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Multi-site domestication: taming technologies across multiple institutional settings

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ABSTRACT

This article advances domestication theory by developing the concept of *multi-site domestication.* Whereas domestication theory traditionally focuses on the 'taming' of technologies at a single site (most often, the household), the concept of multi-site domestication captures how technologies often require *different* taming processes across *multiple* institutional settings. In this article, we apply the concept to understand the multi-site domestication of *AV1*: a communication solution for children who are homebound because of chronic illness or disabilities, which creates a communicative bridge from an app on the homebound student's phone/tablet and to a 'telepresence robot' that is placed physically in the classroom, where it is meant to function as the homebound student's proxy. Using data from a larger qualitative study of the implementation of AV1 in Norway, the article shows how the 'traditional' domestication processes of appropriation, objectification, incorporation, and conversion play out and are complicated when domestication occurs across settings with different and at times opposing norms, rules, values, and logics. In charting these multi-site dynamics, the article updates domestication theory for an age of increasingly intertwined technologies, thus helping future studies to look beyond single sites and appreciate more complex taming processes.

Introduction

'Domestication' is a key concept in social studies of technology. While uses vary, the concept most fundamentally refers to acts of domesticating or 'taming' technologies that are new and, therefore, also 'wild,' confusing, unruly, or uncontrollable. Guided by these metaphors, domestication studies have ranged from the microscopic to the macroscopic, covering issues such as technological acceptance, rejection, and use (Berker et al., 2006, p. 1).

When Roger Silverstone and colleagues first began using the domestication concept in the 1980s and 1990s, the empirical frame of reference was the domestic setting

of the home and the technologies under study were primarily stationary and/or stand-alone devices such as televisions, telephones, and personal computers (Silverstone, 1994; Silverstone & Hirsch, 1992). While later contributions have expanded the empirical focus to include non-domestic settings (cf. Sørensen et al., 2000) and increasingly mobile and networked technologies (cf. Brause & Blank, 2020), most theorizing on domestication still centers on the 'taming' of technology within a single institutional setting.

With this article, we argue that this single-site focus overlooks how communication technologies and other networked devices often require different taming processes by an array of actors across multiple institutional settings. We refer to this as *multi-site domestication* and aim to show how such processes are characterized by distinct dynamics and complexities.

To that end, we draw on data from a larger qualitative study of the implementation of the communication solution 'AV1' in Norway. Produced by the Norwegian startup company No Isolation and designed for children who are homebound because of chronic illness or disabilities, AV1 is made to be the child's 'eyes, ears, and voice' in the classroom (No Isolation, 2022). The solution comprises two distinct interfaces: (1) an app to be downloaded on the homebound student's phone or tablet, and (2) a 30 cm tall 'telepresence robot' that is placed in the classroom, where it is to act as a communicative bridge between the homebound student and their teachers and classmates in school.

In our analysis, we show how the taming of these two different devices across two institutionally distinct settings creates a series of distinct multi-site challenges, and how these challenges have implications for key concepts from 'traditional' domestication theory – including the four dimensions of appropriation, objectification, incorporation, and conversion (Silverstone & Hirsch, 1992). In so doing, the article provides a much-needed update to domestication theory, sensitizing researchers to processes of taming across multiple institutional settings and how these can entail a series of complexities that increase the risk of *failed* domestication processes – an outcome that has tradition-ally been a blind spot in theorizing on domestication.

Domestication theory and research

Domestication theory mainly comprises two theoretical branches: a British media studies variant that can be traced back to work by Eric Hirsch, David Morley, and – in particular – Roger Silverstone (Silverstone, 1994; Silverstone et al., 1992), and a Nor-wegian technology studies variant that is primarily associated with the work of Merete Lie and Knut Holtan Sørensen (1996). Although distinct, these two branches are heav-ily intertwined, and we combine insights from both in our understanding of multi-site domestication.

While domestication theory has traditionally focused mostly on the domestic setting (ie, the home), later contributions have expanded the empirical scope to include non-domestic settings such as small businesses (Harwood, 2011; Pierson, 2006) cafés (Henrik-sen & Tjora, 2018), municipalities (Liste & Sørensen, 2015), schools (Martínez & Olsson, 2021), healthcare (Lüchau & Grønning, 2021; Pols & Willems, 2011), and IT courses (Hynes & Rommes, 2006).

In these expanded approaches, 'domestication' is separated from the domestic to denote acts of domesticating – of 'taming the wild' – irrespective of setting (Helle-Valle & Slettemeås, 2008). The key idea, then, is that new and 'wild' technologies – just like wild animals – require 'taming' and have to be 'housetrained' to 'be integrated into the structures, daily routines and values of users and their environments' (Berker et al., 2006, p. 2). This work of 'taming' is considered a crucial mediator between technologies as designed – with their imagined and intended uses – and technologies as they are adopted, used and fitted into the lives and needs of its users (Lie & Sørensen, 1996). Domestication thus captures all those processes of sense-making, negotiation, and 'tinkering' that mediate between technologies and their so-called 'impacts' (Sørensen, 2006).

Besides the general importance of 'taming' technologies, these expanded approaches also highlight issues and processes that are less relevant, or harder to spot, when focusing solely on the home. One such set of issues concerns conflict and power. While of course central to traditional domestication theory as well, conflict and power differences abound when the work of taming takes place within formally stratified and highly regulated institutions such as schools or municipalities. This is evidenced, for instance, in Martínez and Olsson's (2021) study of the domestication of new media within the educational context of Swedish leisure-time centers, where power relationships go beyond those within the home and family to include those 'between employers and employees, between teachers and children, and between teachers and parents' (2021, p. 493). In extension, these expanded approaches are also more likely to highlight domestication processes that are 'problematic, reversed, stopped altogether' (Hynes & Rommes, 2006, p. 125), thus counteracting the tendency of traditional domestication studies to emphasize instances where actors succeed in domestication the technology under investigation.

Despite these valuable contributions, these expanded approaches have mostly followed traditional domestication theory in doing single-site investigations. What escapes the analytical gaze, then, is how domestication can involve *simultaneous* taming processes of *several* devices *across* multiple sites – what we refer to in this article as *multi-site domestication*. To the extent that this is recognized in existing research and theorizing, this is mainly done either implicitly (as when Martínez and Olsson note 'how something that has already been domesticated in the home context becomes rewilded as it enters the LTCs as educational contexts' (2021, p. 488)), or with a view to more macro-scale processes involving large-scale institutional players (cf. Sørensen, 2006). There are, of course, some notable exceptions, including Lüchau and Grønning's (2021) study of the 'collaborative domestication' of video consultations between patients and general practitioners, in which the authors make the fundamental point that '[o]ne part cannot succeed in domesticating video consultations without the other part contributing' (2021, p. 238). Similarly, Ask and Sørensen (2019) show how users engage in 'collective domestication' when they coordinate actions at a distance in online games, and a series of studies show how users work to 'tame' social media and other algorithmic platforms across a series of contexts and devices (Leong, 2020; Siles et al., 2019). Taking these and similar studies (cf. Hartmann, 2013) as a source of inspiration, our study seeks to advance the field further by putting the multi-site dynamics of domestication front and center of the analysis and thus fleshing out multi-site domestication as a more fully developed concept.[1]

In our understanding, *multi-site domestication* comprises an array of actors involved in taming an interconnected 'bundle' of technologies across multiple sites. By 'sites', we refer not just to physically isolated but also institutionally differentiated settings, each with distinct norms, rules, values, and 'logics' (Scott, 2013). In the subsequent analysis, for example, we will show how the home and the school are characterized by different structural demands, with the school putting much greater emphasis on privacy regulations and bureaucratic principles. At the same time, we will also show how domestication is not only a multi-site but also a multi-actor process, distributed across an array of actors who can interpret and act towards the technologies in widely different ways, not just across both also *within* each site. Furthermore, our focus is on the domestication of a 'bundle of technologies' rather than a single artifact or device. We thus see multi-site processes as involving *multiple* and *interconnected* technologies, all of which must be 'housetrained' according to the logics of their particular site. These bundles can comprise similar technologies (eg, the use of broadly equivalent cellphones to communicate between home and school) or – as in the present case – different technologies, which offer different functions, represent different levels of 'wildness', and require different processes of taming.

To analyze these multi-site processes, we build on but also extend the understanding of domestication as a multi-dimensional process comprising the four dimensions[2] of appropriation, objectification, incorporation, and conversion (Silverstone et al., 1992):

1. *Appropriation* comprises the first encounters between a site and a technology, where members of the site decide whether to adopt the technology or not (Silverstone et al., 1992, p. 21). Actors then engage in a process of 'imaginative work' in which they construct the technology in question as an object of 'desire' or 'non-desire' (Hynes & Rommes, 2006, p. 128; see also Johannessen, 2023). Should the users decide they do not want the technology, the process will begin and end with the appropriation phase. If they decide (or are forced) to adopt the technology, however, the dimensions of objectification, incorporation, and conversion also come into play.
2. *Objectification* encompasses all the work involved in finding a physical place for the technology. This puts into play the spatial logics of each institutional setting, thus revealing the classificatory principles of the site where objectification occurs (Silverstone et al., 1992, p. 22).
3. *Incorporation* captures the temporal aspects of domestication, such as deciding when and for how long a technology is used, and how to incorporate the technology into the routines of the site in question (Silverstone et al., 1992, p. 24).
4. Finally, whereas the latter three dimensions refer to how 'outside' objects are made private, *conversion* refers to how the 'privatized' technology is again related to the outside world, as actors (typically within the household) use the domesticated technology for purposes of self-presentation and identity work (Silverstone et al., 1992, pp. 25–26).

In the coming Results section, we show how each of these dimensions display distinct multi-site characteristics. Given our focus on a bi-directional communication technology, we also re-interpret the dimension of conversion, treating this not just as a process where domestic meanings are 'exchanged' (conversed) with the outside world but also as

a process of 'conversation' ('to converse'), as this allows us to grasp how the domestication process, if successful, enables physically isolated actors to articulate and (re)produce their social relationships (see also Wu, 2021). In so doing, we update the four-dimensional approach to domestication – which was initially constructed with a view to more stationary technologies such as TV sets – to better understand our contemporary landscape of increasingly mobile and interconnected technologies.

Materials and methods

This article is part of a larger qualitative study of 'AV1' (Johannessen et al., 2023b). Produced by the Norwegian start-up company *No Isolation*, AV1 is a telepresence robot for children who are 'homebound' because of illness or disability (see Figure 1). As of June 2023, there are roughly 2500 active robots in Norway, Sweden, Denmark, Germany, the UK, and several other European countries (according to the producer's numbers).

AV1 is a particularly apt case for studying multi-site domestication because it comprises two distinct interfaces that are meant to link two physically isolated sites: (1) an app-based interface to be used on the homebound student's phone or tablet and (2) a 30 cm tall 'telepresence robot' that is placed in the classroom, where it is supposed to function like a personified web camera and facilitate communication between the homebound student at home and their teachers and classmates in school. Thus, rather than a single, isolated artifact, AV1 is a communication solution consisting of two interlinked devices – both of which must be domesticated for the AV1 solution to work. In contrast to most communication technologies, AV1 is also designed to offer a single link between two unique devices, meaning that the homebound student can only connect one device (ie, their phone or tablet) to one particular robotic device in the classroom. This design reflects both privacy concerns and the idea that the robot is supposed to be the student's

Figure 1. AV1 in group work. Photo: Estera K.-Johnsrud/No Isolation.

proxy or avatar in the classroom (ie, the robot is supposed to represent an *individual* student). Regardless of intentions, this design creates a particular dependency between the connected actors, thus increasing the importance of them succeeding with domesticating their uniquely connected devices. Adding to this, AV1 also differs from most communication technology in offering distinctively different interfaces for the two interacting parties: an app-based interface with sound and video for the homebound child, and a faceless robotic interface with only sound for teachers and classmates. This further adds to the challenges of domestication this communication solution, all of which makes AV1 an analytically salient case to think with to unpack the characteristics of multi-site domestication.

Our research into AV1 has largely been interview-based, with our sample comprising 159 semi-structured interviews with users, producers, school workers, and other stakeholders of the robot in Norway, conducted between the fall of 2018 and the spring of 2021 (Johannessen et al., 2023b). For this article, we focus most closely on the 69 interviews we did with 37 homebound children (or with guardians on behalf of their children) and the 55 interviews we did with 48 teachers, principals, and other educational employees across 29 schools in Norway. The two samples overlap significantly, as most school workers were recruited through the homebound children or their guardians. Concerning the homebound children, 20 were girls, 17 were boys; 2 were in kindergarten, 14 in primary school (ages 6–12), 10 in secondary school (ages 13–15) and 9 in upper secondary school (ages 16–18),[3] and they used the robot for different illness-related reasons, including chronic fatigue problems ($N = 14$); cancer ($N = 11$); operation-related absences ($N = 5$); school avoidance ($N = 2$); and severe intolerances, pains or other issues that regularly kept them home from school ($N = 5$). Concerning the school workers, 31 were female and 17 male; 19 worked in primary school, 5 in secondary school, 11 in upper secondary school, and 13 in other education-related institutions (eg, hospital schools).

All interviews were carried out using a semi-structured interview guide. This article builds primarily on questions about the implementation of the robot. To facilitate detailed, context-sensitive accounts, we mostly used 'descriptive questions' in line with Spradley's (1979) 'ethnographic interview' approach.

For more vivid ethnographic details, we also supplemented the interviews with 8 h of participant observation at an upper secondary school. Several interviews were also conducted in schools (with teachers) or the homebound student's home, thus allowing for additional insight into the sites in question.

Ethics approval was received from the Norwegian Centre for Research Data (NSD) in September 2018. All interviewees have given their written consent to participate in the study. To ensure confidentiality, their names and other identifying information has been made anonymous. All interviews were transcribed verbatim. The included quotes have been translated from Norwegian, making minor grammatical and aesthetical adjustments.

For the project as a whole, the transcripts were first sorted by the use of 'broad brush coding' (Bazeley & Jackson, 2013) in QSR Nvivo 12. For this article, it was decided early to use domestication theory to make sense of relevant data on taming processes. To that end, the first and second authors began by coding the interviews according to the four dimensions of domestication (ie, appropriation, objectification, incorporation, and conversion). When later meeting to reflect on these codes, the authors became increasingly

aware of how the work of domesticating AV1 was distributed across multiple sites, with the two key ones being the school and the home. The data was then re-analyzed with a view to the specific multi-site aspects of domestication, the findings of which are presented in the following section.

Results

We now consider the multi-site domestication of AV1. Before we proceed, we emphasize again that AV1 is not a single, isolated artifact but two interconnected devices placed in the school and home, respectively, and linked through the internet. This means that the 'AV1 bundle' must be domesticated in two physically isolated sites, which creates a series of challenges for the domesticating actors. It is these multi-site-specific challenges that we will focus on in the following analysis (for a more general account of the implementation process, see Johannessen et al., 2023b).

Appropriation: negotiations within and across sites

Appropriation refers to the first encounters between a site and a technology, where members of the site decide whether to adopt the technology. Regarding multi-site domestication, we found it particularly salient how the appropriation phase comprised a multitude of actors across a multitude of sites, each engaging in distinct forms of 'imaginative work' (Hynes & Rommes, 2006).

Starting with the two key sites of the school and the home, we found several examples of clashing institutional concerns. For instance, whereas actors in the home typically put moral emphasis on care for and inclusion of the individual homebound child, school actors tend to emphasize the moral importance of including *all* children, which sometimes lead to speculations about how the robot would affect classroom teaching and the learning of all other students in class. The use of AV1 was also imagined as running counter to additional key values in schools, including concerns for pedagogy and privacy (see also Johannessen et al., 2023a). In addition, school workers' concerns were exacerbated by the fact that AV1 was introduced to schools in a bottom-up fashion by the parents of the homebound child. This made the robot resemble other 'private' technologies, which are typically considered more 'wild' than school-sanctioned technologies (see also Martínez & Olsson, 2021). For these and other reasons, the school site often engaged in various forms of gatekeeping, seeking either to stop the implementation process or pause it for further investigations, thus delaying or even stopping the domestication process at the appropriation stage. Adding to this, the robot also had to be 're-appropriated' every time it encountered a new teacher or other influential school actors. As a result, AV1 involved not a single moment of appropriation but a recurring series of negotiations, many of which could cause complications far beyond the stage where the robot was put into use.

In addition to such *inter-site* negotiations between the school and the home, it was also evident that each site comprised actors with potentially diverging opinions and interests, leading to an additional series of *intra-site negotiations*. For instance, there were several examples of principals having to convince reluctant teachers to give the robot a chance – and vice versa in cases where the principals perceived the robot as an object of non-

desire. We also found examples of diverging imaginative work of actors within the home, typically in the form of parents having to convince a reluctant child to give the robot a chance. For instance, one father told us his daughter was shy and hesitant towards attending the classroom in robot form; as he put it, 'She's afraid that it will create a lot of attention'. In some such cases, we also saw evidence of school workers trying to convince the child to give the robot a chance, thus illustrating a reversed inter-site dynamic in which the school was positive and some actors in the home were negative.

Beyond the school and the home, several other sites were also involved in appropriating AV1, each raising a series of additional concerns. For instance, many processes involved the municipal school owners providing their assessment of the legalities of using streaming technology in school. The homes and families of other students were often also implicated, as the use of AV1 typically required consent from the parents of the homebound student's classmates. Several cases also involved actors at different sites within the healthcare system, who often voiced their opinion on the healthcare implications of the child using AV1. In complex cases, a series of professionals was assembled, as evidenced by a mother who explained that she and her child had monthly meetings with an interdisciplinary team involving, 'The child and youth psychiatric clinic, the teachers in school, the educational and psychological counseling service, the hospital, the school nurse, the physiotherapist – you know, it's a truckload of people. A lot of people with something to say.' In some cases, it was one of these actors who proposed that the family should try using AV1; equally often, however, it turned out that some of these actors could act as gatekeepers for the use of AV1, leading to complex and drawn-out processes of negotiation.

For those seeking to use a robot, the task was thus to ensure that all the potential gatekeepers constructed the robot as an object of desire – or at least not an object of non-desire. This work often fell on the homebound students' guardians, who at times found it daunting to convince the many actors involved about the robot's utility. Often, a critical step involved recruiting an inter-site ally, such as a principal or influential teacher, who could convince their more skeptical teachers to give the robot a chance. If unsuccessful, the domestication process could end or be significantly delayed at the point of appropriation. This was the case for nine of our 37 users, thus illustrating the potential for failed domestication in multi-site cases.

Objectification: moral and practical problems with remote access

Objectification encompasses all the work of finding a physical place for the technology. In terms of multi-site objectification, there are two overarching issues that deserve particular mention.

Firstly, it was evident that objectification raised a series of moral and legal questions because of the multi-site nature of AV1. As a streaming device for use in the classroom, there was much discussion about the emplacement of both the homebound user and the robot itself. Concerning the former, school actors often expressed worry about the context in which the homebound student was using the robot. As AV1 offered a metaphorical window into the classroom, many school actors started asking potentially troubling questions such as: Where, exactly, is the homebound child using the robot? Are they alone? Can others see and hear the video stream? Are we sure that the homebound

child is not purposively sharing the stream with others? And could the robot be misused by other actors with bad intentions (eg, malicious hackers or parents wanting to spy on the teacher)?[4]

Similarly, many school actors worried about the placement of the robot in *the school end*. One set of issues pertained to the placement of the robot while *in use*. For instance, some insisted on the robot being placed on a desk in the front of the classroom, to avoid 'exposing' the other students in the class (thus reconfiguring the robot purely as an educational tool, rather than also being a social tool for interacting with classmates). Another set of issues pertained to the placement of the robot when it was *not* in use. As the robot is rather costly (approx. £2800), the device had to be stored in a locked backstage area to avoid theft; at the same time, however, the robot was also perceived as a threat to the backstage nature of these spaces, as the device is designed to allow the student to log on at all times as long as the robot has battery power (a design choice meant to prevent school actors from intentionally or unintentionally turning off the robot and thus precluding the homebound child from using it). Occasionally, school actors came up with creative solutions to this dilemma, as the following teacher in upper secondary school explained,

> There aren't many places in the school where it [the robot] can be placed without the risk of confidential information getting out. In the end, we had to make a soundproof cabinet for it to be charged in, so that we could be sure – not that we *think* she'll do it – but so that we could be absolutely sure that even if she logged on, she couldn't witness something she wasn't supposed to be seeing.

From the school end, such solutions were seen as attempts to balance concerns for inclusion with concerns for privacy. From the home end, such balancing acts could sometimes be difficult to comprehend, with some students feeling mistrusted or mistreated in light of these privacy measures. One telling case involved a primary school student's frustration with her teacher putting a hood over the robot's head to block its 'eyesight' while not in use; as the mother explained,

> Because of privacy, things become very difficult. [My daughter] was disappointed that the robot was occasionally covered; she felt very sad. After this [had happened the first time], I was a little scared every time she logged in. I didn't know what the robot's situation would be like. Sometimes it was left to charge in a group room with no people. [When she logged on], she heard the class in the classroom. Such experiences are difficult.

From this mother's perspective, AV1 is the student's stand-in or representative in school. In many ways, the robot *is* the student. Thus, when a teacher puts a hood over the robot's head or leaves the robot in an empty group room, these actions say something not just about the teacher's relationship to the robot but also about the teacher's relationship with the student being represented by the robot. In short, students whose robots are forgotten might themselves feel like they have been forgotten. In addition, such actions have additional bearing because of the multi-site nature of the technology, as the robot offers limited mobility and instead assumes the cooperation of those in the school-end. The students therefore have limited agency in resolving these issues, depending instead on the assistance of others.

This leads to the second, more practical issue of accomplishing objectification across physically isolated sites. Given the limited mobility of the robotic device, the homebound

student needs help from those at the school site to figure out how to properly place the robot. At the same time, the school actors have limited insight into how their placement attempts affect the homebound student's viewing experience, as they are not physically copresent with the app and can thus only imagine what the stream looks like from the home site. And while the homebound student can, of course, communicate their placement preferences via voice communication through the robot, this matter is complicated, again, by the fact that the concept of using telepresence robots is new and unfamiliar, which means that placement preferences often have to be *figured out* through processes of trial, error, and sensemaking. In other words, the homebound students often had to 'tinker' with placement options before arriving at a satisfactory balance between competing concerns; should the robot, for instance, be placed at the front of the classroom to better see the blackboard and hear the teacher, or should it be placed closer to the middle of the classroom to afford easier interactions with classmates? Often, the answer was far from given, thus requiring the homebound student to *develop* their preferences in cooperation with remote others.[5] While this could be complex enough within the boundaries of a single classroom, it proved particularly challenging in higher levels of schooling, where the robot had to be objectified across a *series* of classes and classrooms.

'Objectification at a distance' thus poses a series of coordination challenges that can be hard to solve via the robot itself. Solutions to these challenges often involved minor institutional innovations, such as designating a particular school actor as a 'local expert' on the robot, thus tasking them with the work of figuring out solutions for optimal placement of the robot together with the homebound student (and communicating student preferences in encounters with actors less familiar with the device). A similar solution involved having a guardian of the homebound student physically visit the school to demonstrate the technology for those who were to be physically copresent with it, thus temporarily suspending the multi-site nature of the technology. Besides allowing teachers and classmates to see the app and test the robot for themselves, this allowed the guardian to tinker with the robot while in its physical copresence, thus expediting the work of objectification. Multi-site objectification was therefore no impossibility, but it often required greater ingenuity than if the technology had been designed for single-site use.

Incorporation: remote routinization and the aligning of temporalities

Incorporation captures the temporal aspects of domestication, such as deciding when and for how long a technology is used, and how to incorporate the technology into the routines of the site in question. In terms of multi-site incorporation, two issues deserve mention.

The first issue concerns the *practical* aspects of creating working routines across physically isolated sites. As these overlap significantly with the practical points about multi-site *objectification*, we only note that multi-site *incorporation* could involve substantial coordination challenges; in short, as actors at the school site had limited insight into what AV1 looked like from the home site (and vice versa), any site-specific problems with routinization were likely to persist longer than if the actors had been physically copresent and thus had had greater insight into each other's challenges.

The second key issue concerned the alignment of temporalities across the school and the home. The challenge here was to achieve a proper fit between the timetable of the school and the time-specific requirements of the homebound child's situation. Concerning the latter, one source of complication was that the body of a homebound child has its own temporal logic, with opportunities for remote participation often varying with periods of high and low energy. Coupled with the fact that most students aimed to attend only a select number of activities (eg, particular courses or break times), it could, at times, be challenging to find a match between a suitable activity and one's physical readiness. This was particularly challenging for students with chronic fatigue problems, who typically followed only a few courses per week and whose bodies often betrayed them when a participatory opportunity arose.

Adding to this, some homebound children also found themselves, at times, in institutional sites with their own temporal orders, such as hospitals or rehabilitation centers. Besides having their own timetables, these sites were also characterized by a certain degree of unpredictability, as physicians or others could suddenly appear for examinations or similar activities. This made participation a challenging task, as explained by the mother of a 9-year-old boy:

> If he logs on and they [the classmates] just sit there working, it's not exciting enough to be part of, so it becomes boring. It must be suitable [for his purposes] … But it's also not that easy to agree that "at such and such time they'll start a new chapter" or "at this time they'll have blackboard lessons", [… because] suddenly he has to leave for an examination.

Aligning the timetables of schools and other temporally demanding institutions could therefore be a significant conundrum. Complicating this further was the fact that many teachers insisted that the use of the robot had to be planned some time in advance. This reflected both privacy concerns and a series of more practical considerations, such as teachers wanting to adjust their lectures for robot participation or saving themselves the hassle of preparing the robot for use if the student had no intention of using it. While making sense from the school actors' perspective, pre-planned use of the robot proved troubling for students with unpredictable bodies or institutional demands. In such cases, the result was often failed or sub-optimal domestication processes, with the homebound student struggling to align the multiple temporalities involved in AV1's multi-level design.

Convers(at)ion: relational maintenance

While the previous sections have detailed the complexities of multi-site domestication – complications that sometimes lead to failed attempts and the technology remaining 'wild' – we also found several examples of successful domestication processes. This leads us to the conversion phase. Traditionally, conversion refers to how a 'tamed' and 'privatized' technology is used for self-presentation and identity work (Silverstone et al., 1992). There were multiple examples of this in our material, ranging from schools using AV1 to promote themselves as 'modern' and classmates talking proudly about having a robot in their classroom.

In the following, however, we wish to emphasize a modified understanding of conversion, more tailored to capture a salient aspect of multi-site domestication – namely, how successful multi-site processes can enable physically isolated actors to articulate and

(re)produce their social relationships. Such an understanding is closely related to the original taming metaphor of the domestication concept; as Silverstone (2006, p. 231) put it, 'Wild animals then, wild technologies now: what's the difference? In both cases, unconstrained, they pose threats and challenges. In both cases, brought within the fold, they become sources of power and sustenance.' It is this idea of domesticated technology becoming a 'source of power and sustenance' that we now wish to elaborate on.

To begin, we consider the role that a domesticated robot could play for *the homebound student's* relationship with teachers and classmates. We here found that the robot facilitated relationship maintenance in two main ways. Firstly, it served as a communication *channel*, allowing homebound children to keep the conversation going with their classmates. As one mother explained, this allowed her son to 'stay in the loop' of everyday happenings at his primary school, such as someone losing a tooth or breaking an arm, thus reducing her son's feeling of physical and social isolation. In the same vein, the robot also offered an experiential window into the everyday life of schools, allowing the homebound child to follow both day-to-day activities and more special events such as trips, celebrations, and theater visits, all of which added to their feelings of being connected to the class.

Secondly – and in contrast to most other communication technologies under the possession of students in this study – the robot also served as a communication *reminder*, as explained by a parent of a chronically ill girl:

> In relation to her class and friends and best friends, it's evident that without it [the robot] – I think it might have been easier for her to have gone missing. She would have had to be more proactive herself [...] So I think that it would have been, perhaps, more challenging to maintain that proper connection without it [the robot] being in the classroom and reminding them of her, that she is present – or that she is present *via* it – in the classroom setting, every day.

In other words, through its material presence in class, the robot served as a clear reminder that a student was absent, thus stimulating classmates to interact with the missing student.

This latter point helps us appreciate how the robot could also help teachers and especially *classmates* maintain their relationship with the homebound student. According to some of the more seasoned teachers we interviewed, many classmates have, traditionally, found it hard to know when and how to contact a student who becomes homebound. On the one hand, they often miss the student and feel a need to express their care for them, but on the other hand, they are afraid of bothering the student in a time of pain and limited energy. In light of this predicament, many students found it liberating to have a physical representative of – and communicative channel to – the homebound student in class, as this provided both a clear expression of the student's interest in interacting and a readily available option for accomplishing such interaction. In sum, then, a domesticated robot could serve as a central resource for relationship maintenance for the homebound student, their teachers, and classmates.

Discussion

This article has developed the concept of *multi-site domestication* as an extension of domestication theory. Whereas domestication theory has traditionally focused on how

technologies are tamed at a single site (most often, the household), our concept of multi-site domestication captures how communication technologies often require *different* taming processes across *multiple* institutional settings. Taking the telepresence robot AV1 as our case, our analysis has shown how this technological 'bundle' was domesticated across multiple sites, the most salient of which were the home and the school. Specifically, we have demonstrated how the four dimensions of domestication – appropriation, objectification, incorporation, and conversion – are all characterized by distinct multi-site processes in the domestication of AV1. Concerning *appropriation*, we found a multitude of actors across several sites engaging in distinct forms of 'imaginative work' to decide whether or not to adopt the technology. Regarding *objectification*, our analysis showed how placement decisions are complicated when multiple sites are involved, for moral, legal, and practical reasons. Issues of *incorporation* also raised several multi-site issues, pertaining to both the moral and practical aspects of routinizing a technology across physically isolated sites. Lastly, concerning *conversion*, our analysis highlighted how a successfully domesticated communication technology such as AV1 can become a resource for relationship maintenance between physically isolated actors, thus illustrating how 'tamed' technologies can become 'sources of power and sustenance' (Silverstone, 2006, p. 231) for their users.

To some extent, our findings align with other domestication studies outside of the domestic setting. In particular, our study echoes findings on the centrality of conflict and power differences when technologies are introduced in formally stratified and highly regulated organizations such as schools or municipalities. Indeed, while domestication processes in general can be perceived as 'a terrain of contests' (Sørensen, 1994, p. 11), this is often truer for complex organizational settings, as these can involve a myriad of hierarchically related actors, each occupying distinct roles with distinct outlooks and interests. At the same time, however, our analysis also goes beyond most of these studies by highlighting challenges related to the taming of technologies across sites, rather than just within sites. Although single-site processes can be complex, domestication becomes significantly more convoluted when distributed across multiple institutional settings, as this requires the 'domesticators' to align multiple concerns and interests without being in each other's physical copresence.[6] This means that multi-site domestication demands heightened creativity from the 'domesticators', all of which increases the likelihood of unsuccessful or compromised domestication processes. Theoretically, this also highlights the need for 'negotiation' and 'remote coordination' as important meta-dimensions of multi-site domestication, cross-cutting the other and more traditional dimensions highlighted above.

That said, when discussing the complexities of multi-site domestication, some specifics of the AV1 case must be considered. Firstly, AV1 differs from most communication technology by being designed to offer a *single* link between two *unique* devices. This means that those interacting through AV1 are *uniquely* dependent on each other for remote communication to work; the class cannot simply connect to another home-bound student, just as the homebound student cannot connect to another robotic device. Compared to more flexible communication solutions, then, AV1 puts greater impetus on a *specific* set of actors succeeding with taming a *particular* set of devices.[7]

Adding to this, AV1 also differs from most communication technology in offering distinctively different interfaces for the two interacting parties: an app-based interface with

sound and video for the homebound child, and a face-less robotic interface with only sound for teachers and classmates. This asymmetry creates an additional barrier for taming the robot, as actors at each end can find it hard to imagine what the technology looks like *from the other site* (ie, the class must, to some extent, assume what the homebound student sees through the app-based interface, just as the homebound student must, to some extent, assume how it feels for the class to interact with a robotic interface). This epistemic asymmetry can be particularly challenging in light of the novelty and 'wildness' of the robotic interface; as few of the involved actors had used something similar before, the robot itself required significant sensemaking and tinkering *by both parties* (as we saw, for instance, in the difficulties related to creating placement preferences across physically isolated sites).

Still, although AV1 offers some specific challenges in terms of multi-site domestication, these specificities do not suggest that the importance of multi-site domestication is limited to technologies such as AV1. On the contrary, as virtually every communication technology requires taming across multiple sites to serve its users, and as technologies in general are becoming increasingly mobile, networked and interdependent (cf. Brause & Blank, 2020), it is imperative for domestication studies to look beyond single sites and appreciate more complex processes of taming. To that end, we see potential for researchers to develop the concept of multi-site domestication further. One fruitful avenue could be to differentiate the concept of 'sites' itself: While our study has explored the relatively clearly demarcated settings of the home and the school, not all 'sites' have this physically and conceptually distinct character (cf. Marcus, 1995).[8] Going forward, domestication studies could therefore adopt an expanded understanding of 'sites' to explore complex links between the many actors, places, objects, and institutions who make up a domestication process. While fragments of such complexity have been shown in the present analysis with its attention to both inter- and intra-site dynamics, more research and theorizing is needed on how domestication processes are distributed, coordinated and negotiated between multiple sites and actors (cf. Latour, 2005). We have found AV1 to be an excellent case to think with to begin unpacking the specifics of multi-site domestication. Future studies are encouraged to build on this work and advance our understanding of domestication as distributed between multiple sites and actors.

Notes

1. Similar to us, Bijsterveld and Jacobs (2009) speak of 'multi-sited domestication', but they limit the concept and their investigation to processes *within* the home, focusing on how the tape recorder was domesticated as 'a semi-portable device that traveled through the house, from room to room, from cupboard to table, from bookshelf to attic' (p. 40).
2. While domestication was originally presented as occurring through different *stages* or *phases* (Silverstone et al., 1992), later contributions have moved away from such linear language and instead speak of multiple *dimensions* (cf. Hynes & Rommes, 2006).
3. Of the remaining two users, one did not tell us their age, and another had finished school (the latter is included in the count because of offering analytical contrast to the school-based users).
4. See Johannessen (2023) for an in-depth analysis of school actors' fears about the robot being used for surveillance purposes.
5. Complicating this further, we also found *opposing* placement preferences, as evidenced in a case where the homebound student wanted to place the robot in the middle of the classroom

whereas their classmate wanted it placed up front in order not to be exposed to the robot's camera at all times.

6. By uncovering conflicting norms and values, 'multi-site domestication' can also be a valuable lens for studying how technology mediates moral exchanges between different social settings (cf. Verbeek, 2008); thanks to one of our reviewers for helping us see this connection.

7. While AV1 stands out as a particularly 'individualized' technology, similar dynamics are evident whenever more 'generalized' communication technologies are used for individualized purposes. For instance, if a son wants to communicate with his mother, and the mother only has a landline phone, the son is uniquely dependent on the landline phone being 'tamed' in order for the two to communicate remotely.

8. There are some interesting affinities between our concept of 'multi-site domestication' and Marcus' (1995) concept of 'multi-sited ethnography', including an empirical interest in increased global interconnectedness and a methodological insistence on following people and technologies across physically disparate locations. However, Marcus' approach comes with a series of ontological and epistemological commitments that do not have to be adopted for researchers to explore multi-site domestication; our concept of 'multi-site domestication' is more of a guiding framework, and thus open to and compatible with a series of ontological and epistemological stances.

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Data availability statement

The participants of this study did not give written consent for their data to be shared publicly, so supporting data is not available.

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