of technological agency within phenomena that might satiate future analysis. It is perhaps also the least difficult aspect to combine with this article's other protagonist, postphenomenology; one of the founders of this tradition, Don Ihde, would talk about technological intentionality as part of the aforementioned entanglement of agencies within phenomena (Ihde, 2002). But I digress, let us wrap up the presentation of the main insights gained from new materialism, before moving on to what can be gained from postphenomenology. First, however, a short interlude in the form of an excerpt from our case that can help highlight how concepts from these two traditions can intersect.

Before the lesson begins, some of Julie's classmates seem eager to say hi to her and gather in front of the avatar, waving to it/Julie and taking turns to talk about their weekends. One classmate says, "Julie look, I finally got the hoodie", showing off her new sweater by giving a half-twirl. Some of the boys are bantering with each other, seemingly making a point of staying in front of the avatar, in view of the camera, and sometimes including Julie in their banter.

After the lesson starts, while the teacher is presenting the day's tasks, a boy who is sitting at the desk next to Julie's leans over and whispers enthusiastically into the side of the avatar's plastic "head" (where an ear might have been): "Julie, do you know what the problem is with fowl language?" The avatar's head very slowly moves from side to side, controlled by Julie. The boy answers his own question: "It always makes me quack up". The light on top of the avatar's head (which is usually used to indicate that Julie has raised her hand) switches on and off twice.

Intra-action, rather than interaction, represents a step away from causal human-centered understandings of relational agency and subjects. Rather, intra-action involves the "ongoing reconfiguring" of what *is* as well as what *might be* (Barad, 2007). Through such reconfigurings, Barad argues, we are better able to identify the components of phenomena, their boundaries and specific properties in their transformative state. The relevance of such perspectives can be seen in the example above. Here, the avatar is enacted upon as if it were Julie; the boy at the next desk intra-acts with both Julie and the avatar while navigating configurings (and indeed reconfigurings) and adapting to the situation at hand. The children in the first part of the example illustrate a similar point—their intra-actions at least seem to be related to notions of "when Julie was physically present", but simultaneously set specific boundaries for possible actions when engaging with Julie through and with the avatar. To unfold some of the analytical implications of employing the concept of intra-action, it might be wise to also engage with some previous interpretations of Barad's work:

> Barad prefers the term intra-action to interaction because she wants to emphasize that the agencies, elements, and phenomena encountered in the apparatuses permeate and transform each other and that they, in that very transformative movement, enact new agential phenomena that immediately enter the intra-agencies already forming the apparatus that produced them (Søndergaard, 2021, p. 11).

Through such interpretations, intra-action provides analytical approaches that help us grasp the simultaneous and mutual entanglement and reconfiguration of agencies, both human and non-human, as well as how human agency, intentionality, and subjectivity are enabled and reconfigured through and with intra-active entanglements. This is relevant when taking a closer look at the case excerpt above. To some extent, the phenomena at play in this excerpt revolve around Julie and classroom banter as agencies permeate one another, evolve and change. However, to an even greater degree, the intra-action involves Julie through and with the avatar, but also the avatar as an agential entity itself, where agency permeates different physical settings. Thus, the agency of the avatar and of Julie is simultaneously shaped by and shapes the phenomena across the two physical settings. This also underlines the temporalities at play and, through such temporalities, how intra-action changes as the intra-acting agencies develop, evolve and devolve over time.

The issue with new materialism in relation to the excerpt above is not, as I see it, that it lacks the necessary analytical potency and depth to produce an overarching exploration of the apparatus, nor that it does not allow close examination of phenomena. Although this concept in principle applies to any and all phenomena in the universe, it also offers lines of thinking that allow for a very close examination of each single phenomenon. Rather, what is missing, I argue, are tools and concepts that enable a perspective midway between the broad brushstrokes of a bird's-eye view and an in-depth focus on details and specificities. What is missing might be more of a frozen-in-time, exact view of the knots and intersections in the entanglements of human and technological agency. In the following, I argue that postphenomenology, with its concepts of mediation and multistability, might hold the key to accessing such specificity in the entanglements and knots, thus pointing to the crux of the matter: The enigma of how the theoretical terms across postphenomenology and new materialism are different yet similar and, more importantly, how they can be employed diffractively in empirical research.

3.2 POSTPHENOMENOLOGY, MEDIATION AND MULTISTABILITY

Postphenomenology, like new materialism, consists of a myriad of different perspectives, mainly developed within philosophy. Originating as an advancement of Edmund Husserl's phenomenology by Don Ihde and Peter-Paul Verbeek (Ihde, 1993a; Verbeek, 2006), for three decades, postphenomenology has offered novel perspectives on the ways technologies engage

and interfere with—and potentially permeate—human experience (Besmer, 2015; Ihde, 2002; Rosenberger & Verbeek, 2015a; Verbeek, 2011; Aagaard et al., 2018b). At the heart of the tradition is an emphasis on the development of a philosophy of technology, and as especially pointed to in later years, such a philosophy must be empirically founded (Rosenberger & Verbeek, 2015b). A key point of emphasis within this school of thought is that technologies, in the same sense as culture, cannot be understood in isolation from the world around them. Technologies always exist within the context of sociality and, more importantly (to postphenomenologists), culture (Verbeek, 2006). Conversely, both culture and sociality shape what technologies are or become through engagement with humans (and potentially with other technologies). As such, postphenomenology shares an overarching relational ontology with both poststructuralism and new materialism (the latter taking the point of onto-epistemology further still, as mentioned earlier).

In the classical sense, *technological mediation* defines the way in which technologies as mediating entities can alter human agency within the world, as well as how these technologies are themselves altered (or at least perceived differently) through this process. Here, technologies are defined not only as static objects perceived within the physical world, but also as things and objects that affect humans' ability to act within such a world. Likewise, "tools" are not only objects that humans perceive within the world, but technologies that transform human capabilities and indeed perceptions in what Ihde calls the "embodiment relation" (2002). Peter-Paul Verbeek elaborates on this concept:

> Technological mediation is no phenomenon that takes place 'between' a pre-given world of objects and pre-given human subjects. Rather, human beings and their world are constituted in the 'act' of mediation. (Verbeek, 2011, p. 8)

This notion of technology as immersed within our environment—not as phenomena, but as a co-constituent actively shaping (human) intentionality—could be viewed as contradictory to the notion presented above, with reference to Barad, that human and technological subjects and objects intra-act as components of the phenomena. However, I will later argue that both notions are needed if we are to adequately comprehend and engage with empirical fields in which technologies represent human counterparts. I contend that the notion of intra-acting agencies and how phenomena come into being through the inseparability of these agencies becomes far clearer when we include a notion of mediation as a specific act in the *now*, and each *new now* to come, across physical, material worldly settings. At the same time, technological mediation might be expanded upon as an applicable theoretical concept when it is intertwined with the exploration of such intra-acting agencies within the phenomena. The terms are thus neither mutually exclusive nor interchangeable. To act in a setting that involves telepresence of any kind is to engage both with and within the phenomenon, and engaging with phenomena simultaneously entails action, thus constituting human subjects and the world around them through mediative processes that potentially move across physically and materially different perceivable phenomena (e.g., the classroom *through* the robot or the classroom *with* the robot, as well as the absent child's bedroom or hospital ward). This latter point draws on another of Ihde's key concepts relating to mediation, that of "*alterity relation*". Alterity relation describes situations where "(…) the machine entity becomes a quasi-other or quasi-world with which the human actor relates" (Ihde, 2002, p. 81). Ihde uses the example of computer games, where technology clearly presents a fictitious world with which humans interact.

Ihde further elaborates on the mediative relationship between humans and technologies, coining the term "*hermeneutic relation*" (Ihde, 2002). As rhetorically alluded to, the idea of such a relationship between humans and technology draws inspiration from Martin Heidegger's philosophical hermeneutics (Heidegger & van Buren, 1999) and is of a more interpretive nature compared to the former relational concepts mentioned. As such, hermeneutic relation involves

the interpretations at play when humans perceive and try to make sense of technological actions, readouts or data produced by technologies. Such human subjectivity relating to technologies is furthermore often found to become more or less "transparent" (Rosenberger, 2018). This is perhaps best illustrated by Robert Rosenberger's example:

> Despite the fact that they sit perched on my nose, and despite the fact that they radically change my entire field of vision, I am so accustomed to my glasses that they often remain deeply transparent as they are worn. As I hammer nails into a piece of wood, the project I am attempting to accomplish is more present to me than my grip on the hammer itself. (Rosenberger, 2018)

After the first two lessons, Julie logs out of the avatar due to exhaustion, needing an hour's break. This is in line with the arrangement her family has with the school.

In the classroom, the avatar responds by switching off the LED eyes and lowering the head (the shoulders remain lit, implying that Julie can log in again). At this moment, Julie's classmates note her absence, proclaiming that "Julie has left" and that now "Roberta is in class" (Roberta being the other name they use for the AV1, primarily when Julie is not logged in). After the lesson in which Julie was absent, the pupils have to move to another classroom. One of them asks the teacher: "Should we bring Julie as well?", referring to the inactive avatar at Julie's desk. The teacher responds "yes, thank you", and the pupil picks up the still inactive AV1 and carries it out of the classroom.

The avatar is something through which Julie views the classroom and her engagement seemingly stops the moment she logs out. To the teacher and other pupils, the avatar seems to imply a broader horizon of presence and agency and is perhaps interpreted more as representing Julie—so much so that the demarcation between when the avatar "is" Julie, and when it "is" Roberta becomes blurred, not determined by the simple and seemingly logical criterion of whether or not Julie is logged in. To more deeply engage with such complexity related to real-world technology usage, postphenomenologists argue that technology must be viewed as multistable (de Boer, 2023; Rosenberger, 2020; Rosenberger & Verbeek, 2015a). In the example with Julie above, the avatar takes on what could be viewed as multiple roles or positions of engagement; it is multistable. Essentially, multistability denotes a way of actively engaging with the non-neutrality of artifacts. Technologies are not monolithic or one-dimensional, possessing instead a plurality of possible interpretations and functions—interpretations that are contingent on the human-technology relationships, contexts and cultures in which they are embedded. Empirical analysis must involve exploring how a particular technology is (and can be) understood differently by different users or in different material contexts (Rosenberger & Verbeek, 2015c) or practices (Hasse, 2015). Thus, notions of multistability enable us to investigate various ways in which technology shapes humans and, vice versa, how technology is shaped by humans and their experiences, perceptions and practices. In the case of Julie, the technology's role as an avatar representing Julie becomes blurred by its multistability, potentially resulting in Julie being engaged, and thus intra-acting, in a setting where she is not present (not even remotely or virtually). In line with a new materialist view, this clearly transcends a human-centered approach, posing questions about the relation between subject and object, but also necessitates specific, concrete examples of potential interpretations.

> So for the postphenomenologist, the brainstorming of a technology's multiple stabilities serves to highlight technology's very context-dependent and materially-situated relationality. (Rosenberger & Verbeek, 2015a, p. 28)

Introducing the concept of multistability can therefore establish a common ground between new materialism and postphenomenology, both potentially offering posthuman perspectives. However, it is also worth underlining why it makes sense to combine these two approaches through diffraction. As shown above and discussed below, new materialism often offers a wide-angle perspective on phenomena, allowing us to understand their intricacies and entanglements within a much broader horizon than that offered by a postphenomenological approach, but the same terminology also helps us to see intra-acting agencies at play. Meanwhile, the concept of multistability, as mentioned earlier, can offer a perspective midway between these two poles, where intra-actions entangle with one another and different interpretations engage with each other in quite specific ways, with different meanings coming to matter and revealing themselves to us as researchers through multi-dimensional, interpreted mediations. In the following section, I will expand on this point.

4 INTEGRATING THEORIES: WHEN WAVES COLLIDE

Later in the day, Julie logs back into the avatar. The class is then asked to work on individual assignments. Each pupil is asked to draw an alien creature, and afterwards describe the creature in writing, using as many fitting descriptors as they are able. During the assignment, the avatar is stationary. The eyes are lit but otherwise passive, implying an active connection to Julie. At home, Julie has set aside her tablet during the assignment so that she can draw and write.

Later on, the teacher walks around the classroom acknowledging the students' work by looking over their shoulders and providing brief commentary on several of the drawings and the written work. When the teacher gets to Julie's desk, he hunches down, puts his arm around the "shoulders" of the avatar and asks: "So how is the assignment going, Julie?", while looking into the avatar's eyes. Julie responds that things are "fine", but later talks to her parents about being frustrated by the lack of opportunity to show her work to the teacher and receive acknowledgment and feedback.

When analyzing empirical material on human interactions with and mediated by technology, an approach that integrates postphenomenology and new materialism through diffractive reading can provide a more holistic, nuanced and multi-dimensional understanding of the complex dynamics at play. The specificity that the terminology provides may enable more precise engagement with the complexity of the field of study, where we as researchers need to be able to engage with the subject matter across different agencies that themselves move across and beyond several different physical and virtual settings. The excerpt above provides a clear example of this, with agency represented by Julie at home, Julie on her tablet, "Julie" as mediated by the avatar in the classroom, and potentially "Roberta" in the classroom, all differing in their material and intra-active make-up. Indeed, what type of mediative relation does the telepresence avatar represent? *Alterity, embodiment* or *hermeneutic*? Or are we dealing with a technology whose multistability represents (or at least can represent) all three mediative relations? As such, the case is also a prudent example of exactly why new materialism is needed: to provide a lens for exploring entangled intra-actions and the aforementioned multistability, and to offer new perspectives on the empirical material by posing further questions. When Julie engages with teachers and classmates via the avatar, she views the world through the screen of her tablet; this represents a real world, but could be experienced by Julie as a quasi-world as her subjective becoming is mediated by and with the technology, thus constituting an alterity relation. Meanwhile, as demonstrated in one of the previous excerpts, when Julie is asked through interviews about her experiences using this technology, she uses terminology that places her in the classroom: "they whispered in my ear", the ear actually being

the side of the avatar's head, where an ear would be had the plastic device been a biological human body, representing an embodiment relation. Finally, as Julie's teacher hunches down to place his arm around what he describes as "Julie" (despite physically and materially being the avatar), is he engaging in a hermeneutic relation with the technology? Or is he actually "acting" appropriately by including Julie through performance? Answering such questions requires further empirical material, but we also need to employ analytical concepts such as agency and intra-action, as argued above. By employing concepts that engage with relational aspects of human and technological agency, we might better understand phenomena that are far more complex than can be properly captured by any single term. When applying a new-materialist perspective, however, one issue that might arise is that specificity can limit our ability (as researchers) to see beyond established and "known" types of technological actions; it is therefore always crucial to be aware of such potential shortcomings.

Kirk Besmer has previously examined the case of telerobotics based on the postphenomenological concept of virtual embodiment (2015). Besmer's study is strong in its exploration of postphenomenological concepts and provides a highly relevant contribution to notions of technological re-embodiment with telepresence as a catalyst for refining what he coins the "extension thesis"(Besmer, 2015, p. 56). However, when bringing in empirical material and new material perspectives, it could be argued that that we risk overlooking the social entanglements at play if we simultaneously set out to demarcate the real from the virtual. Viewing them as two separate phenomena (Besmer, 2015) might mean missing the entanglements at play in the case excerpt above. I find that this exemplifies the potential in employing new materialism together with a postphenomenological perspective. It is therefore necessary to further explore specific diffractive readings of the two theoretical frameworks. On the notion of mediation, Barad states that it "(…) has for too long stood in the way of a more thoroughgoing accounting of the empirical world" (Barad, 2007, p. 152). They further argue that their own reconceptualization of materiality enables a way of viewing the empirical world through its objective referent: phenomena (Barad, 2007). Here, we arrive at the crux of the disagreement between our two protagonists. Barad, I suggest, is simultaneously both right and wrong in their assumptions of what can be done with and through the use of the concept of mediation. Conversely, they are simultaneously both right and wrong in their view of the possibilities when using the concept of materiality alone. Within the realm of social psychology, such a term is hugely relevant and has somewhat revolutionized the ways in which we as researchers are able to engage with the world as an empirical field, moving beyond an anthropocentric approach to examine phenomena of material entanglements. However, when we need to explore post structural notions of subjectivity through such a term, we lack greater theoretical specificity than the concepts of intra-action and agency allow to conduct salient empirical analysis that engages with and can be used by the fields we study. I contend that we also need *mediation*. We need a way of engaging with what I tentatively term *mediating materialities* in research settings, and we need to consider the terminology of practice while simultaneously acknowledging the inability of either theoretical stance to grasp the complexity of human–technology interactions. This is especially evident when technologies are communicative avatars. I would also argue that, in the passage quoted above, Barad goes against their own principles of diffraction. Rather than engaging inventively and provocatively with mediation, they end up critiquing it as a way of placing theories against each other; as such, they fail to engage in dialogue with the concept, which is the very essence of reading theories diffractively (Barad, 2007, p. 30). In the following, I seek to engage in precisely such a dialogue-centered reading of the two frameworks.

4.1 DIFFRACTION REVISITED

Diffractively reading these two divergent yet in many ways also similar theoretical frameworks, it is important to take into consideration their somewhat different ontologies, while

acknowledging that both frameworks share ambitions of exploring the fluidity of complexity and agentiality. Through its inherent sensitivity to details, diffraction negates the risk of overlooking the theoretical differences coming to matter, across the humanist background of postphenomenology or Barad's intention of moving beyond humanism towards a post-human ontology. In the following, I will address such issues, while hopefully explaining why it therefore makes sense to combine such perspectives. In the interest of transparency, the primary theoretical foundation for this article is Barad's ethico-onto-epistem-ology, which underlines the inseparability of ethics, ontology and epistemology in knowledge production (Barad, 2007, p. 90), rather than postphenomenology's overarching relational ontology. Barad's approach highlights researchers' responsibility to engage with the world and its human and non-human agencies. As researchers, we are accountable for the intra-actions we engage with(in) and the worldings that ensue (Barad, 2012), and we are neither able nor supposed to separate *ethics* from *being* and *knowing* (Barad, 2007). Postphenomenology adds to this by offering a distinct philosophy of technology that underlines the need for an empirical turn—and that this turn must be at the heart of philosophical reflection (Rosenberger & Verbeek, 2015a, p. 30), where technology is furthermore viewed as a non-neutral agent. I wholly agree with this and argue that combining these perspectives enables the creation of highly relevant, interesting and saturated descriptions of human–technology interactions (and intra-actions).

One potential issue with meeting the universe halfway (as one of Barad's books is titled) when conducting empirical, qualitative research is that such a meeting—when following a pure, new material train of thought—risks leading to the methodological conundrum of being a human subject who needs to examine apparatuses and consequently phenomena from heterogeneous perspectives, where the human subjects are engaged. This puts the "post" in posthumanism and at the same time makes it a risky endeavor. Thus, ontological inquiries into how phenomena within the apparatus engage through and with a potentially human subject might, nay will, be framed by the inquirer, who in turn is materially and discursively enacted with and through phenomena in a never-ending and complex process. This means that, prior to the inquiry, there is a need for theoretical formations that engage with this specific problem of engaging with human and non-human activity as a researcher while trying not to position oneself within either, but still clearly acknowledging that we represent the former through the pre-conditions of our somewhat common lingual and epistemic qualities.

Postphenomenological perspectives such as those mentioned above might just be what is required to satisfy this need. With the ability to engage with intra-actions of subjects and objects as they permeate one another's reality, terminology such as *mediation, technological intentionality* and *multistability*, as well as the concepts of *embodiment, hermeneutic* and *alterity relations*, might provide us with the means to situate new-material terminology empirically, enabling otherwise abstract concepts to be applied in practice settings. Put simply, it enables us to view intra-acting agencies in more fixed states, but also to examine how such agencies are mediated through and with one another in quite specific ways and with quite specific consequences for (especially) the human subjects engaging through and with technology across physical-material and virtual settings. Conversely, postphenomenologists underline that each engagement or action involving technology is novel and shaped by and with human and non-human agency and intentionality. While mediation offers specificity when engaging with the empirical field—specificity that is not possible when only employing concepts drawn from new materialism and poststructuralism— it is nevertheless crucial to remember that such temporally frozen perspectives are always a simplification or theoretical abstraction, unable to capture the entirety and complexity of the phenomenon being studied.

I argue that this diffractive reading enables us to be "(…) open and alive to each meeting, each intra-action, so that we might use our ability to respond, our responsibility, to help awaken, to breathe life into ever new possibilities" (Barad, 2007, p. x). To be fair, Barad was talking about

the concept of *justice*, but the same applies to researchers seeking to understand complex phenomena. Through combination and following Barad's advice to read the world (in this case including theories) diffractively, with an interest in what happens in theoretical entanglements, we might engage in research that grasps the necessary complexity of phenomena involving human and non-human agencies. This is especially true when the latter also represent the former and thus alter existing subjectivities and produce new ones that shape the engagement of human subjects, even in their absence, as is the case with telepresence robots. This may seem lofty ambition, but I would argue that that we learn far more by engaging with and relating to phenomena than by trying to view the world from perspectives that attempt (but ultimately fail) to transcend humanness, as we ourselves are humans. The point is not to explore beyond humans or "humanness", but to acknowledge that representations of phenomena in the world are always seen through the watching eyes of the human researcher, and in this acknowledgement allow for every new worlding that ensues from every new "watcher".

In summary, diffractively reading these theoretical perspectives within a framework of absent pupils attending school through and with technology can highlight the different voices at play within the phenomena of the apparatus. As such, combining a view of the entanglements of pupils in intra-action with an exploration of positionings and subjectification from a poststructuralist perspective enables empirical examples involving the voices and views of the pupils. Furthermore, adding the postphenomenological concepts of mediation, technological relations and transparency enables us to enhance the "voices" of the technologies and clearly present the consequences of these technologies for the fields we study.

4.2 METHODOLOGICAL PERSPECTIVES

How, then, do we structure inquiry and empirically grounded research to enable the theoretical and empirical analysis of a field where telepresence avatars are used by absent pupils? I suggest that, to engage methodologically with such a phenomenon, we might look to the foundations and potentials of the two main perspectives presented above. Postphenomenology offers a number of analytical concepts, some of which I have already mentioned above, while others stem from traditional phenomenological theory. From Martin Heidegger, postphenomenology borrows perspectives on *breakdowns*—Heidegger argued that failures or collapses of the "(…) equipmental aspects of the world (…)" (Aagaard et al., 2018a, p. xiv) make everyday practices clearer, and thus also the artifacts that inhabit them. In the case of telepresence avatars, breakdowns are important as they represent the potential for non-use and enable perspectives on what technology was not able to *be* to certain subjects—thus leaving us with views of the technology's material composition and how it, in a Baradian sense, is able (and not able) to engage in processes of intra-action with, through and across human subjects. From a poststructuralist perspective, notions of subjectification are also relevant in this regard: when the technology works, it may become an integral part of the processes of subjectification and positioning of the absent pupil; however, when it does not work, it may itself be an illegitimate quasi-subject within the practice and be subjected as such. It can potentially cause the child to experience a sense of inadequacy, ultimately engaging with peers and practices through the technology. When the avatar is referred to as "Julie", even when she is not logged in, does this refer to Julie's subjectivity without her being an active referent in *the now*, or does the avatar become a sort of quasi-subject that both represents Julie as a persona and is something else entirely (Roberta, as Julie's classmates sometimes also call it). To further underline this point, postphenomenology reiterates Maurice Merleau-Ponty's concepts of *embodiment* and *habits*, where embodiments underpin human experiences of being their body and being a part of the world through that very same body. In this regard, habits then "(…) blur the classical distinction between subject and object, between body and world" (Aagaard et al., 2018a, p. xv). These perspectives become key takeaways for researchers engaged with technologies such as

telepresence avatars. There are already excellent empirical studies of such a *blurring* of bodies (Weibel et al., 2020), but the theoretical framework, I argue, has not yet been sufficiently developed to deal with such notions methodologically or analytically.

Within qualitative research that draws upon new materialism, it is important to reflect upon the complex engagement and iteration of *objectivity* (see:Barad, 2007; Juelskjær et al., 2020), which renders the term an almost utopian vision. This is due to both the complexity and heterogeneity of phenomena in any given apparatus, and thus the inability to grasp the entirety of an apparatus through scientific observation. Furthermore, as Barad themself puts it, reading texts is in a way always diffractive, furthering the complexity of conducting qualitative research on such grounds. I therefore argue that, if "(…) objectivity requires an accounting of the constitutive practices in the fullness of their materialities, including the enactment of boundaries and exclusions, the production of phenomena in their sedimenting historiality, and the ongoing reconfiguring of the space of possibilities for future enactments" (Barad, 2007, p. 391), such objectivity becomes, in and of itself, an idealistic (perhaps utopian) ambition, due to the massive complexity of entanglements. The argument here is that researchers should always aspire to such an ambition but will never be able to accomplish it fully. Additionally, the knowledge of and engagement with this inability is itself the methodological point, and paramount to ensuring scientific success and empirical and analytical insight.

5 CONCLUDING REMARKS: POSING FURTHER QUESTIONS

In this article, I have attempted to navigate the intricate theoretical landscapes of new materialism and postphenomenology to demonstrate the analytical implications of both when observing the telepresent child. Diffractively reading analytical potentials might enable researchers to examine the nuanced ways in which agencies, both human and technological, intra-act, evolve and co-constitute the phenomenon under scrutiny. The theoretical lens is further broadened by postphenomenological perspectives, such as mediation, multistability and technological intentionality. The integration of the latter concepts is particularly relevant when examining the specificity of entanglements in human–technology interactions. The notion of multistability, in particular, emerges as a crucial bridge between new materialism and postphenomenology, providing a means to explore the various interpretations and functions of technology within different contexts. The article argues that combining these theoretical frameworks while engaging with empirical material offers a more in-depth understanding of the complexities inherent in human–technology interactions.

Ultimately, the integration of new materialism and postphenomenology, viewed diffractively, provides a more comprehensive and multi-dimensional analytical tool for researchers. Such an approach potentially enhances our ability to grasp the intricate dynamics of phenomena involving human subjects and non-human objects, especially in the realm of technology-mediated interactions. Even though Don Ihde argued that we "can't have it both ways" and Barad criticized postphenomenology, I find the differences between the two approaches subtle, and indeed necessary. The points made in this article need further empirical exploration. I did not set out to find all the answers, but rather to point towards he potential of combining new materialism with concepts from other theoretical frameworks to help researchers better observe the telepresent subject.

Barad argues that sedimentation occurs when material-discursive practices of science stabilize and become ingrained over time (Barad, 2007). Sedimentation concerns the idea that certain concepts or ways of understanding the world become solidified and taken for granted through repeated use, thus shaping the way we perceive and interact with the world. Diffractive reading of theoretical insights and critical analysis of a complex, heterogeneous field such as

telepresence might contribute to the destabilization of ingrained concepts, even as they relate to new materialism itself, by reexamining sedimented assumptions of what agency might be, who or what might hold it, or what concepts such as intra-action and entanglement might (and might not) entail.

Throughout the case excerpts presented here (and indeed the entirety of the empirical material behind it), the pupils involved (perhaps surprisingly) are kind and inclusive in their intra-actions with Julie as she is mediated by the avatar. Future studies might engage with what happens when more exclusionary processes evolve from the use of such avatars: whether bullying occurs, mediated by the avatar, or whether the intra-action through and with such technology somewhat negates more negative social engagements (although that seems unlikely). I have also experienced classrooms (and indeed meeting rooms filled with scholars) where everyone present completely loses focus on the topic at hand when a telepresence avatar is first introduced. Such reactions quickly fade, but they do further highlight the need to explore such potential practical sedimentation, and how the phenomena and intra-actions are altered by such a process. Might there be a half-life to the technology's novelty? A way of gaging when a technology becomes an integral part of practice setting, or even its overall usefulness? Julie from the case stopped using the technology after a long period due to the family's license expiring, but we must also further explore cases of non-use or "opting out".

Data Access Statement

The participants of this study did not give written consent for their data to be shared publicly, in a non-pseudonymized manner, so due to the sensitive nature of the research supporting data is not available. Some of the anecdotal material were related to a previous study wherein the author participated, which is referenced as external, when relevant.

Contributor Statement

Mads Lund Andersen is the sole author of the article. He conducted all collection of empirical data as well as all of the curation, conceptualization and writing.

Use of AI

N/A.

Funding Statement

The authors did not receive any financial support for the work on this article.

Acknowledgments

Thank you to Prof. Dorte Marie Søndergaard from Aarhus University, DPU who provided supervision in relation to the production of the article, as the primary supervisor of the Ph.d. project, from which the article is based.

Thank you to Robert Rosenberger from Georgia Institute of Technology, who shared his tremendous insights with me, throughout my stay at Georgia Tech, and continues to do so.

Conflict of Interest Statement

There is no conflict of interest.

References

Aagaard, J., Friis, J. K. B. O., Sorenson, J., Tafdrup, O., & Hasse, C. (2018a). An Introduction to Postphenomenological Methodologies. In J. Aagaard, J. K. B. O. Friis, J. Sorenson, O. Tafdrup, & C. Hasse (Eds.), *Postphenomenological methodologies : new ways in mediating techno-human relationships* (pp. xi-xxv). Lexington Books.

Aagaard, J., Friis, J. K. B. O., Sorenson, J., Tafdrup, O., & Hasse, C. (2018b). *Postphenomenological methodologies: new ways in mediating techno-human relationships*. Lexington Books.

Alaimo, S., & Hekman, S. (2008). *Material Feminisms*. Indiana University Press. http://www.jstor.org/stable/j.ctt16gzgqh

Barad, K. (2012). On Touching—the Inhuman That Therefore I Am. *Differences (Bloomington, Ind.)*, *23*(3), 206-223. https://doi.org/10.1215/10407391-1892943

Barad, K. M. (2007). *Meeting the universe halfway quantum physics and the entanglement of matter and meaning*. Duke University Press. https://doi.org/10.1515/9780822388128

Besmer, K. M. (2015). What Robotic Re-embodiment Reveals about Virtual Re-embodiment. In R. Rosenberger & P.-P. Verbeek (Eds.), *Postphenomenological investigations : essays on human-technology relations*. Lexington Books/Fortress Academic.

Bird, B. (1999). *The Iron Giant* D. M. Allison Abbate; Warner Bros.

Blond, L., & Olesen, F. (2020). Unpacking the cultural baggage of travelling robots: How socially assistive robots are integrated in practice. In C. Hasse & D. M. Søndergaard (Eds.), *Designing Robots, Designing Humans* (1 ed., pp. 111-131). Routledge. https://doi.org/10.4324/9781315227207-8

Butler, J. (1997). *The psychic life of power: Theories in subjection*. Stanford University Press.

Bühlmann, V., Colman, F., & van der Tuin, I. (2017). Introduction to New Materialist Genealogies: New Materialisms, Novel Mentalities, Quantum Literacy. *the minnesota review*, *2017*(88), 47-58. https://doi.org/10.1215/00265667-3787378

Cameron, J. (2009). *Avatar* J. L. James Cameron; 20th Century Studios.

Cameron, J. (2023). *Avatar: The Way of Water* J. L. James Cameron; 20th Century Studios.

Ceder, S. (2018). *Towards a Posthuman Theory of Educational Relationality* (First edition. ed.). Routledge.

Chang, E. (2019). Museums for everyone: Experiments and Probabilities in Telepresence Robots. In R. L. Garner (Ed.), *Exploring Digital Technologies for Art-Based Special Education* (pp. 12). Routledge.

Chimirri, N. A., Andersen, M. L., Jensen, T., Kristiansen, A. E. W., & Søndergaard, D. M. (2018). Concerned with Computer Games: A Collective Analysis of Being and Becoming Gamer in Denmark. . In S. Estrid Sörensen / Estrid (Ed.), *Cultures of Computer game concerns: The Child Across Families, Law, Science and Industry* (Vol. 23). transcript Verlag. https://doi.org/10.1515/9783839439340

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC medical research methodology*, *11*(1), 100-100. https://doi.org/10.1186/1471-2288-11-100

Davies, B., & Harré, R. (2007). Positioning: The Discursive Production of Selves. *Journal for the Theory of Social Behaviour*, *20*, 43-63. https://doi.org/10.1111/j.1468-5914.1990.tb00174.x

de Boer, B. (2023). Explaining multistability: postphenomenology and affordances of technologies. *AI & SOCIETY*, *38*(6), 2267-2277. https://doi.org/10.1007/s00146-021-01272-3

Edwards, A., Edwards, C., Spence, P. R., Harris, C., & Gambino, A. (2016). Robots in the classroom: Differences in students' perceptions of credibility and learning between “teacher as robot” and “robot as teacher”. *COMPUTERS IN HUMAN BEHAVIOR*, *65*, 627-634.

https://www.proquest.com/docview/1800416000?accountid=14468&bdid=33090&_bd=5fJXmMYWtfo9FeTnB6jTruAuArM%3D

Fletcher, M., Bond, C., & Qualter, P. (2023). User perspectives of robotic telepresence technology in schools: A systematic literature review. *Educational Psychology in Practice*, 1-18. https://doi.org/10.1080/02667363.2022.2155932

Flyvbjerg, B. (1988). *Case studiet som forskningsmetode*. Institut for Samfundsudvikling og Planlægning, Aalborg Universitetscenter.

Foucault, M. (1982). The subject and power. *Critical inquiry*, *8*(4), 777-795.

Garland, A. (2015). *Ex Machina* A. R. Andrew Macdonald; Universal Pictures.

Haraway, D. J. (1997). *Modest_Witness@Second_Millenium. FemaleMan©_Meets_OncoMouse™: Feminism and Technoscience.* Routledge. https://doi.org/10.4324/9780203731093

Haraway, D. J. (2016). *Staying with the Trouble: Making Kin in the Chthulucene*. Duke University Press. https://doi.org/10.1215/9780822373780

Hasse, C. (2015). *An Anthropology of Learning : On Nested Frictions in Cultural Ecologies* (1st 2015. ed.). Springer Netherlands. https://doi.org/10.1007/978-94-017-9606-4

Hasse, C. (2018). Studying the Telescopes of Others: Toward a Postphenomenological Methodology of Participant Observations. In J. Aagaard, J. K. B. O. Friis, J. Sorenson, O. Tafdrup, & C. Hasse (Eds.), *Postphenomenological Methodologies: New Ways in Mediating Techno-Human Relationships* (pp. 241-258). Lexington Books.

Hasse, C. (2020a). Material concept formation: Inequality in children's conceptual robot imaginaries. In C. Hasse & D. M. Søndergaard (Eds.), *Designing Robots, Desiging Humans* (1 ed., pp. 88-110). Routledge. https://doi.org/10.4324/9781315227207-7

Hasse, C. (2020b). *Posthumanist Learning: What Robots and Cyborgs Teach us About Being Ultra-social* (1 ed.). Routledge. https://doi.org/10.4324/9781315647661

Heidegger, M., & van Buren, J. (1999). *Ontology--The Hermeneutics of Facticity*. Indiana University Press. http://www.jstor.org/stable/j.ctt16gzmw1

Ihde, D. (1993a). *Philosophy of technology : an introduction*. Paragon House.

Ihde, D. (1993b). *Postphenomenology : essays in the postmodern context*. Northwestern University Press.

Ihde, D. (2002). *Bodies in technology*. University of Minnesota Press.

Johannessen, L. E. F., Erik Børve, R., & Haldar, M. (2023). Student at a distance: exploring the potential and prerequisites of using telepresence robots in schools. *Oxford Review of Education*, *49*(2), 153-170. https://www.proquest.com/docview/2777516608?accountid=14468&bdid=33093&_bd=yuzO543c7VRxu55esA2Y9y05Hn0%3D

Juelskjær, M., Plauborg, H., & Adrian, S. W. (2020). *Dialogues on agential realism : engaging in worldings through research practice*. Routledge.

Knage, F. S. (2023). Becoming an Absent Student: Analysing the Complex Entanglements in Persistent School Absence. *Human arenas: an Interdisciplinary journal of psychology, culture, and meaning*. https://doi.org/10.1007/s42087-023-00329-7

Leoste, J., Heidmets, M., Virkus, S., Talisainen, A., Rebane, M., Kasuk, T., Tammemäe, K., Kangur, K., Kikkas, K., & Marmor, K. (2023). Keeping distance with a telepresence robot: A pilot study [Article]. *Frontiers in Education*, *7*, Article 1046461. https://doi.org/10.3389/feduc.2022.1046461

Lucas, G. (1977). *Star Wars: Episode IV - A New Hope* G. Kurtz; 20th Century Studios.

Lungeforeningen. (2022). Fra dit værelse til klasseværelset – sådan kommer I godt i gang med at bruge en telepresence-robot: Samlet vejledning til eleven. In (pp. 28): Lungeforeningen.

Merriam-Webster. (n.d.). Avatar. In *Merriam-Webster.com dictionary. Retrieved March 13, 2024, from https://www.merriam-webster.com/dictionary/avatar*.

Minh-ha, T. T. (1997/1988). "Not You/Like You: Postcolonial Women and the Interlocking Questions of Identity and Difference." In A. M. Edited by Anne McClintock, and Ella Shohat. (Ed.), *Dangerous Liaisons: Gender, Nation, and Postcolonial Perspectives.* (pp. 415-149). University of Minnesota Press.

Murris, K., & Bozalek, V. (2022). *In Conversation with Karen Barad: Doings of Agential Realism*. Taylor & Francis Group. https://doi.org/10.4324/9781003282877

Newhart, V. A. (2018). *Are They Present?: Homebound Children with Chronic Illness in Our Schools and the Use of Telepresence Robots to Reach Them* https://www.proquest.com/docview/2097146785?accountid=14468&bdid=33095&_bd=iiR5Q7Y0JslCR84gZreF9NorGpU%3D

Newhart, V. A. (2019). Are they present?: Homebound children with chronic illness in our schools and the use of telepresence robots to reach them. *Dissertation Abstracts International Section A: Humanities and Social Sciences*, *80*(1-A(E)). https://www.proquest.com/docview/2130087257?accountid=14468&bdid=32930&_bd=9SjcsaCVr1XozjJtbRr5FnwHuF4%3D

Newhart, V. A., Warschauer, M., & Sender, L. S. (2016). Virtual inclusion via telepresence robots in the classroom: An exploratory case study [Article]. *International Journal of Technologies in Learning*, *23*(4), 9-25. https://doi.org/10.18848/2327-0144/CGP/v23i04/9-25

Page, A., Charteris, J., & Berman, J. (2020). Telepresence robot use for children with chronic illness in australian schools: A scoping review and thematic analysis. *International Journal of Social Robotics*. https://www.proquest.com/docview/2460121910?accountid=14468&bdid=32930&_bd=Xp9mj0r6u4qLDZxeh%2Bbo2NEruNc%3D

Perifanou, M., Economides, A. A., Häfner, P., & Wernbacher, T. (2022). Mobile Telepresence Robots in Education: Strengths, Opportunities, Weaknesses, and Challenges. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* (Vol. 13450 LNCS, pp. 573-579).

Powell, T., Cohen, J., & Patterson, P. (2021). Keeping Connected With School: Implementing Telepresence Robots to Improve the Wellbeing of Adolescent Cancer Patients [Article]. *Frontiers in Psychology*, *12*, Article 749957. https://doi.org/10.3389/fpsyg.2021.749957

Rosenberger, R. (2018). Why It Takes Both Postphenomenology and STS to Account for Technological Mediation - the case of LOVE park. In J. Aagaard, J. K. B. O. Friis, J. Sorenson, O. Tafdrup, C. Hasse, & D. Ihde (Eds.), *Postphenomenology and the philosophy of technology.* Lexington Books.

Rosenberger, R. (2020). "But, That's Not Phenomenology!": A Phenomenology of Discriminatory Technologies. *Techné: Research in Philosophy and Technology*, *24*(1/2), 83-113. https://doi.org/https://doi.org/10.5840/techne2020210117

Rosenberger, R., & Verbeek, P.-P. (2015a). A Field Guide to Postphenomenology. In R. Rosenberger (Ed.), *Postphenomenological investigations: essays on human-technology relations* (pp. 7-42). Lexington Books/Fortress Academic.

Rosenberger, R., & Verbeek, P.-P. (2015b). Introduction. In R. Rosenberger & P.-P. Verbeek (Eds.), *Postphenomenological investigations: essays on human-technology relations* (pp. 1-6). Lexington Books/Fortress Academic.

Rosenberger, R., & Verbeek, P.-P. (2015c). *Postphenomenological investigations: essays on human-technology relations*. Lexington Books.

Schouten, A. P., Portegies, T. C., Withuis, I., Willemsen, L. M., & Mazerant-Dubois, K. (2022). Robomorphism: Examining the effects of telepresence robots on between-student cooperation. *COMPUTERS IN HUMAN BEHAVIOR*, *126*, Article 106980. https://doi.org/10.1016/j.chb.2021.106980

Stanton, A. (2008). *Wall-E* J. Morris; Walt Disney Pictures Pixar Animation Studios.

Søndergaard, D. M. (2020). On humanoids, avatars and the rest of us: Gender and designing our new Others. In C. Hasse & D. M. Søndergaard (Eds.), *Designing Robots, Desiging Humans* (1 ed., pp. 21-39). Routledge. https://doi.org/10.4324/9781315227207-3

Søndergaard, D. M. (2021). Psychology challenged: Refocusing our conceptual endeavors when culture-nature and technology kick in. *International Review of Theoretical Psychologies*, *1*(1). https://doi.org/10.7146/irtp.v1i1.127074

Takayama, L., Marder-Eppstein, E., Harris, H., & Beer, J. (2011). *Assisted driving of a mobile remote presence system: System design and controlled user evaluation*. https://doi.org/10.1109/ICRA.2011.5979637

Tuin, I. v. d., & Verhoeff, N. (2022). *Critical concepts for the creative humanities*. Rowman & Littlefield.

Turner, A., Andersen, M., Søgaard, V., Christiansen, K., Rockenbauer, G., Scherde, T., Zillner, C., Sakrowsky, S., Bienzle, H., Tallon, M., Schults, A., Leesmaa, K., Fernández-Morante, C., Casal-Otero, C., B, & Mareque-León, F. (2022). Telepresence Systems in Schools for Children and Adolescents with Chronical Illnesses in Europe: A Transnational Analysis Report. In D. B. Klagenfurt University, Bednet, VIA University College, Tallinn University, University of Santiago de Compostela (Ed.), *https://abiliti.eu/resources/* (pp. 84): ABILITI.

Verbeek, P.-P. (2006). Materializing Morality: Design Ethics and Technological Mediation. *Science, technology, & human values*, *31*(3), 361-380. https://doi.org/10.1177/0162243905285847

Verbeek, P.-P. (2011). *Moralizing Technology : Understanding and Designing the Morality of Things*. University of Chicago Press. https://doi.org/10.7208/9780226852904

Weibel, M., Nielsen, M. K. F., Topperzer, M. K., Hammer, N. M., Møller, S. W., Schmiegelow, K., & Bækgaard Larsen, H. (2020). Back to school with telepresence robot technology: A qualitative pilot study about how telepresence robots help school-aged children and adolescents with cancer to remain socially and academically connected with their school classes during treatment [Article]. *Nursing Open*, *7*(4), 988-997. https://doi.org/10.1002/nop2.471

Weibel, M., Skoubo, S., Handberg, C., Bertel, L. B., Steinrud, N. C., Schmiegelow, K., Hallström, I. K., & Larsen, H. B. (2023). Telepresence robots to reduce school absenteeism among children with

cancer, neuromuscular diseases, or anxiety—the expectations of children and teachers: A qualitative study in Denmark. *Computers in Human Behavior Reports*, *10*, 100280. https://doi.org/https://doi.org/10.1016/j.chbr.2023.100280

Yin, R. K. (2018). *Case study research and applications: : design and methods* (6. edition. ed.). SAGE Publications, Inc.

Zhang, G. T., & Hansen, J. P. (2022). Telepresence Robots for People with Special Needs: A Systematic Review. *International Journal of Human-Computer Interaction*, *38*(17), 1651-1667. https://doi.org/10.1080/10447318.2021.2009673