

Doing Routine Maintenance:
Families Designing for Learning at Home with New Media and Technology

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Abstract

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Home is a vital setting for children learning in the context of everyday routines of family life. As technological developments create new opportunities for children to make use of domestic spaces and materials, families must reconfigure their homes, learning, and busy schedules. This dissertation examines ethnographically how families are designing for learning at home given the wide use of mobile technology and new media. Findings show how, through their daily activities and interactions with each other and material resources, families are continuously improvising with tools they have on hand and new ones that become available. Families perform routine maintenance through a number of different sociotechnical practices: media multi-tasking; invisible homemaking; and re-newing learning. These design strategies enable families to make sense of technological change in ways that maintain familiar activities and valued practices.

To Grandma Naomi
and John and Cary McMahon,
bookends to my intergenerational learning at home

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CHAPTER 1: INTRODUCTION

Families as Everyday Designers of Home Learning Environments

“When we were packing up our house to move here three months ago, we sold our TV. Since we got here, the boys have not seemed to miss watching TV, so I’m considering not getting a new one at all!”

-- *Mrs. Yu, mother of Mark and Brad*

This statement presents a number of compelling questions about the current state of technology use in the lives of American families. For one, it challenges assumptions about the convergence of technological practices around screens or the ubiquity of common forms of media in children’s lives (Jenkins, 2006; Jenkins, Ito & boyd, 2016). For another, it points to the reciprocal nature of raising children; children’s own actions influence how their caregivers guide their development or organize learning environments (Rogoff, 2003). Finally, it suggests that while families face many choices about how to support or structure children’s media engagement (Takeuchi & Stevens, 2011), these are also partly *design decisions*. That is, they are questions about how homes get designed and what contributes to families making home environments feel like home to them and to children when it comes to media and technology (Pink, 2004, 2012). This study considers these related questions.

Today, the possibilities for children’s media engagement are rapidly expanding, presenting new opportunities for families to decide what are good ways (for them) of using technology to pursue learning at home (Levinson, Siyahhan, Pressey & Taylor, 2015). In other words, what kinds of materials and activities belong at home, and how should they be arranged to support daily life? These questions are not new, but they are reanimated as more families are using more kinds of media (Rideout & Katz, 2016) in more of their regular routines (Taylor,

Takeuchi & Stevens, 2018). While anxious questions about children's screen time dovetail with concerns about families' diminishing free time, this has not slowed the near constant influx of new devices and forms of media engagement in homes. As vital sites of learning, home settings present both problems and possibilities for maintaining everyday routines and valued sociotechnical practices (Wacjman, 2015).

The home is the original learning environment for children (Gonzalez, Moll & Amanti, 2005), but little is known about its significance for learning in a networked era. The literature on how parents guide their children's development of valued skills and competencies is robust (Gauvain, 1999; Goodwin & Goodwin, 2013; Harkness & Super, 1996; Lareau, 2011; Mead, 1930; Rogoff, 1990, 2003; Rogoff, Topping, Baker-Sennett & Lacasa, 2002, Whiting & Whiting, 1975). However, today's homes are increasingly saturated with digital technology (Pink & Mackley, 2013), a trend that has yet to translate into a strong body of empirical work in research on learning (Ito, Baumer, Bittanti, boyd, Cody, et al., 2010). Recent studies of modern-day American families (e.g. Ochs & Kremer-Sadlik, 2013) and their home settings have explored cultural shifts in families' daily routines. However, if technology is part of these accounts, it is typically considered as only a peripheral aspect of a larger project (e.g. Arnold, Graesch, Ragazzini & Ochs, 2012; Kremer-Sadlik & Gutiérrez, 2013), not as a central force reorganizing family life (Silvis, Taylor & Stevens, 2018b; Taylor, Silvis & Stevens, 2018). In this dissertation, I consider the home as an important starting point for understanding learning with technology.

Home as a Starting Point for (Studying) Learning

Researchers who study technology and learning at home have described digital media practices as “genres of participation” enacted by children and youth (Ito et al., 2010, p. 14), or have examined the technological fluency they develop with the help of parental “learning

brokers” (Barron, Martin, Takeuchi & Fithian, 2009, p. 67). Such research addresses the importance of home learning ecologies (Barron, 2006; Barron, Martin, Gomez, Pinkard & Austin, 2014) and media ecologies, or “the technological and social context in which young people are consuming, sharing, and producing new media” (Ito et al., 2010, p. 27). The ecological metaphor has been broadly applied in the social sciences (Barker, 1968; Bateson, 1979; Bronfenbrenner, 1979; Gibson, 1986; Ingold, 2000; Pink, 2012); yet, little attention has been paid to describing what makes up the media spaces in homes (Horst, 2010), and less still to what goes into designing them. Thus, while extant literature on media ecologies significantly advances understanding of children’s diverse technological practices by contextualizing them, this presents new questions about *how families design home settings for technology use*.

Drawing on theories of situated learning (Brown, Collins & Duguid, 1989; Lave & Wenger, 1991) many scholars of teaching and learning have emphasized the importance of informal contexts for youth engaging in technology-based activities (Barron, Gomez, Pinkard & Martin, 2014; Livingstone, 1998; Rogoff, Callanan, Gutiérrez & Erickson, 2016; Sefton-Green, 2004). This work contributed to a framework for Connected Learning, which focuses specifically on how technology is involved in bridging the connections or maintaining networks of interest-driven learning between learning environments (Ito, Gutiérrez, Livingstone, Penuel, Rhodes et al., 2013; Barron et al., 2014). According to its developers, connected learning is concerned with three things: digital links between home, school, community, and peer contexts; intergenerational, shared interest; and creating more connections between diverse (i.e. nondominant) youth and opportunities to learn with technology and digital media (Ito et al., 2013). Within this framework, the home is situated as a vital context for learning that is essential for understanding how digital media relates to learning across settings.

Researchers have also addressed how school and home are uniquely connected in terms of youths' emerging sociotechnical practices (Livingstone & Sefton-Green, 2016), orienting studies of home-based learning around its cultural counterpart: school. In a chapter of their recent ethnography of a class of secondary school students, whom they observed at home and school to understand learning through youths' emerging digital networks, Livingstone and Sefton-Green laid the groundwork for more thoroughgoing study of spaces for learning with technology at home. These authors suggest that parents must "construct the home as a new kind of 'learning provider'" (p. 169). Conceptualizing this active role that home environments play in learning aligns with other recent ethnographers of family life who observed that "home was not just the backdrop of family relationships and events; it was a central protagonist" (Ochs & Kremer-Sadlick, 2013, p. 8).

Still others have studied learning with technology at home at the scale of the room and in the context of shared activity systems. Such an approach orients the phenomenon of interest around a particular form of media or technological activity, such as video games (Stevens, Satwicz & McCarthy, 2008) or TV (Mehus & Stevens, 2011). A recent initiative aimed at studying media co-viewing in American homes looked at the (re)configuring of parents' and children's interactions with digital media and technology at home, with an emphasis on changing TV viewing practices (Takeuchi & Stevens, 2011). An important contribution of such work is the concept of joint media engagement (JME), or the "the variety of *spontaneous and designed experiences* of people using media together" [emphasis added] (ibid, p. 7). A related study of video game play analyzed how the material resources enrolled into game play, strategic arrangements of people, and even the ambient space of the room in which games were played all contributed to the ecology of in-room media engagement (Stevens et al., 2008).

In general, the available accounts of young people learning with technology at home could be characterized as media-centric (Pink, Horst, Postill, Hjorth, Lewis, et al, 2016) in that they position mobile phones (Horst & Miller, 2005), TV (Mehus & Stevens, 2011), or video games (Stevens et al., 2008) as explicit objects of analysis, orienting perspectives on families' practices around specific media or devices as opposed to asking more broadly how "media play a role in this everydayness" (Pink & Mackley, 2013, p. 685). What we do not yet have literature on is *non* media-centric approaches to the home as a place of learning with technology that emphasize how the planned, though sometimes impermanent, arrangements of media and technology emerge as spaces or sites for learning. Therefore, while we have good models for how research on home technology use can be designed (e.g. Takeuchi & Stevens, 2011, Horst, 2010; Livingstone, 1998) there is still a gap in how researchers approach diverse material arrangements of homes. This gap demands closer attention to the roles of parents and families in making the home a place where children's everyday routines are simultaneously "situated in" and "saturated by" digital media and technology (Pink & Mackley, 2013, p. 678).

When parents' choices and perceptions regarding children's technology use have been studied, this work has primarily focused on parents as gatekeepers of technology (Barron et al., 2009) or as consumers (and sometimes producers) of media content (Papert, 1996; Rideout & Katz, 2016). Positioning parents as arbiters of technology can end up "reproducing generational divides" (Jenkins et al., 2016, p. 50) or inadvertently fueling anxieties about technology's potentially negative consequences for young people's lifestyles (e.g. Pea, Nass, Meheula, Rance, Kumar et al., 2012; Turkle, 2011; Twenge, 2017). Such assumptions have their roots partly in the TV wars of the 1950s (Livingstone, 1998; Spigel, 1992), but are currently inflected with new concerns ushered in by children's pervasive use of the internet for everything from writing

research papers or chatting with friends (Ito et al., 2010) to producing their own content and media platforms (Barron et al., 2014; Jenkins et al., 2016). As the opening quote suggests- and the connected learning framework clearly articulated (Ito et al., 2013)- these historical issues, though unresolved, take on new salience given our emerging home media ecologies, the intergenerational nature of digitally mediated interests, and new opportunities available (often inequitably) to today's learners.

Repositioning Families as Designers

Previous studies of parents' attitudes about technology (e.g. Barron et al., 2009) have generally drawn on interview and survey data, rather than ethnographic observations of families' "daily media rounds" (Taylor, Takeuchi & Stevens, 2018, p. 2). There are scant observational studies of how families organize media engagement (Barron, 2006), though researchers are beginning to provide descriptive, design-oriented accounts of families and technology. In a casebook created in the Families and Media project, Levinson and colleagues (2015) drew on families' heterogeneous, multi-sited, multi-media practices to imagine designing for learning that is relevant to diverse families and addresses their needs in a digital age. One of the objectives of this work was to offer ideas to families, who "want to know more about how to use media to support their children's learning" (p. 8). Such work advances research on families' media engagement and fills an important gap in culturally relevant media practices, but attends more closely to how families (or learning designers) might implement others' designs than the nature of the sociotechnical processes or design thinking underlying families' domestic technology use.

Research has yet to position *families as designers* of the technologically mediated spaces and everyday routines in their own homes. Even though parents are the primary purveyors of technology (Barron et al., 2009; Rideout & Katz, 2016), furniture and fixtures (Arnold, 2013;

Livingstone & Sefton-Green, 2016), and media (Horst, 2010) that support digital literacies, we do not yet have a body of literature that elaborates how specific design choices families make are then taken up (or not) by children. The shift in thinking about parents as transmitters of technical expertise to parents as designers of spaces where technology is embedded in routine activity, tracks with a similar shift in research on designing with families in informal learning contexts like libraries and makerspaces (e.g. Tzou et al., 2019). Whereas other learning designs have created activities and projects for families to engage together with technology, researchers are now considering how co-designing with families opens up learning opportunities that are more equitable, sustainable, and meaningful within local community sites.

This perspective on designing technological spaces for learning contrasts sharply with conventional approaches in the field of designing learning technologies (e.g. DiGiano, Goldman & Chorost, 2009; McQuiggan, McQuiggan, Sabourin & Shores, 2015) and children's learning materials more broadly (Ogata, 2013). Engineers and designers who imagine parents and children simply need the "right tool" to automate their everyday activities at home have missed opportunities to factor in parents' (and children's) creative agencies in designing learning environments. For example, the uptake of smart homes (Strengers, 2016) hinges on uploading a large-scale infrastructure (Star & Ruhleder, 1996) into the home that is ready-made for families' activities. However, as designers of domestic spaces, families are adept at finding things ready-to-hand (Swan, Taylor & Harper, 2008) and arranging these materials for learning. *This study takes families' design choices-rather than those of professional software designers, researchers, game creators, TV producers, or teachers- as the starting point for understanding children's learning with technology.* This approach decenters anxieties about purchasing the latest, greatest

learning tool (Rideout & Katz, 2016) or limiting children's screen time and instead redistributes families' everyday agencies across quotidian arrangements at home.

Locating Children's Sociotechnical Practices in Everyday Routines

In this study I attended closely to the material organization of media ecologies (Arnold et al., 2012; Pink, Ardèvol & Lanzeni, 2016). This meant situating family life as a substrate of learning and social activity, that is, seeing everyday routines as being constructed over space and time and analyzing learning as sedimented in ongoing, collaborative activities (Goodwin, 2018). Mapping families' design choices and children's media engagement onto the home environment localized learning in concrete, everyday practices. This approach followed a tradition of conceptualizing people's everyday routines as rich sites for learning (e.g. Lave, Murtaugh & de la Rocha, 1984) and for its digital re-mediation (Cole & Griffith, 1983; Taylor, Silvis & Stevens, 2018). Taking this perspective enabled me to examine the relationship between (1) families' design thinking, (2) children's emerging digital practices, and (3) dynamic, complex media ecologies. It shed light on important spatial and technological dimensions of the home setting, lending specificity to how the arrangements and movements of people and materials in-room made certain learning opportunities available for children (e.g. Tulbert & Goodwin, 2011). And it provided insights into how everyday sociotechnical practices endure through time, how families made sense of technological changes in ways that still maintained familiar ways of living and learning. I refer to this as families "doing routine maintenance" as they design for learning with technology at home, an idea that I will articulate in the chapters that follow.

Because families play a central role in making home a place for children to meaningfully engage with technology (Barron, 2006; Barron et al., 2009; Livingstone & Sefton-Green, 2016; Ito et al., 2010), it is essential that we begin to conceptualize how families- *as designers*- shape

children's changing relations to sociotechnical systems. This will allow us to learn more about if and how children take up families' design plans to accomplish their own learning objectives, providing potential insights into families' ideas about their homes as sites of learning as well as presenting implications for professional designers. Taking this new perspective is important for continuing to promote children's sense of agency in their own learning designs (e.g. Taylor & Hall, 2013) and to elucidate endogenous theories of learning (Stevens, 2010). In addition, the current study contributes to an understanding of rapidly changing sociotechnical systems (Star, 1991, 1999; Star & Ruhleder, 1996) by focusing on family life as an often invisible site for reconfiguring- and maintaining- such systems. In this dissertation, I take families' design choices as a point of departure for examining children's creative use of technology and new media at home by addressing these questions:

How do families design for learning at home given the wide use of mobile and networked technologies and new media?

What sorts of domestic learning arrangements do families design for?

How do children improvise within these designed spaces of learning to pursue their own objectives or create new opportunities to learn with media and technology?

While today's media practices are certainly a moving target, this does not in any way diminish the value of stopping the clock briefly to take stock of how families are designing for their young children's media engagement. It is arguably *because* of this rapidly shifting learning terrain that studies designed to understand media engagement ought to occur with increasing frequency, if only to update findings that, while compelling, risk obsolescence in the wake of constant technological change. This study advances an understanding of the current significance of technology in children's learning and extends it by asking how families design their activities and arrange for learning with these pressing, practical questions in mind.

In **Chapter 2** I will outline the relevant literature. First, I will synthesize various situative approaches to knowledge, learning, action, and research. Then I discuss sociotechnical theories, defining how I understood media and technology- and their re-mediation- in this study. This leads to a discussion of the home as an important context for studying everyday design and learning, an idea that I frame around STS theories of feminist technoscience.

In **Chapter 3**, I will describe the methods I used in this study. I will first outline my approach to digital ethnography, including some limitations and ethical considerations for conducting video-based research. Then I will provide details about the research design of this study, including the methods of data collection, methods of data analysis, and the participants and settings. I will map different analytic approaches onto the empirical chapters in which they were employed. As an appendix, I provide a summary of each focal child and family as well as a panoramic image of each home.

In **Chapter 4**, I will present empirical findings related to how families design for media multi-tasking, that is, how they manage to collaboratively accomplish many routine activities using multiple tools, people, tasks, and objectives. Families have a number of approaches to multi-tasking, and their designs allow children to learn *through* multi-tasking, learn *to* multi-task, and learn *despite* multi-tasking. These various forms of multi-tasking enable families to maintain multiple interactional floors around the home, an idea that locates designs for media engagement in the moment to moment interactions between family members and material ecologies.

In **Chapter 5**, I will examine how families designed domestic routines to support children's home-work around the house. As I discuss in the preceding chapter, children are responsible for many assigned tasks and chores at home. However, the ways families reorganize these routine tasks with available technology is often invisible. Through microanalysis of

representative moments, I will show how families kept domestic routines humming along as they made home “work” for learning with technology. Here, I highlight how, through the lens of feminist technoscience, we can make visible how children’s media engagement is implicated in maintaining social orders and infrastructures in the everyday context of domestic routines.

In **Chapter 6**, I place a historical lens on common learning activities in these designed spaces of home. Situating everyday routines like reading books, filing information, and practicing music in historical context revealed how families are not so much innovating- in the sense of designing new activities. Rather they are renewing their media practices in improvisational ways with tools at hand. The recycling, remixing, and reassembly characteristic of these new practices challenges the newness of new media and offers renewability as a design practice that families enact. I introduce what I see as the ecological implications of historicizing families’ sociotechnical practices as well as what this might mean for designers.

In **Chapter 7**, I will discuss my overall findings and the implications of a theoretical framework I developed regarding families’ designs and children’s media engagement at home. I suggest that families’ media engagement- the particular forms it took, which, in the empirical chapters, I called *media multi-tasking*, *invisible homemaking*, and *re-newing learning*- reflects how they are designing for “routine maintenance.” As a design principle, routine maintenance is aimed at preserving families’ everyday, collective ways of learning and living together. I unpack what I mean by routine maintenance and how it was made possible by families designing for learning. I end by pointing to implications of designing for routine maintenance in a time of rapid technological change.

CHAPTER 2: CONCEPTUAL FRAMING

Situating Home as a Space for Designing for Learning with Technology

Learning as Situated and Sociotechnical Practice

In this dissertation I take learning to be both a situated and sociotechnical practice (Brown, Collins & Duguid, 1989). According to this view, learning through participation involves tools and artifacts, or “the technologies of everyday practice” (Lave & Wenger, 1991, p. 101), and how they are put to use in a given situation. Since the situated nature of activity is so central to developing fuller understanding of what people know and how they learn, it is worth rehearsing some ways situatedness has been theorized or what Bang (2015) referred to as different “*situative*” perspectives on situated knowledge, action, and learning. These various approaches to situatedness informed my study and also intersect with views on sociotechnical practice. I believe these interrelated perspectives are productive for understanding families’ approaches to designing for learning in a digital age.

To say something is situated opens up questions about how activities are based in dynamic, concrete contexts and are interactionally achieved (Lave et al., 1984; Lave & Wenger, 1991). Situated learning, or the idea that knowledge reflects social and cultural practices that are the accumulated action of prior historical actors, is understood to take place somewhere and to occur in time (Goodwin, 2013). The activities that take place as learners participate in social life involve multiple mediational means, which themselves reflect prior ways of knowing, being, and doing (Vygotsky, 1978; Herrenkohl & Mertl, 2010); prior action is sedimented in material tools and is also the basis upon which people are able to continuously produce shared meanings and

materials, recycling some and improvising with others (Goodwin, 2018; Holland, Lachiotte, Skinner & Carole, 1998).

It follows that not only thinking and knowing, but also *action* is situated, in the sense that actions reflect how people always demonstrate their knowledge in particular material circumstances. As Suchman (2007) put it, “the significance of artifacts and actions, the methods by which their significance is conveyed have a particular relationship to the particular, concrete circumstances” (p. 70). Situative accounts of situated action are perspectival in that they help social scientists understand how knowledge varies by the socially located knower. They help us develop better theories oriented around “learning as a member’s phenomenon” (Sevens, 2010), rather than a god’s eye view of learning that is “from nowhere” (Haraway, 1988).

Contextualizing social life through perspectival accounts is a major contribution of feminist theories of knowledge, which I draw on in this dissertation.

As a key example, Haraway’s (1988) ideas about situated knowledge and gender politics in technoscience dovetailed with contemporaneous theories of situatedness but also departed from these in a significant way. Feminist epistemologies aimed to critique knowledge as simply situated in a neutral context of use unfettered by relations of power. Instead, Haraway presented an argument “for politics and epistemologies of location, positioning, and situating, where partiality and not universality is the condition of being heard to make rational knowledge claims” (p. 195). Situative perspectives like this are crucial for centering the often unseen, everyday knowledge of children and families. Such a recognition of the ideological nature of everyday situations, has invited new methods of situational *analysis*, where the locations, social structures, and dominant discourses shaping knowledge are made an inseparable part of investigating what people know (Clarke, 2005). Taken together, various situative perspectives on the situated nature

of knowledge, action, and research challenged conventional, decontextualized approaches to understanding learning and social life.

In contemporary digital ethnography (the approach I took in this study and which I describe in the next chapter), the situatedness of everyday life references contexts and spaces that emerge from the advent of ubiquitous digital technologies (Pink et al., 2016). It is now no longer sufficient to explain human activity as situated in “a” place, when so much of what constitutes our environment and experiences is distributed across digital and physical spaces. Digital material environments are both the grounds for much of our daily activity and the means of achieving it (Pink, Ardèvol , & Lanzeni, 2016). That is, learning is both situated in and saturated by the digital (Pink & Mackley, 2013), with important implications for understanding people’s sociotechnical practices in and through digitally mediated spaces.

Along with situative perspectives, the current study is framed by sociotechnical accounts of knowledge. The idea that the social and technical orders are entangled unites feminist epistemologies with theories of learning in communities of practice (Star, 1996). In other words, to say that “technologies are skilled practices” (Haraway, 1988, p. 194) introduces the question of just how these skills come to be through technologies. The making of sociotechnical orders, or the mutual ordering of people and tools over time (Ueno, Sawyer & Moro, 2017) requires ongoing study in a digital age. New contexts of family life and everyday learning situations resulting from sociotechnical change are the subject of this dissertation. These “changing social spaces of learning” (Leander, Taylor & Phillips, 2010) brought about through digital practices open up epistemic possibilities, new ways of collaboratively achieving everyday life.

Learning as Digitally Re-mediated and Collaborative

Every day it seems there is a new gadget or app available that potentially changes the nature of everyday practice (and learning). Still, while devices and services fall out of use and others come to take their place, there is often continued coordination between old and new technologies (Stevens, 2000), while new skills are being acquired or infrastructures accommodate new systems. As danah boyd (2014) concluded, this exchange- or trading zone (Vertesi, Ribes, Forlano, Loukissas & Cohn, 2017)- of different media forms does not usher in all new practices as much as it provides new mediums for maintaining social practices over time. The technologies may disappear (or remain in play), but the social practices they reflect and enable are constantly reworked (boyd, 2014). Thus, everyday sites of learning- like family life at home- are set pieces for studying changing relationships between people and technologies during collaborative activity.

With the intense focus on emerging digital spaces for learning, one might ask what the implications are of studying home settings. When so much of kids' media engagement today is digital, why bother examining physical spaces? While one response to this question is empirical- and I address this through analysis in this dissertation- there is a real sense in which everyday activities are still very much mediated by older technologies, not only because such tools are sunk in (Star, 1999; Star & Ruhleder, 1996), embedded in everyday routines, but because they are still serviceable for users (Cole, 2017). Re-mediation involves less a replacement of one tool by another than a reorganization of the underlying activity (Cole & Griffin, 1983) that mixes new technologies with old, transforming everyday practices (i.e. learning). It is this ongoing reorganization that I am studying in this dissertation. Tracing the use of generations of

technologies across generations of people provides insights into how sociotechnical arrangements are jointly achieved through collaborative activity.

Definitions of technology or what counts as media engagement are, to a significant degree, open questions in the chapters that follow. Nonetheless, it is useful to do a bit of definitional ground clearing in order to mark what some common ways of conceptualizing media and technology have been and how I tended to operationalize these terms within collaborative activity. At our initial meetings, when I interviewed children and their parents to establish an understanding of their media engagement and technology use, I provided them with basic (overly simplistic) definitions of these terms to help organize their thinking about how to respond or what to include in (or exclude from) their answers. I defined “media” simply as the content or subject matter that they engage with or consume, such as books or music. By “technology,” I explained, I was more interested in knowing about the hardware or devices they used, such as TVs or smart phones. Of course, things are more complex than this, but as a heuristic, this framing allowed children to organize their responses about the kinds of media they engaged with and how (i.e. using what technological means).

The difficulties of defining or differentiating media/ technology, sign/ tool, or semiotic/ material means of mediations are well theorized (e.g. Cole, 1996; Latour, 1999; Volosinov, 1973, Vygotsky, 1978). In the field of media studies, McLuhan’s (1964) oft quoted principle “the medium is the message” captures this complexity. That media and technology are now constructed of digital materials, makes it all the more challenging to bracket media from the devices that they are “in.” For analytic purposes, I ascribe to a definition that differentiates media as material tool (i.e. the medium of photography) from media as “social practices that makes use of a range of different materials and means” (Henning, 2007, p. 50). As an example, according to

how I am treating or defining media, writing itself is not so much a tool or medium, as a social practice that makes use of different sorts of historically constructed, material means of mediation for making inscriptions. Consequently, when children reported that they enjoyed engaging with media like video games, books, or music, I took those media to represent complex sociotechnical practices and analyzed the material means of mediation underlying these practices.

I took the material means of mediation of such sociotechnical practice as the “technologies” under investigation. Like media, the term technology has its definitional complexities. The history of technology is long, an obvious historical point that is easy to overlook in a computer-driven technological age (Cole, 1996; 2017). Technological objects have heterogeneous histories (Acland, 2007; Daston, 2000; Gitleman, 2006). Look far enough back into the history of any new technological form, and things quickly start to look old (Edgerton, 2007). Of course this is a matter of perspective, and sociotechnical theories are sensitive to the social construction of binary technological categories like digital/analog or old/new (Wacjman, 2015). In addition, there is growing recognition that received versions of sociocultural theory have erased or misrepresented views of history and of technology originating outside Western thought (Barajas-Lopez & Bang, 2018; Mavungha, 2014). Intellectual debates about a search for technological origins or history’s periodicity are intensified by the emergence of “new” media or digital technology, the status of which is an object of analysis in Chapter 6.

Still, media engagement in emerging media ecologies reflects reconfigurations stemming from changing means of mediation. Looking across forms of collaborative activity, it is difficult to deny that, as ubiquitous cultural artifacts supporting accumulated and sedimented prior action, *screens* have significantly changed how people work together on a range of everyday tasks. One such pattern is joint media engagement, a way of understanding how digital media (like TV)

support collaborations and shared sensemaking (Takeuchi & Stevens, 2011). An important finding of this work was that, rather than disruptions of families' valued everyday routines, mundane media engagement was constitutive of families' learning together and served as a vital source of talk and meaningful interactions. As generations of families gathered around the TV set to engage in watching a show together, they were sharing in an important form of cultural sensemaking (Spigel, 1992). But as screens proliferate in homes and everyday settings, it is important to ask how such collaborations are changing or how JME is being actively reorganized.

Today's heterogeneous media ecologies require elaborating how multiple media are often mixed together in collaborative activity as well as how multiple tasks are maintained and coordinated by co-participants as they engage with media and technology (Lin et al., 2016). Stevens (2000) found that tasks that utilized screen-based media and paper-based media were often deconstructed by participants to reveal multiple subtasks accomplished individually and then jointly articulated across media. This work process, which Stevens called "co-articulation," draws together individuals' tools and labor to jointly achieve the overall task. Recently, Mejía-Arauz and colleagues (2018) have examined collaborative learning at home, distinguishing between task objectives that are met through negotiation, completed individually and then combined together, and those achieved collaboratively, through joint synchronous activity. This work points to how families' collaborative activities frequently exhibit multi-tasking during culturally valued routines like cleaning, cooking, caregiving, or conversing. In Chapter 4, I analyze media multi-tasking as an emerging form of computer-mediated collaborative learning.

Some researchers who focus closely on the interactional dynamics of families' routine activity have characterized collaborative activities as ways of "choreographing attention"

(Tulbert & Goodwin, 2011). Choreographing attention is important for maintaining the focus of a task or conversation and is a cornerstone of interactional and conversational repertoires (Erickson, 1982; Goffman, 1964). Keeping interactions and collaborative tasks on track requires “mutual monitoring,” as people establish shared understanding of “a single, albeit moving, focus of visual and cognitive attention” (Goffman, 1964, p. 134). Whereas orthodox JME and mutual monitoring assumed a single screen or focus of attention, placing *multiple* screens (and an array of non-screen-based media) in the hands and fields of view now presents new questions about the re-mediation of collaborative activity. In Chapter 4, I illustrate how families are practiced at choreographing attention through their learning designs, and how their approaches involve multiple modalities and material means (Tulbert & Goodwin, 2013; Goodwin & Cekaite, 2018; Goodwin, 2013, 2018).

Studying Everyday Learning Design at Home

Homes have long served as important settings for studying everyday learning and development (Rogoff et al., 2016) (e.g. Erickson, 1982, 2004; Gonzales, Moll & Amanti, 2005; Heath, 2012; Ochs & Kremer-Sadlick, 2013; Rogoff, 1993; Rogoff, Topping, Baker-Sennett & Lacasa, 2002). Recently, this interest in the home as a site of learning research has turned to new media and technology as a focus of analysis (e.g. Barron et al., 2009; Ito et al., 2010; Livingstone & Sefton Green, 2016; Levinson et al., 2015; Taylor, Silvis & Stevens, 2018). Incorporating studies of technology into studies of family life brings attention to how homes are often cherished places (Csikszentmihalyi, 1991) where young people can pursue their own interests with a variety of new media (Ito et al., 2010). Homes are mundane sites for everyday interactions where quotidian materials- like paper lists, books and comics, trading cards, and televised cartoons- are still very much in play (Swan, Taylor & Harper, 2008). Accounting for

heterogeneous technologies in the context of families' everyday learning designs is one focus of this study.

Long before the advent of ubiquitous mobile devices and smart technologies, homes have also been popular settings for studying *design* (e.g. Cowan, 1983; Csikszentmihalyi, 1991; Maldonado, 1991; Murphy, 2015; Ogata, 2013; Pink, Ardèvol & Lanzeni, 2016; Shove et al., 2007). Domestic activities associated with daily life- such as cleaning, recreating, preparing and consuming food, using household appliances- have been the subject of recent studies of design and continue to be grist for the mill of an emerging design anthropology. Perhaps this affinity between design and domestic studies is not surprising given that architecture has long been considered a paradigmatic design field (Margolin, 2002), and residential architecture continues to shape design thinking (Krampen, 1989). Studies of interior design (e.g. Ogata, 2013) and DIY design projects (e.g. Shove et al., 2007) also contribute to the home becoming an important setting for the study of everyday design. But what is the nature of families' designs?

In approaching this question empirically, I am guided by recent reorientations in design theory towards designing as user-centered (Binder, De Michelis, Ehn, Jacucci, Linde & Wagner, 2011), continually reshaped through situated actions (Suchman, 2007), sensitive to social complexity (Norman, 2011), and often improvisatory (Gatt & Ingold, 2013). The notion of improvisation is key to reconfiguring the field of design and a critical mode of action for users and designers alike. Ingold (2012) asked, "How can designers move from devising solutions that constrain practitioners to play by their own rules, to a position in which these rules are open to negotiation, and in which the *improvisatory interventions of practitioners* present an opportunity rather than a threat?" [emphasis added] (p. 32). This is a radically different way of conceptualizing interventions than that under which designers have historically operated, which

offers a view of “user-producers,” as potential “designers and makers in their own right” (p. 32).

Design is baked into everyday human activity. According to Gatt and Ingold (2013),

far from being the exclusive preserve of a class of professional experts tasked with the production of futures for the rest of us to consume, [design] is an aspect of everything we do, insofar as our actions are guided by hopes, dreams and promises (p. 144).

In analyzing families’ approaches to design in this study, I examined ethnographically how the improvisatory activity of design is distributed across media ecologies.

Proponents of design anthropology, or anthropology “of, with, and for design” (Gunn & Donovan, 2012, p. 9) argue that anthropology and design have much to learn from each other. Describing the emerging field of design anthropology as distinct from both studies of material culture and ethnographic market-based research, Gunn and Donovan wrote that “design anthropology is concerned with different ways of designing and different ways of thinking about designing and using” (ibid, p.11). I am situating my study in this emerging field of design anthropology because much can be learned about everyday activities from studying people’s *designerly ways of thinking* (Cross, 2006; Ingold, 2000; Pink, Ardèvol & Lanzeni, 2016; Rabinow & Marcus, 2008). Understanding how parents think about arranging domestic settings and routine activities contributes to more adequate theories of learning in a digital age where families’ sociotechnical practices are vital sites of design.

The embeddedness of technology in domestic infrastructures, from smart homes (Strengers, 2016) to media-saturated living environments (Pink & Mackley, 2013) centers contemporary design studies in the home. Yet not only new media, but entire histories of designed objects are also imbricated in domestic settings. Echoing sociocultural theorists of

learning, media archaeologists put forth that technologies sediment prior activity in material form, making it possible for ideas (and ideologies) to be translated across place and time (Mattern, 2017). What appears to be a new device or innovation, in fact was constituted over time and conceals both a complex process of designing and its own earlier iterations (Latour, 1990). Frequently lost in these translations is any sense of the deep time across which media are constituted by fossils, minerals, and compounds that are embedded, then extracted from the earth and expended through design and mass production of digital technologies (Parikka, 2015).

Moving across scales of human activity, it is also possible to view technological designs as evidence of archaeological change, as human culture being made material in the present, or what archaeologists refer to as the production of “material culture” (Wylie, 2002). In the CELF project, Arnold and colleagues (2013) studied how examining domestic material environments- artefacts of home, furnishings, fixtures, decorative elements, room arrangements- allowed for construction of an archaeological story about family life in contemporary US culture. Part of the work of excavating *contemporary* material culture- as opposed to studying culture from the ruins as archaeologists of antiquity do- is to trace, backwards and forwards in time, the materials that surround people today and that constitute their current practices (Mattern, 2017).

For example, by looking at the design and material organization of people’s kitchen cabinets- the contents, arrangements, consumption, replenishment of goods- Arnold (2013) made inferences about cultural practices such as feeding a family, acquiring food, and even ideals about health and wellbeing operating in a given social group. Studies of material culture, or the ways materials and the built environment embody our social ideas and practices, are one way of exhuming the processes that once were at work in creating any durable cultural form of technology (Latour, 1990). That these sociotechnical processes have distributed work inequitably

and have obscured deep time scales through which they operate are issues I take up in Chapters 5 and 6 respectively.

Theories of design are ultimately theories of materiality that put in relief the dynamic relations between people and designed objects (Norman, 2013; Suchman, 2005, 2007). If, as Latour (1990) famously saw it, “technology is society made durable,” then what of the slippery materialities of *digital* objects? How is it that people collectively locate meanings and stabilize cultural practices in emerging digital spaces when so many of today’s designs are not tangible? Forget to hit save, and your file disappears. Close a window on a screen, and your entire music collection vanishes. Can’t remember your password? There is no metaphorical ribbon around your finger that can reconjure it (although there is always an app for that). These emerging sociotechnical configurations appear to lack materiality (Pink, Ardèvol & Lanzeni, 2016), prompting questions about how everyday practices endure in the first place. It is this deeper question about material means of preserving practices in the midst of technological change- of the relationship between technology, design, everyday routines, and learning- that this dissertation addresses.

Perspectives on Design and Domestic Work from Feminist Technoscience

Recognizing situated knowledges of families, saturated as they have become in new media, demands attention to the unseen sociotechnical processes that make their learning possible, or, as is often the case, that cause trouble (Haraway, 1988; Pink & Mackley, 2013). For example, a family member’s smartphone that fails to find a good signal conceals complex, domestic technical infrastructure that only becomes visible upon breakdown (Star, 1999). Getting this cell phone working again requires work; it is precisely this work of getting routine practices back on track, so that children can participate meaningfully in their media engagement,

that often goes unnoticed (Taylor, Silvis, & Stevens, 2018). In the chapters that follow, I uncover some of these hidden forms of work by analyzing designs that underly everyday routines and fuel learning and living together.

I frame such questions about sociotechnical processes and families' designs around theories of feminist technoscience. There are a number of ways in which my project resonates with such perspectives. For one, domestic work and sociotechnical work are common aspects of a gendered division of labor at home. Like learning, labor is "a political and social force" (Rose, 2004, p. 4). In this dissertation, I align with a view of work that asks about people's ways of purposefully "doing something in the world" (ibid, p. 3), whether these activities are subject to remuneration or are done off the books. I foreground work that is often backgrounded, such as domestic labor, children's homework, and unpaid work of women. Of defining what counts as work, Star & Strauss (1999) wrote that

we know that it is possible to observe another sweat and suffer and not see exertion as work. We know that it is possible to observe no direct physical action, but to have that lack of movement defined as work, and so paid. This shift moves us away from commonsense and often misleading ideas about work as obvious (p. 15).

This shift marks an important move made by feminist technoscience to revalue what counts as work, and as I will argue, what counts as learning.

Researching home as a workplace complicates arbitrary distinctions between so-called routine and knowledge work (Blomberg, Suchman & Trigg, 1997). Part of what is at stake in the mystification of work is that some forms of expertise seem to matter more than others. Some work may be extremely vital, and yet go unaccounted or undocumented. For example, in the

context of studying hotel housekeepers' work experiences, Brody (2016) commented that "housekeeping, as an operation, is a designed, labor-intensive activity," suggesting the kind of expertise required for the job. As another example, in her study of Black domestic workers in the 1980s, Rollins (1985), exposed how housekeeping knowledge is systematically erased from accounts of legitimate work, while domestic workers themselves are rendered invisible and dehumanized as "non-persons" (Goffman, 1959).

Housekeeping or homemaking is being reconfigured through technology, a sociotechnical phenomenon happening in each of the homes we observed in this study and which I examine in Chapter 5. This is a second way my project is informed by feminist technoscience and has to do with the relationship between technology and domestic labor (Cowan, 1983; Wacjman, 2015). Plugging cords into devices and walls, finding chargers, dealing with breakdowns and broken machines, and ubiquitous frustrations related to internet connectivity in homes all require routine maintenance. Despite how prevalent it is, technological maintenance work is often hidden from view or beneath our notice (Graham & Thrift, 2007). Upgrading is downgraded. Backups are backgrounded. Tolmie and colleagues (2007) adopted the term "digital housekeeping" to refer to such backstage sociotechnical practices that take place behind the scenes and upstream of work processes, but are essential to making home "work." They emphasize how these work processes take place at home as often as they do outside of it.

Questions about relations between home, children, parents, and technology are powered, both in the technological and political sense. In the context of the food justice movement, Jurow, Teeters, Shea and Van Steenis (2016) made the point that "what is visible and what is invisible, when, to whom, and why is deeply shaped by issues of power and privilege" (p. 212). Making visible the unseen, forgotten, erased, or disregarded aspects of social life is, therefore, a political

project, something Ahmed (2017) refers to as “doing feminist homework” (p.7). Star (1991, 1996, 1999) and Strauss (Star & Strauss, 1999) often cited the need to surface the invisible work that holds together complex sociotechnical systems- such as caregiving and domestic labor- that is often behind more visible and valued labor, but without which work could not get done. This work takes on new dimensions as the home becomes a critical site for networked technologies and where homemaking can mean making home a particular kind of place that is comfortable, convenient, and conducive to learning (Pink, Hjorth, Horst, Nettheim & Bell, 2017; Pink & Mackley, 2016; Shove, 2003).

Home is not simply a metaphor for feminist thought, it is a literal place, charged with meanings. And yet, these meanings are not all perceptible through talk or even observation of action in homes. Pink and colleagues (2017) suggested how what they call an “atmosphere of home” gets “constituted at the interface between work/home as people work from home, take work home or access work through their mobile media while at home” (p. 9). In related research on household lighting practices, Pink and Mackley (2016) found that people made home “work” using improvisational design strategies. Not only did this literally make work visible by properly illuminating their homes so work could get done. People also made “home” through homemaking. Places for learning are made, not given (Taylor & Phillips, 2017). In addition to serving as a metaphor for feminist thought and an important work site, home is an achievement, and unseen sociotechnical processes contribute significantly to an ongoing social project of assembling family life. The many ways that families design home as a place for learning with new technologies is the subject of this dissertation.

There is a third way in which my project draws on ideas from feminist technoscience. A central concern in the chapters that follow, which has also been a central concern for feminist

theories of technoscience, is the need to un-blackbox the design work that make everyday life possible. According to Suchman (1995), within design contexts,

we are able to effectively ‘black box’ the work of others, not worrying ourselves about just how their work gets done while at the same time being able to depend on and make use of the products of their labors (p. 58).

A study of learning with technology is an ideal place to study these problems, because technologies serve as paradigmatic black boxes in which many forms of invisible work are enshrouded. As relatively durable forms of society’s labor, technologies *themselves* tend to be black boxed; what went into making them (upstream) and how they operate to “raise the world” (downstream) is largely written out of the story (Latour, 1983; Star, 1999). However, as the miniature black boxes we carry around in our pockets fall into disrepair or become obsolete, forgetting the “frozen labor” (Bowker & Star, 1999, p. 135) inscribed in digital devices intensifies ethical concerns associated with invisibility.

Dis-embedding background work is a way of addressing this problem. By documenting and describing people’s taken-for-granted efforts that get relegated to the backstage of work processes, what is invisible can then be recognized (Strauss & Star, 1999). This project is underway in areas of education research, where a renewed interest in invisibility/visibility has led some to critically examine hidden or “shadow work” (Illich, 1981; e.g. Vossoughi, Hooper & Escude, 2016). Surfacing the work of relatively devalued people means listening to and documenting their own accounts of their work...and then naming their work as such (e.g. Jurow et al., 2016). Dis-embedding background work from its larger work processes, however, is not only about making it visible. It is in service of a larger social and political project for

reconceptualizing what counts as valued work or learning, that is, what is consequential for learning (Hall & Jurow, 2015).

This emerging project in the learning sciences is fraught with unanswered questions. Who is invisible and to whom? Who benefits from making work or sociotechnical processes visible? Given concerns about children and families' diminishing online privacy (Livingstone, 2009), might remaining less visible while learning at home be a good thing? As Strauss and Star suggested, perhaps there are invisible costs to *visibility* or very good reasons- from the worker's perspective- why their work should remain in the shadows. With these tradeoffs, comes a recognition that prying open the black box of one technology often reveals another black box concealed within (Latour, 1986, 1987; Star, 1991; Suchman, 1995). Such recursions abound in complex media ecologies. Routine breakdowns- in tasks, conversations, or work processes- often lead to creative troubleshooting (Taylor, Silvis & Stevens, 2018). Just as often, this can lead to more trouble. In this dissertation, in the words of Haraway (1988), I stay with the trouble. I analyze often invisible sociotechnical practices that help organize children's tasks and keep family life humming along despite constant technological change. This involves paying attention to how technologies and domestic routines "work" together when families design for learning at home.

CHAPTER 3: STUDY DESIGN AND METHODS

Digital Ethnography: Learning Across Networked and Emergent Spaces (LANES)

This study emerged from a larger ethnography called Learning across Networked and Emergent Spaces (LANES) (NSF Grant SBE-0354453), developed by Reed Stevens and Katie Headrick Taylor in 2013. Devised to investigate the role of mobile media and technology in reorganizing families' everyday routines (Taylor, Takeuchi & Stevens, 2018), the LANES project was itself part of an even broader multi-sited, multi-year, multi-method consortium aimed at understanding families' changing technology and media engagement, the Families and Media project (FAM). Prior to this collaboration, the LANES study grew out of efforts at the Learning in Informal and Formal Environments (LIFE) Center, where researchers were examining the rich spaces and deep learning that exist outside of formal education settings (i.e. school) and across the lifespan (Banks et al., 2007; Bransford et al., 2005; Stevens, Bransford & Stevens, 2005).

Within the broader research agenda of the LIFE Center, home and family life emerged as one important avenue to explore, especially given what was then and is still now a heightened anxiety around common, yet controversial practices like youth TV watching and video game play. What were the consequences of children engaging with these media for learning in homes and families? And what sorts of activities and arrangements supported children and families to learn from and with each other? Stevens led a number of studies addressing these questions that examined joint media engagement, its contexts, and consequences (Takeuchi & Stevens, 2011). One was a study of everyday mathematics that looked at how families used money and how their financial practices- like saving for college or buying a home- served as a context for consequential learning (Stevens et al., 2006).

Another examined learning across contexts, focusing on how children applied knowledge obtained during a specific practice- TV viewing- to other contexts (Dugan, Stevens & Mehus, 2010; Stevens & Mehus, 2007). Like the JME work more broadly, this study elucidated how interactions that happened between and among family members during TV time can lead to learning and influence other parts of their lives. A related cross-context study of learning in home and preschool focused on how parent-child interactions can support early childhood scientific inquiry (Mehus, Stevens & Grigholm, 2010). Yet another precursor to the LANES study was an investigation of video game play in homes and the significance of this media space for learning. By situating learning across children's interactions in-game, in-room, and in-world while they played video games with their friends and family members, Stevens and colleagues (2008) addressed questions of knowledge transfer. All of these early studies as well as a growing interest in learning across networked and emergent spaces created the conditions for a study of families' uses of mobile technologies and new media around their homes and communities (Leander, Phillips & Taylor, 2010).

In this chapter, I begin by situating the LANES study in the methodological literature on digital ethnography, a contemporary approach to understanding the embeddedness of digital media and technology in everyday life (Pink & Mackley, 2013; Pink, Horst, Postill, Hjorth, Lewis, et al., 2016). Having laid out the methodology, I then critically examine this approach, discussing limitations of video-based methods and ethical considerations for doing ethnography of young people at home. Then I will describe the recruitment and selection of participants; I will point to an appendix that includes a summary of each family and focal child, including panoramas of their home media ecologies. I will explain the LANES study design, outline methods of data collection, and describe the data collected. Next I will describe my analytic

approach and process. Finally, I will map the analytic methods and questions onto the empirical chapters that follow.

Digital Ethnographic Approach and Methods

In the previous chapters I suggested that there was a gap in the literature on young people's changing media engagement that involves families' designs and plans for home technology use. I presented a number of research questions that address our incomplete knowledge of families' everyday sociotechnical arrangements that concern (a) how families design home environments for learning at home, (b) what learning arrangements look like in home settings that are being reconfigured by the digital, and (c) how children improvise within these changing spaces to pursue their interests with technology and new media. Because I am positioning families as designers, I then looked across literature on design theory to surface key concepts that are pertinent to theories of learning. I elaborated how ideas from design intersect with notions of learning, and I emphasized the role of everyday routines in conceptualizing young people's changing media practices. And because I am considering how families are designing from feminist perspectives on technoscience, I framed the study around how technologies and sociotechnical practices both reorganize family life and maintain entrenched (often invisible) aspects of social orders.

To approach the questions outlined in Chapter 1 and building from the conceptual groundwork laid in Chapter 2, I conducted a digital ethnography of young people in their homes. Digital ethnography represents a contemporary approach to studies of young people's new media practices that is uniquely attuned to the ubiquitous role of technology in everyday life. The purpose of a digital ethnography is less to focus explicitly on the social significance of a single device or media form (i.e. tablet computers or the latest video game) and more to orient the

ethnographic lens towards what is *technological* about how research participants are going about their everyday activities (Pink, Horst, Postill, Hjorth, Lewis, et al., 2016). This approach does not diminish the continued importance of *nondigital* media nor preclude a perspective on how unplugged technologies might persist, even in the midst of intensified reliance on digital forms (Stevens, 2000). In fact, many digital ethnographers are sensitive to the continued interplay between analog (paper-based) and digital technologies (e.g. Sellen & Harper, 2007). Reflecting the heightened attention to digital technology in everyday life, digital ethnography attends to how media saturate contexts and social practices (like learning) (Pink & Mackley, 2013).

While digital ethnographic methods of inquiry into learning- and attending theories (Hall, 2000)- can arguably be traced back several decades to the advent of video technologies (Erickson, 2011; Goldman-Segall, 1998), the approach is most closely associated with studies of ubiquitous, wireless technologies introduced by the widespread use of smartphones and mobile devices (e.g. Ito, Okabe & Matsuda, 2005). In *Digital Ethnography: Principles and Practices*, Pink and colleagues (2016) present a collection of case studies that describe how technologically mediated activities are organized around digital experiences, practices, things, relationships, social worlds, localities, and events. *Digital Ethnography* is less a handbook than a theoretical toolkit for methodologists, which articulates perspectives on methods in changing technological times. Pink and colleagues (ibid.) explain how this new method, “explores the consequences of the presence of digital media in shaping the techniques and processes through which we practice ethnography, and accounts for how the digital, methodological, practical and theoretical dimension of ethnographic research are increasingly intertwined” (p. 1).

Digital ethnographies recognize a productive tension across scales of interaction and technological mediation; such studies account for the inextricable interplay between digital

methods researchers *employ* and digital worlds they attempt to *describe*. The implication of this methodological move is twofold: on the one hand, there is increasingly little human activity today devoid of the digital (Parikka, 2017); on the other, it is virtually impossible, in the current moment, to conduct ethnographic research without reflexively acknowledging the imbrication of digital technologies in our empirical work (Pink, 2015). This entanglement bears significantly on my study, because, as I will describe in the limitations section, I studied young people's technological practices and media engagement using my own technological practices and methods (e.g. video recording; extensive use of software in postproduction and analysis; wearable action cameras complete with real-time remote viewing capability; interviewing via smartphones, etc.).

Digital ethnography traces the entanglements of the digital and material, of methods and objects of study, and of social and technical orders. It is, therefore, an appropriate approach to studying sociotechnical practices and media engagement, which are at the center of my dissertation. Another principle of the digital ethnographic approach is attention to the everyday activities of social life (e.g. Pink, 2012), something I discussed at length in the previous chapter. Orientation to the everyday is certainly not new, and has long been an organizing idea for building social theory (e.g. de Certeau, 1984). What has changed is how technology has insinuated itself into social life in such a way that it is now part of the fabric of contemporary experience. As Geertz (1973) famously saw, culture is not based on fixed structures, but on a semiotic web, the weaving of which organizes everyday life (Rabinow & Marcus, 2008). Digital ethnographers today see digital technologies and ubiquitous new media as woven into the same social fabric (Pink, 2012; Pink & Mackley, 2013; Pink, Mackley, Mitchell, Wilson, Bhamra, 2016). How this then (re)organizes learning, as a central driver of the social order, is the subject

of this study.

More and more- and whether or not digital technology and media are the focus of inquiry (as they are in my study)- young people's daily rounds (Erickson, 2004) are truly their daily *media* rounds (Taylor, Takeuchi & Stevens, 2018). Digital ethnography represents a contemporary approach to studies of young people's new media practices that is uniquely attuned to the ubiquitous role of technology in everyday life. This is because unplugged methods and research procedures that were once hallmarks of ethnographic studies have themselves gone digital, and even virtual (e.g. boyd, 2014). Therefore, digital ethnography responds to the need for new methods to investigate the new spaces of learning (Leander et al., 2010). However, these new methods are not without limitations and present new (or renewed) ethical considerations for digital ethnographers.

Limitations and Ethical Considerations in Digital Ethnography

As I describe later in this chapter, I used video methods extensively in this study. Digital ethnography fundamentally involves a critical reflexivity engendered by video-based methods. Video-based methods increasingly engage critical theories of visibility (Pink, 2015) and materiality (Pink, Ardèvol & Lanzeni, 2016) emerging from fields such as anthropology (Grasseni, 2009) and science studies (Vertesi, 2015). The researcher herself, no less than the digital tools and media (with which) she studies, is similarly situated in this digital space. That is, through our use of digital methods such as video recordings (e.g. Hall, 2000), netnographies (e.g. boyd, 2014), or experimental visual methods (e.g. Kullman, 2015), contemporary ethnographers recognize how our methods are part of the digital worlds we study, or the ethnographic place (Pink; 2012, 2015), which we construct. This recognition reflects a widespread reflexivity that is now endemic to contemporary ethnographic practice (Lave, 2011).

One thing that has changed as digital forms of ethnography become more common and video camera technologies more affordable, is that first person perspective video (FPPV) is now widely used in studies of learning (Umphress & Sherin, 2015). While these technologies give researchers novel insights into the embodied perspective of learners “on-the-move” (Taylor, 2017; Taylor & Hall, 2013), they still do not provide unmediated view of what our participants know and can do. New methods like FPPV may improve our vantage point for seeing what people are viewing on screens, but they also present new challenges for understanding what action camera wearers might be looking at, not to mention how they are making sense of what is happening or available around them (Taylor, Silvis & Bell, 2018). Therefore, while I used action cameras with children in this study, I remained critical about what new ways of seeing learning from endogenous perspectives also conceals about how learning takes place (Stevens, 2010). In addition to these epistemological tradeoffs, I also recognize ethical issues in using camera technologies that are mounted on learners’ bodies, a set of dilemmas that others in the field have critically engaged (Pink, 2015 Vossoughi et al., 2016; Taylor, Silvis & Bell, 2018). Questions about privacy and ownership of such data are important, as are the personal, intimate questions of asking children to use their bodies as a sort of technology for research, given the power dynamics that might be in play between children, parents, and researchers.

A couple of examples may serve instructive for understanding how I navigated these tensions. For all children, I made the use or wearing of action cameras optional; if they did choose to don a camera during observations, they could wear a head harness, which was worn like a cap, or a chest harness that was worn like a backpack that strapped in front. Many children were happy- and even excited- to wear cameras in these ways (this incidentally created an interesting subset of data related to how children interacted with the GoPros™, which, for some,

were novel technologies). One nine-year-old boy, whose brother wore a chest-mounted GoPro™ while he played video games on his tablet, was opposed to wearing one while he played his own video games in the other room; he said it did not feel comfortable, that the camera “didn’t feel good.” Because he *did* want me to see the games he was playing (all children tended to enjoy having their gameplay recorded and observed), he agreed to have the action camera positioned on the back of the couch, close to his players-eye view, but not tethered to his body.

Another interesting example of supporting children’s agency within the methodological design of the study involved the *uses* of the video data, or where these data might travel after the study was complete. Only one child withheld partial consent for future use of video data (she agreed I could analyze the data and share it within our research group, but she did not want it shown at conferences). When pressed by her parents about this, she expressed concern about not knowing who might chance to witness her in the video down the road, perhaps a teacher or professor in her future academic career (when she graduated from high school, she wanted to pursue a degree in the sciences at our university). Of course, I wholeheartedly supported this decision, though her parents tried to talk her into giving full permission. Later at a subsequent visit, her parents privately shared with me that, in hindsight, they were pleased that their daughter was developing what they perceived as a healthy skepticism about data privacy and thoughtfulness about protecting her identity across digital contexts.

My methods of inquiry became part of the very media ecologies I was studying in ways that were sometimes difficult to disentangle in analysis. For example, during one home observation, a nine-year-old girl became preoccupied with the battery life of the small GoPro™ camera that I had positioned on a dresser in her room, periodically checking on the battery bar and calling out updates to me throughout the observation; she even developed a working theory

of how adjusting the camera's settings could potentially preserve battery life, bringing other devices into her room for comparison, to test her hypothesis. *My* camera became a significant part of how she constructed *her* media space, and her ideas about how (and which) technologies worked there. My own technology's presence in the ethnographic place of homes does not factor into my substantive analysis in the findings I present in this dissertation; in other words, I did not ask explicit analytic questions about camera technologies and children's interactions with them. However, there are likely further analyses of the GoPro™ footage that would yield interesting methodological findings related to the role of digital youth in doing digital ethnography.

I now turn to the study design, where I will describe the different types of data collected in more detail. In closing, a major consideration for doing research like this that is largely based in video data and located in people's private homes, is the need to continuously interrogate digital technologies' epistemological, ethical, and ideological implications. Critically reflecting on the interplay of digital ethnographer and the media ecologies we study will likely become even more salient in the future, as new research technologies emerge- and constitute- ethnographic places. Furthermore, as more and more video produced by young people becomes available in the public domain, it is critical to continue to question how we treat video collected in private spaces like homes.

LANES Study Design

Phase 1 and Phase 2

The LANES project was designed as an ethnography of family life and media engagement. The study was conceptualized as addressing questions of mobility and redistribution of routine activity in light of rapid uptake of mobile technologies (Taylor, Takeuchi & Stevens, 2018). It was divided into two phases, representing two geographic

locations and data sub-sets. Phase 1 began in the fall of 2013 in Chicago, IL. Supervised by Reed Stevens, Katie Headrick Taylor (then a postdoc) and Dionne Champion (then a graduate student) recruited ten families to the study, seven of which (nine focal children) contribute to data in the present analysis. Data collection in Phase 1 took place over a period of eight months. In the spring of 2015, Taylor moved the project to Seattle, and hired me as her research assistant. After analyzing the Phase 1 data corpus in the fall of that year, I initiated Phase 2 of the recruitment and field work under her supervision. In spring of 2016, I recruited six families and conducted data collection with nine more focal children through fall of that year.

Recruitment, selection, and description of families

Phase I families were recruited to the LANES project by Taylor, who publicized the study using fliers and by word of mouth. The majority of participants found the flier or heard about the project at the Northwestern University neighborhood YMCA. Interested families contacted Taylor and were enrolled in the study beginning in fall of 2013. Phase I families participated in the study beginning in the fall and continuing through the following summer of 2014. After helping to analyze Taylor's LANES Phase I data in the fall of 2014, I submitted a new Human Subjects application to continue the study at UW. I then recruited the families for Phase I beginning in the early spring of 2015, again using a flier that advertised the project.

While the questions I pursue in the current study related to families' designs of home settings are new and emerged in Phase II, the underlying ethnographic orientation of the study and the procedures and protocols did not change when the study moved to Seattle. I first attempted to recruit families from local recreation centers and public libraries, but met with institutional barriers to soliciting young people for research from these settings. I recruited two families affiliated with the University of Washington (both parents were graduate students from

the College of Education) and the rest through the Robinson Center for Young Scholars summer enrichment program, with the help of its director Nancy Hertzog. Because of the timing of this program, most of the Phase II families joined the study in the summer; this differed from Phase I, when most families enrolled during the school year. All families were given an Amazon gift card for participating; in addition, focal children received a separate Amazon gift card, as their contributions were particularly valuable.

While recruitment looked slightly different in Phase I than in Phase II, all families in the study shared a number of characteristics. All the children were between the ages of nine to thirteen years old. This is a time when children are interested in using digital technology but may not have yet been formally introduced to it in school (Taylor, Takeuchi & Stevens, 2018), so it is a prime time to examine how young people pursue their own objectives through media engagement. The fact that the study took place in homes facilitated a research focus on discretionary time, though many participants also completed homework or housework or reported doing assigned tasks during experience sampling phone calls. While I anticipated differences in the amount of homework children did at home during the summer versus during the school year (i.e. that kids would have more discretionary time in the summer), what I found was more complicated than this, a broad finding that cuts across the chapters that follow and which is the focus of Chapter 5.

Another criterion for inclusion in the study was that all the children have some self-identified interest in technology. In other words, if parents were interested in participating but their children self-identified as being *disinterested* in technology, then we would not invite them to take part in the study. The nature and intensity of these interests, of course, varied widely across children, as did the diversity of media-based interests held by any one child. However, all

children engaged in some sort of media-based activity during observations, and most participants interacted with a heterogeneous collection of devices and media over any given observation session. Most children had younger (and a few older) siblings present during observations, and a few of these non-focal children were actively engaged in observed activities. While I do not focus on non-focal siblings in analysis, they were important actors in the technology-based tasks and games of their focal siblings, and thus warrant mention here.

Another consistent characteristic across participating families was their location in urban and suburban contexts. No families in rural areas participated in this study, due largely to our recruitment strategies that tended to target neighborhoods around major universities in large metropolitan areas. However, a few of the families lived approximately one hour's drive from the city center or university campus, and young people who lived in these outskirts sometimes referenced their locatedness outside urban centers, especially insofar as this distance restricted access to coveted amenities (such as density of Pokéstops, for kids who played *Pokémon Go*). On the other hand, participants did not all stay in their hometowns during the study, and quite a few took road trips across states or traveled by plane to foreign countries to visit extended family. Mobilities of family life across context and over time provided rich insight into how technologies travel across contexts and how this impacts media engagement (Ito et al., 2013; Leander et al., 2010).

Finally, participants were fairly evenly split along dimensions of geography, gender, age, and sibling status. Half of the children had a sibling in the study, and half participated alone (all but one of these lone participants had a non-focal sibling living at home). Having a sibling was significant because it tended to increase the interactions we observed and the density of technologies available to kids at home. We had equal numbers of children who identified as girls

as boys, and a fairly even distribution of nine year-olds (6), ten year-olds (4), eleven year-olds (3), and twelve year-olds (5). Of the thirteen participating families, just over half identified as White (7), one as Black, one as Latinx, three as Asian, and one as tri-racial (Black, Japanese, and Mexican). Most of the white families lived in the Midwest, while the Northwest was a site of greater racial diversity in our population of families. Appendix A includes a synopsis of each participating family and child (organized by *Phase 1* and *Phase 2*) as well as a panoramic image of their homes or media spaces.

Procedures and data collection



Figure 3.1 LANES study design and methods

For each family in the study, data collection lasted roughly five to six weeks and involved weekly research activities or visits to the home (Figure 3.1). On the first visit, we conducted interviews of both focal children and a parent (typically the mother, though not by design). This interview involved a structured protocol based on a series of questions that addressed the kinds of media/technology children used, where they engaged with these tools, what they did on a typical day, and their parents’ perceptions of- and any rules regarding- their media use. Initial interviews typically lasted thirty minutes per child and another thirty to sixty minutes per parent.

All interviews were audio recorded. After the interviews, we presented participants with a homework assignment: to create (using a template we provided) a map of their homes that depicted different media/technology in the places where one would typically find these items. We called these Home Technology Maps. Drawing maps is a way of making visible how participants planned everyday activities and how such activities were spatiotemporally organized (Silvis, Taylor & Stevens, 2018; Rogoff, 1991). We also asked each parent to complete a national Home Technology Survey, on which they listed the types, numbers, and brands of their families' digital devices and other media and responded to standardized questions about technology/media use.

During the next two visits, which, for continuity, we tried to schedule in the weeks immediately following initial interviews, we conducted video recorded observations of our participants engaged in regular activities around the house. Some participants chose to wear GoPro™ action cameras to record first person perspective video (e.g. Umphress & Sherin, 2015), which is useful for visualizing their endogenous perspectives on learning in a setting or activity (Stevens, 2010). These observations typically lasted one and half to two hours and often took place after school or after summer camp activities. Between observation 1 and observation 2, we took a weeklong break from home visits and conducted nightly experience sampling (Csikszentmihalyi, 1984) in which we called participating children and asked them a brief series of questions about what media they were engaged with or had used during the day. These recorded conversations typically lasted ten to fifteen minutes per call and helped us fill in gaps in what we were able to observe during our visits to their homes. For example, while many participants completed homework during observations, we were often absent for the TV-watching portion of the evening, thus experience sampling gave us information about what

programs or movies they watched, where, and with whom.



Figure 3.2 Summary of data collected in Phase 1 and Phase 2

On the final visit, we facilitated an activity we call Community Technology Mapping (CTM) (Silvis, Taylor & Stevens, 2018). CTM incorporated interactive digital mapping technology (Google Earth™) with a structured interview protocol as a pedagogical tool for young people and a methodological tool for researchers. During CTM, children located the places they tended to go during a typical week, labeled these places and drew pathways between them, and identified places that they perceived as technology hotspots, where they felt particularly engaged with technology and digital media. We then used these maps as prompts for a series of questions we asked as part of the final interviews with children and their parents. The CTM task and subsequent interviews were video recorded, and live mappings were screen recorded. The final visit was also an opportunity to conduct a final interview in which we asked children and parents a series of questions broadly addressing their experiences in the study and any changes in their technological practices or media engagement during their time in the study. Finally, we gauged their interest in participating in follow-up activities and supplementary visits;

all participants expressed interest in this option. A summary of all data collected is included in Figure 3.2.

Data analysis

Interaction analysis and video recording. Through the process of analysis of video and audio recordings (as well as artifacts such as digital and paper-based maps), I built an explanatory framework for families' designing for learning with technology. To analyze video data, I drew on Interaction Analysis (IA), an approach particularly suited to interpreting video data and to answering my research questions. According to Jordan and Henderson (1995), IA is "an interdisciplinary method for the empirical investigation of the interaction of human beings with each other and with objects in their environment" (p. 39). My study paid close attention to interactions between young people and the objects in designed environments, therefore IA provided a set of robust analytic tools for understanding these activity settings (Hall & Stevens, 2016). Home and family life has been an important site for analysts to study social dynamics and interactional formations, and my study drew on this rich ethnographic and analytic tradition (e.g. Erickson, 1983; Goodwin, 2003; Goodwin & Goodwin; 2013; Marin & Bang, 2018; Ochs & Beck, 2013).

Video technology has been critical in developing IA as an analytic method, because video allows for multiple views, for multiple viewers, and for detailed content logging of activity in multiple modalities, not only verbal communication (Jordan & Henderson, 1995). Video-based methods are now common in the learning sciences (Goldman, Pea, Barron & Derry, 2009), in part because these methods draw attention to how knowledge is always embodied and embedded in use or in practice (Hall and Stevens; 2016). Video data, like any other data are not "found" they are created and theory laden (Hall, 2000), and their process of creation involves many hours

of preparatory planning (where to position the camera in homes, how many batteries and chargers to bring on field visits, etc.) and post-production (establishing a file structure and nomenclature, how to compress and convert video files into data available for analysis, etc.). While there is not space here to describe these more mundane methodological considerations, I believe our upstream (typically unseen) data decisions bear significantly on video analysis and shape findings in ways that warrant further study (Silvis, Kalir & Taylor, 2019).

During data analysis, I reviewed recorded interviews, observations, and mapping activities, and content logged, annotated, and time-stamped the content of talk, action, gesture, body movements, and use of materials. Logging over 150 hours of video (including multi-angle views on activity made available through GoPro™ recordings) also yielded approximately 35 analytic memos, where I documented themes and extended analytic notes after ongoing rounds of video viewings. These memos incorporated my fieldnotes, and were the beginnings of what ultimately became the analytic findings. Some memo-ing and logging was highly descriptive, detailing how families were going about mundane moves in-task (i.e. tabbing between windows on a computer, googling some term or topic, or plugging in controllers to play a video game). Other memos and content logs involved description at a higher level of induction (i.e. how families were multi-tasking, how they were navigating technical breakdowns, or how they were prioritizing which device to use). During all these processes of rendering the data, I looked inductively for patterns in families' routine media engagement, in how home settings were designed, and in young people's interest-driven activities with technology.

Unit of analysis. Across viewings, and following Hutchins (1995), I focused on the dynamic system of “person-in-interaction-with-technology” (p. 155) as a unit of analysis, recognizing that “the unit of analysis is defined by the media that are actually in coordination”

(p. 157). As different tools and associated sociotechnical practices became salient (for participants), I adjusted my analysis accordingly to focus on what appeared to be organizing or animating young people's dynamic activities in their homes. As patterns developed, I then also looked deductively for further instances of emerging codes and categories during rounds of open coding. I used constant comparison to iteratively refine codes and categories (Bryant & Charmaz, 2007; Strauss & Corbin, 1994), which took me back to the data for multiple viewings, depending on what emerged from the data. During this step in the analytic process, I asked the central questions: what is this a case of? And how is it different from and related to other cases like it?

I analyzed the Phase 1 data before recruiting families and doing Phase 2 fieldwork. Therefore, preliminary Phase 1 analysis- content logging, memo-ing, visualizing data, thematizing, and writing up findings (see Taylor, Silvis & Stevens, 2018; Silvis et al., 2018a)- served as an organizing perspective or lens on the phenomenon of interest that ultimately emerged in Phase 2. Whereas in Phase 1, we had primarily been focusing on interactions between family members as markers of changing sociotechnical practices and were keyed into mobile technologies as focal objects, my analytic focus in Phase 2 was much more oriented towards the material arrangements and designs of home environments. This shifting analytic focus is common in long term, multi-sited ethnographic engagement in field sites, where the key concerns that seem to be at stake reveal themselves over time as the researcher becomes more familiar with the local environment (Bryant & Charmaz, 2007; Strauss & Corbin, 1994; Tsing, 2015). As an example, after analyzing Phase 1 data, we wrote about how children used technology to connect with family members and friends (Taylor, Silvis & Stevens, 2018). In contrast, in this current analysis my new focus was on the design of activity settings and

spatiotemporal and material reorganization of learning environments. I was especially focused on the ways families' design thinking was concretized in the activities that took place at home.

Developing analytic methods. Reflecting this new analytic lens, I developed a number of novel analytic tools, methods of data visualization that represented the spatial, temporal, and material focus of my questions regarding design. These methods were also a way of recapturing complexity of media ecologies or reanimating the unique spatial and temporal dynamics of video data in order to render ongoing activity and make it available for analysis. The first was the creation of panoramas of each home learning environment, open floor plan, or room where media engagement tended to be centered in each home (e.g. Arnold et al., 2012). I created these by stitching together multi-angle video stills from the video record. The analytic affordance of panoramas was twofold. On the one hand, they represented composite snapshots of the physical environments of homes (furniture, fixtures, décor, devices and peripherals, media, and use of space) that served as a means of addressing analytic questions related to placement, density, and arrangement of objects, or the material culture of home (Graesch, 2009, 2013).

On the other hand, and just as analytically fruitful as *analyzing* them post hoc, *creating* panoramas was an analytic exercise in and of itself. As I searched through the video record locating angles or shots that included all the crevices, corners, and contours of a room, I also sought to eliminate people from the scenes. I did this in order to produce an analytic artifact or data visualization that I could later analyze for how the movement of people and things over time took place against this unpopulated backdrop. However, finding shots without people in them often proved difficult, and as I cropped around a home's inhabitants I gained insight into families' tendencies to be in one room as opposed to another, their preferences for sitting at a desk rather than a couch (or vice versa), and their overall patterns of moving between these

spaces. Room arrangements and objects (and even wall colors) often changed from one observation or one week to the next in a home, and this led me to interrogate how or why these transformations occurred. Far from static instruments, the thirteen panoramas I produced and analyzed were a way of recapturing the ongoing reconfiguring of home environments (see Appendix A).

A second data visualization tool I invented was a method of timelining observations that included still shots of activities and interactions with time stamps. Rather than only documenting activity taking place in the *present*, I also tracked how the ways in which people were talking about or organizing their activities in the present stretched back into the *past* and reached into the *future*. That is, as children went about their daily media rounds, they also explicitly drew on their storied histories with media and technology, on their families sociotechnical histories, and on broader social histories or media biographies in which their activities were embedded (Natale, 2016). Likewise, as they went about their everyday routines with media and technology, children and their families were advancing prospectively towards imagined futures, futures in which media and technology would continue to play a part even as these tools played a part in their real-time, “future-making” (Suchman, 2011, p. 2) in the present. These tangled temporalities, made visible through the method of technology timelining, proved invaluable in understanding the ways families were designing for and making sense of technological change through their sociotechnical practices. This method was especially relevant for analysis in Chapter 6.

A third and related method emerged from creating these timelines, and this reflected a need to historicize sociotechnical practices and technologies in order to make sense of families’ media engagement. I conducted historical analysis of technologies, or media biographies (Natale, 2016), of tools that were important to children, realizing that in order to understand how they

were incorporating novel media into their routines, it was important to locate their everyday sociotechnical practices in a broader historical context. As one example, when the mobile augmented reality game *Pokémon Go* was released during Phase 2 fieldwork, and through my conversations with many children in the study who were longtime Pokémon fans, I recognized a need to understand the history of the genre. Studying the history of Pokémon allowed me to contextualize children's contemporary media engagement with this genre (see Tobin, 2005). Consequently, in Chapter 6, in which I explicitly examined the relation between children's practices and technological change, I conducted media biographies of focal technologies, an analytic practice that has been widely used in media studies and ethnographies of technological practice (e.g. Acland, 2009; Cowan, 1983; Gitelman, 2011)

Identifying categories and representative cases. Returning to the entire corpus after Phase 2 data had been logged, I identified a collection of approximately 30 instances- across both phases- which I analyzed more closely. These cases were selected because they represented times or activities in which interactions with materials or people were dynamic (as opposed to instances where a child read a book on the couch for an hour, but nothing else much happened) or when technology and media were foregrounded as endogenous objects of interest (i.e. I excluded times when children were engaged in non-media-related routines like eating a snack). I then posed analytic questions (related to design of activities, use of technology, and arrangement of learning settings) to these multi-modal transcripts, content logs, and data visualizations I had produced of the focal cases, questions that provide “ways-into-a-tape” (Jordan & Henderson, 1995, p. 57). I describe these questions in more detail at the conclusion of this chapter. During this step of the process, I was also analytically focused on building an explanatory framework for how families were designing for learning at home with media and technology and on grounding

this in the empirical findings that were emerging. Ultimately, I wrote through an argument for a theory I built regarding how families are designing for routine maintenance, based on three central families of findings. These findings constitute the three empirical chapters of this dissertation.

Before articulating this theory but after iterating on ways of organizing and reorganizing findings and framing arguments in a series of conference papers (e.g. Silvis et al., 2018b), I settled on a structure for the patterns the cases represented. I organized families' three top level design approaches and their constitutive sociotechnical practices into three chapters: (1) *media multi-tasking* whereby people learn through multi-tasking, learn to multi-task, and learn despite multi-tasking; (2) *invisible homemaking* by doing digital housekeeping, sound-tracking, and finding mobile work-arounds; and (3) *re-newing learning* through recycling, remixing and reassembling media. Next came the process of narrowing cases further, culling from the video corpus specific video clips or instances- out of hours of observations and many other representative cases- which stood as exemplars of the three key themes and associated practices. At last, within the empirical cases representing these 9 sociotechnical practices, I conducted microanalysis, detailed transcription of the talk, gesture, gaze, coordination of body movements (or lack thereof), uptake of tools, use of space, and other aspects that played into moment-to-moment interactions (e.g. Erickson, 1982; Goodwin & Goodwin, 2013; Tulbert & Goodwin, 2011).

As part of microanalysis, using screen shots, I traced images of the scenes and interactions I described, yielding approximately 20 drawings. In some cases, I traced around or erased from the image objects or elements not relevant to analysis in order to focus the reader's attention on the precise dimensions and dynamics of analytic focus (Goodwin, 2018). As with

the creation of the panoramas (and despite the fact that substantive analysis was complete at the time I rendered these drawings) I found that creating the drawings was also analytically useful; the representational process was yet another way of triangulating the data and testing the analytic power of the finding (i.e. did the image, as I was reproducing it, warrant the argument? did the empirical data illustrated in the representation faithfully evince the finding?). Finally, these drawings had the unintended consequence of masking the identities of participants and their family members, who appear more anonymized in the final, hand-drawn data displays.

Mapping Questions and Analysis onto Analytic Findings

In this chapter, I introduced the approach to doing digital ethnography and explained why it is an appropriate methodology for addressing the kinds of questions I engage in this dissertation, questions related to how families are designing for learning with technology and how technology is embedded in everyday routines around the home, in which learning is situated. I described the study design in terms of methods of data collection and the types of data collected. I explained how families were recruited and provided summaries of participating families in an Appendix. I outlined my analytic process and described new forms of data visualization I created and how they were used. And I described the iterative process of producing analytic findings and developing an analytic framework.

Before turning to what I found, I want to provide a sort of outline that maps my data analysis onto the analytic questions and findings that follow in subsequent chapters. Each of the three major findings represents approaches families had of designing for learning at home, however the underlying sociotechnical practices are different, reflecting distinct categories that emerged from analysis. I found three key approaches to design, which I call media multi-tasking, invisible homemaking, and re-newing learning. Each of these larger design processes can take

multiple forms which were instantiated in families' sociotechnical practices, and I elaborate three of these forms within each key finding. To arrive at these findings, I asked a number of analytic questions that emerged during fieldwork and iteratively throughout the process of analysis.

Recall from Chapter 1, that the very broad question we asked at the start of the LANES study was: *How are new media and mobile technologies transforming families' everyday learning at home?*

As I analyzed Phase 1 data, a new set of overarching research questions emerged about home learning design, which were:

How are families designing for learning at home given the wide use of mobile and networked technologies and new media?

What kinds of learning arrangements do families design for at home?

How do children then improvise within these learning arrangements to pursue their own objectives or find opportunities to learn with technology?

As I iteratively analyzed the corpus, I subjected the data to more specific questions, narrowing the focus of analysis as themes emerged ethnographically (e.g. Tsing, 2015). These research sub-questions, organized by the emerging finding (i.e. chapter) were:

Chapter 4 *Given all there is to do at home, how do families use media and technology when designing for tasks and routines? Whose perspective on tasks is consequential for learning?*

Chapter 5 *What is involved in the upkeep of domestic environments (in) which families design for learning? And how are children, in particular, working to keep learning environments in good condition for learning with technology?*

Chapter 6 *What novel ways do families find or create for learning with media and technology? How are children and families innovating during everyday routines at home?*

In the following three empirical chapters, I will present findings that illustrate how families design through media multi-tasking, invisible homemaking, and re-newing learning. As I will eventually argue in the conclusion, these three approaches to design represent families' ways of

doing “routine maintenance,” that is of stabilizing the sociotechnical order despite the ongoing reorganization of learning at home with technology.

CHAPTER 4: FINDING #1

Families and Media Multi-tasking: Reorganizing Collaborative Learning at Home

On a bright April day, after nine-year-old twins Oscar and Eddie had returned home from school, I interviewed their Mom Steph about her sons' technology routines. After detailing their daily media round (Taylor, Takeuchi & Stevens, 2018), or all the routine places people go and things they do with media and technology, Steph described some of the activities they did as a family on a more infrequent basis. For example, Steph participated in several community organizations, and the twins usually accompanied her when she attended weekly or biweekly meetings. Steph gave the following account of Oscar and Eddie's involvement during such family outings.

If they want to take off the headphones and engage in the dialog at the meeting, they can participate and soak things in. Sometimes in the car on the way home they start to talk about what the adults were discussing. Even though they are on their tablets or with their headphones, they are still soaking in what's going on around them. *They are obviously multi-tasking*, because they will reengage in the conversation [emphasis added].

Later in this chapter I will describe how the twins (and their mom) accomplished such multi-tasking, a phenomenon I observed across all the families I studied. This chapter examines how families' approaches to media engagement allow learners to "soak in what's going on around them" despite multiple demands on their attention. Drawing on three instances of families' media multi-tasking, I take the perspective that multi-tasking is intrinsic to everyday activity, and I elaborate elements of multi-tasking that bear on learning: how tasks involve multiple sub-tasks, multiple tools, multiple purposes, and multiple people. In this chapter I consider how families are mobilizing these elements when they use technology and new media for learning.

Designing for Multi-tasking as a Means of Everyday Learning with New Media

In any given daily round, families must accomplish meal prep and eating, cleanup and chores, commuting, attending school, paid work, homework, community meetings and parties, shopping, sports or music practice, paying bills, worship, play time, pet care, bedtime, and more. The work is never done, and in today's socioeconomic context, families are busier than ever (Ochs & Kremer-Sadlik, 2013). But, as Graesch (2009) suggested, "busier families are not necessarily working harder or longer hours, but instead are having to reconfigure their lives around a growing number of bids for their attention" (p. 86). How is it that families manage to do more in the same amount of time? What are the primary tasks or objectives families try to accomplish? What material and human resources must they assemble to manage it all?

I found that families are commonly multi-tasking during everyday activities in a number of ways that reflect how they use media and technology in their designs for learning. Because family life places multiple demands on time and attention, it is important to ask how multi-tasking animates learning in order to have a fuller understanding of today's media saturated learning environments (Pink & Leder-Mackley, 2013). Whether alone or together (or alone together, as some critics decry, i.e. Turkle, 2011), multi-tasking involves developing new means of organizing learning. Particularly given the density of digital devices and new media in homes, family life is a vital site for this reorganization of people, tools, attention, and work.

Contrary to both Westernized frameworks for single person, single task completion and cognitive perspectives on the negative effects of divided attention (Wood, Zivcakova, Gentile, Archer, DePasquale, et al., 2012), the data that follow present an alternative picture of how families' daily media rounds enable- and demand- layering attention to jointly achieve routine tasks (Bickford, 2017). Rather than simply serving as distractions from or disruptions of ongoing

tasks, multi-tasking catches families up in an interest-driven work flow across the environment, over time, and with diverse collaborators. Often within these layered and technologically mediated interactional spaces, one thing leads to another, and tasks bleed into one another. Ultimately, work gets done, but understanding how this happens requires reconsidering multi-tasking in light of families' changing sociotechnical practices. A revitalized definition of multi-tasking begins to address the evolving dynamics of learning at home.

The literature on multi-tasking has largely centered around cognitive constructions of the phenomenon, and definitions have tended to focus on attention shifting (Rosen, Carrier & Cheever, 2013) or cognitive overload (Andrade, 2010) during dual-task completion, typically studied experimentally. Others have defined multi-tasking as involving the simultaneous, independent completion of discreet, bounded tasks (Lin et al., 2011). As an alternative, I define multi-tasking according to multiple dimensions intrinsic to activity systems (Engeström, 2001). One definition of multi-tasking is that it “refers to the layering of attention among different, immediate contexts” (Bickford, 2017, p. 124). I extend this and analyze multi-tasking across physical *and* virtual contexts, attending to how digital technologies collapse contexts (boyd, 2014), blurring boundaries between immediate and remote task environments. In this chapter, I offer a way of understanding multi-tasking through a number of multiple elements: how tasks fracture into sub-tasks; how multiple tools are used within tasks; how tasks are multi-party or jointly achieved; and how tasks are multi-purpose or have multiple objects-of-activity. This reconceptualization of multi-tasking reflects how families collaboratively organize their everyday routines in complex media ecologies.

Because multi-tasking performance has consistently been found to improve with age, teaching and learning has been a major focus of multi-tasking research (Krampe, Schaefer,

Lindeberger, & Baltes, 2011). And perhaps unsurprisingly, in recent years, given the proliferation of mobile media and screen-based learning designs, there has been renewed interest in *media* multi-tasking research. Recent work has suggested the importance of collaboration in multi-tasking environments (Lin et al., 2016). However, there is still much work needed on how people actually go about media multi-tasking (MMT) together in their everyday lives. What is still missing from the literature on multi-tasking is any substantial qualitative or ethnographic studies of multi-tasking as a member's phenomenon (e.g. Stevens, 2010).

If we want theories of learning that account for the richness of families' home-based activities and the possibilities for transforming knowledge of young children in new media environments, then studying how children's learning involves multi-tasking is important. A few studies have addressed MMT in homes and with families, though reviewing this work leaves the distinct impression that children either *are* primary distractions (for parents) or they are primarily distracted *by* media (Craig & Jenkins, 2016). When children have been the subjects of MMT studies, findings are framed as caveats against distractions in everyday situations like texting while reading (Rosen et al., 2013), using computers in a lecture setting (Hembrooke & Gay, 2003; Wood et al., 2012), or in the context of studying (Pea et al., 2012). As an alternative approach, asking not *whether* people multi-task, nor whether they *should*, but *how* people learn by multi-tasking will help contextualize the powerful role of screen-based technologies in media saturated homes and everyday life. This is the approach that I took in this chapter. By looking across all the many tasks families accomplished in diverse home settings, I found that one way families designed for learning with technology was to engage in media multi-tasking, and I tried to understand how children might be mobilizing different aspects or elements of multi-tasking in their learning at home.

Doing so engaged the critical question of what exactly constitutes a meaningful learning task and who decides this. Viewed in this way, routine tasks are sites of ongoing negotiation in families, where multi-tasking can resolve- or renew- tensions over technology use in assigned tasks or decisions about what are good uses of discretionary time. This view of multi-tasking troubles easy definitions of being “on task” and prompts the question of *whose perspective* on task objectives, strategies, and completion is consequential for a given task. From a learner’s perspective, in what ways is multi-tasking consequential for learning? In this chapter, I address this question, taking multi-tasking as a lens for making visible what is consequential from a learner’s perspective. As the current analysis will show, home is a literally and figuratively a powered place, where decisions about sociotechnical practices are charged and pivot around multiple tools, people, objectives, and tasks.

Analyzing Multi-Tasking as Multiply Configured

The nature of task objectives is a central issue in research on multi-tasking. A single task may achieve multiple aims (Engeström, 2001). Take for example a routine activity like checking email. Because many different topics and tasks sit within different email messages, the objects of the task “checking email” can range from coordinating a meeting with colleagues to getting the latest deals on produce from the local grocery store. Task objectives proliferate in complex media environments, even with a single task. In my analysis in this chapter, I took the nature of the task as an open question, one that depended on analyzing a number of elements of multi-tasked environments.

As an everyday way of accomplishing routine tasks, multi-tasking is comprised of a number of elements. First, multi-tasking is often *multi-tooled*, and in today’s dynamic media ecologies, digital technologies are not the sole means of multi-tasking (e.g. Andrade, 2010). A

surprising amount of paper-based activities persist in homes, and these are interleaved with screen-based activities, a pervasive feature of learning environments that I revisit in Chapter 6. Second, as collaborators draw these materials together in-task, the task itself may splinter into *multiple sub-tasks*. Third, media multi-tasking is a strategy that supports collaborative learning (Lin et al., 2016), and so can be understood as *multi-party*. Finally, when undertaken collaboratively, tasks may serve *multiple purposes* or objectives for different members. Activities that serve one person's objectives may engage someone else in the family for a variety of different reasons, only some of which are shared among collaborators. Even a single task may achieve multiple aims, depending on its point of origin (i.e. who assigned it).

Accordingly, multi-tasking requires establishing and maintaining multiple floors for interaction across physical, virtual, and discursive contexts. Erickson (1982) studied how families manage to maintain topical cohesion, effectively holding a routine like dinner table conversation together despite constraints on attention or topical shifts. In conversation, people sometimes take the floor or hold the floor, allowing interaction analysts to see how the topic of conversation is being negotiated. Because “topics require floors to be in” (Erickson, 1982, p. 47), floor maintenance involves the ongoing interactional work of negotiating what to spend time discussing... or *doing* during daily routines. In the analysis that follows, I extend the floor metaphor to the broader discursive and interactional work of maintaining everyday tasks, and I argue that both topics *and* tasks require floor maintenance. To analyze MMT as a key site for maintaining multiple floors of interaction is to inflect Schultz, Florio and Erickson's (1982) incisive question- where *is* the floor of interaction? - with a new sociotechnical significance. The current analysis addresses this sociotechnical question in home spaces, literally organized across floors as well as rooms, surfaces, and screens.

In order to understand how families' multi-tasking across all these dimensions related to learning, I asked a number of analytic questions: What sorts of tasks take place contemporaneously at home? What tools or materials do people use during these tasks, and who uses them? How are tools-people-and tasks configured during multi-tasking? How do people negotiate multiple objects-of-activity to accomplish shared work? Where is the floor of ongoing interactions in conversation? Where is the floor of the task? What seems to be the focal task, and for whom is this a primary task objective? What other tasks or sub-tasks compete for learners' attention? How do these other tasks arise? Who assigns tasks to children? By analyzing multi-tasking situations across these dimensions, I was trying to understand (1) whose perspective on task objectives, strategies, and completion was consequential for learning and (2) what the relationship was between multi-tasking and learning.

In what follows I present empirical findings for three forms of multi-tasking and explain what this meant for learning, elaborating patterns in families' practices for configuring multiple technologies, tasks, objectives, and people during everyday routines. Within each representative case, I do three things: (1) I provide a descriptive account of "the" task(s) including the setting or what Ingold (1993) called the "taskscape" (p. 153), (2) I highlight one element of multi-tasking that was salient in-task and that made the task multiply configured, and (3) I articulate a relationship between learning and multi-tasking. In the first case, I show how a single device or technology contributes to learning *through* multi-tasking by supporting multiple sub-tasks at once and over time. In the second case, I take a look at how, conversely, multiple tools are often required to accomplish a single task, but this then demands a division of labor that can help children learn *to* multi-task. In the third case, I examine how the complexities of multi-tasking

are multiplied when more people and tasks are in play, and I explain how families' designs for learning skillfully manage these complexities, supporting learning *despite* multi-tasking.

I draw on these findings to argue that families multi-tasking supports- and reflects designs for- learning at home. I discuss how technology contributes to on-going maintenance of multiple tasks at once, though the metaphorical floor of interaction is increasingly virtual, and the interactional work of maintaining multiple floors while multi-tasking is often distributed across time and space online. I highlight the role of background work processes in multi-tasking and point to challenges in distinguishing between primary/central and secondary/background tasks. These challenges call into question easy designation of what a member's perspective on being "on-task" would look like in complex media ecologies. Judgements about which task is central during multi-tasking are always powered and implicate multiple perspectives on what is consequential when children learn through media multi-tasking.

1. Learning *Through* Multi-tasking Using a Single Device

Moving to a new house can reorganize learning, disrupting daily routines or reconfiguring the daily media round. Within such reorganizations of home life, treasured technologies- like smartphones or handheld gaming consoles- can anchor familiar activities. Alternatively, these devices might provide a means of managing multiple, new tasks associated with busy times for families. As an example, ten year-old Katherine, her mother, and her older brother had moved to the Seattle area from Shanghai only three weeks prior to participating in our study. Katherine's father had remained behind in China to run the family business and planned to join them in their new home later that year. Busy preparing to enter new schools a month later, the family was still unpacking, decorating rooms, and ordering living room furniture at the time of my first visit.

A ballet dancer with interests in cooking and writing, Katherine was encouraged to participate in multiple summer camps and enrichment programs as a way of meeting new friends and enjoying her time off before school started. Katherine's summer break had been disrupted by moving homes, but her free time nonetheless remained oriented around her prized possession: a MacBook air. According to her mom, when she was not participating in a summer program, dancing, or making plans to attend her new school in the fall, Katherine was inseparable from this mobile device. Indeed, she relied on the tool for a myriad of activities. During my observations, with few exceptions, Katherine constantly used her laptop to accomplish multiple tasks, often simultaneously. Even when she was engaged in a non-digital activity (e.g. sewing alterations to a swimsuit with needle and thread), her laptop was situated nearby, at the ready.



Figure 4.1 Katherine's makeshift multi-tasking work station in her bedroom.

Probably due to the family's recent arrival, some rooms of the home remained partially unfurnished, so Katherine designed a make-shift work station on the floor in her bedroom: she set up an array of pillows and a backrest to lean against while seated on the floor; she positioned a small area rug to delineate the space; she set up a small fan several feet from her to cool down the work site; she placed accessories like headphones and charger at arm's reach; and, sometimes

she brought snacks or drinks into the space to refuel while she worked (Figure 4.1). Configured around comfort and convenience (Shove, 2003), this makeshift work site made it possible for Katherine to use her laptop for a sustained series of activities, remaining there (despite the oppressive midsummer heat) for hours while she multi-tasked. And because her single device afforded endless possibilities for media engagement, organizing a space for multi-tasking was important to Katherine. Other children in the study arranged *ad hoc* work stations at home, but for Katherine, this task environment supported her to learn through multi-tasking, using a single device.

A single task splinters into multiple sub-tasks

One day, when I joined her in her bedroom work site, Katherine was already busy working on a video she had animated in QuickTime the previous evening. She was uploading it to a site called Magisto.com, that hosts videos for sharing or publishing on social media. While this larger underlying activity progressed in the background, she busied herself with a number of other tasks that emerged as she worked. This is a ubiquitous aspect of new media ecologies, where rabbit holes appear behind every hyperlink, and multiple media constantly compete for our attention (Citton, 2017). Over an hour, and across multiple sub-tasks and platforms, she used her laptop to manage the density of media involved in multi-tasking (Figure 4.2). A timeline of her media engagement on this device illustrates how she tabbed back and forth between active windows, continuously checking the status of uploads, or opening new windows and programs in order to accomplish a task at hand. Her single device was a key means of multi-tasking, especially as a primary task splintered into sub-tasks.

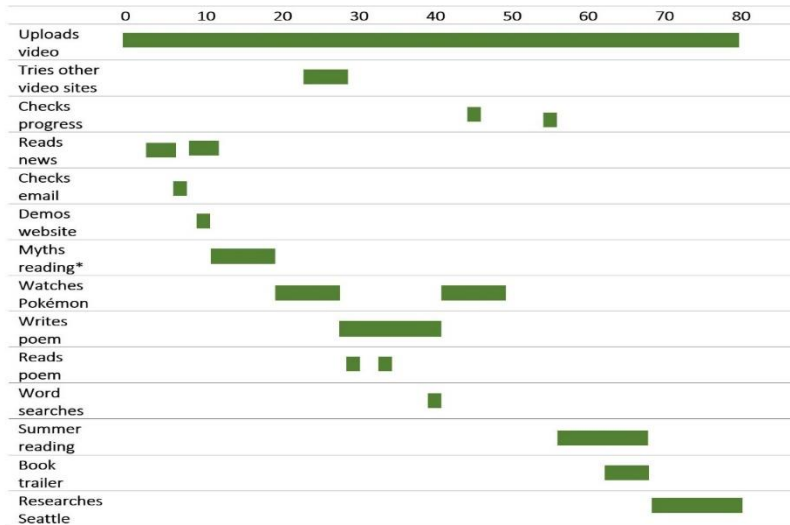


Figure 4.2 Timeline (in minutes) of all the separate, at times overlapping, tasks Katherine engaged in while uploading a video. *With the exception of reading her Mythology packet, all of these tasks utilized her laptop.

After about thirty minutes (and at least seven discreet tasks), Katherine began working on a poem she was writing for one of multiple summer programs she was enrolled in. She explained that she normally would use the program Pages for writing projects like this, but she had already begun the poem in Google Docs, so that she could easily share early drafts with her teacher. A few minutes into her poetry writing, Katherine opened Google Images in a separate tab, something she said she sometimes did “for inspiration.” The poem she drew on was called *Ode to Tears*, and the image depicted the forlorn face of a small child juxtaposed with a heartrending poem.

Katherine tabbed back and forth between this poem and the one she was authoring, and eventually positioned the windows so that she could simultaneously view both on screen. She selected and scanned one or two other poems, as she moved back and forth between the images and her writing. A few moments later, she hit an impasse in her writing and opened up another tab to search on Thesaurus.com, which she identified as her “favorite website.” She scrolled through lists of synonyms and toggled back and forth between her Google doc, where she wrote

a few lines, and the thesaurus, where she referenced word choices. When she encountered a word she was unsure of, she opened up Dictionary.com in yet another tab and looked up the definition.

Her task (i.e. writing a poem) splintered into sub-tasks. This is common in activity systems, where objects-of-activity are continually emerging through evolving action and material transformations (Engeström, 2001). She maintained the unfolding task by arranging- and tabbing back and forth between- multiple tabs for her working poem document with what she called “inspirational” Google images of poems, the thesaurus, and the dictionary websites (Figure 4.3). As the floor of the ongoing activity falls out from under the user, they must configure their media ecologies to manage the multiplying task objectives. Katherine enacted this computer-mediated form of floor maintenance (Erickson, 1982) by reconfiguring her desktop, temporarily stabilizing a task that was splintering into sub-tasks. Behind all of these tabs, the window displaying her Magisto.com video upload remained partially visible; an animated ad on the site flickered in the background, and she checked file progress twice while she wrote the poem. Katherine



Figure 4.3 Reconstruction of Katherine’s single-device multi-tasking. Google Docs, Google Images, Thesaurus.com, Dictionary.com all represent different sub-tasks of writing a poem. Meanwhile, while a video uploads in the background.

transformed the limitations posed by the lagging video upload into an opportunity to learn *through* multi-tasking by writing a poem, itself a multiply sub-tasked activity.

Learning through multi-tasking

Insofar as web-based services embed resources in multiple websites and platforms, they multiply opportunities for learning, while simultaneously collapsing contexts where activities take place (boyd, 2014). Katherine was able to enter many sites of learning from the comfort of a single, personally designed location and with a single, personally meaningful tool. Media multi-tasking mobilizes these emergent learning arrangements, transforming a single device into a means of learning through multi-(web)sited inquiry. These multiple sites also represented multiple sub-tasks comprising the larger task of writing a poem. Because task objectives are moving targets, it is sometimes difficult to determine what activities matter in activity systems (Engeström, 2001). As such, they are differently powered; therefore, prioritizing tasks or assigning them relative importance depends partly on whose perspective is granted more prominence.

On the one hand, sub-tasks multiply what is possible to learn in any given task. One way of understanding what learning through multi-tasking affords is that it increases the density of learning opportunities. On the other hand, many critics of multi-tasking argue that as we open more tabs and more sites compete for our attention, we actually learn less. How do we understand this contradiction in Katherine's case? One way of answering this requires asking what the primary task actually was. Recall that the original task, the one that took place in the background of all the rest, was uploading a video. Had Katherine waited for this task to be completed, she would have wasted an entire hour *doing nothing*. Instead, and like most of us, Katherine used her time judiciously, toggling between tabs while multi-tasking. She arguably

learned much more through multi-tasking than she would have doing one thing at a time. Any assessment of whether learning happens through multi-tasking must, therefore, account for how tasks break down into sub-tasks and what epistemic value there might be in backgrounding some tasks or sub-tasks during complex work processes.

2. Learning *to* Multi-task by Mixing Tools and Balancing Objectives

For Katherine, learning *through* multi-tasking involved pursuing multiple objects of activity on a single device. Conversely, it was often the case for the families we studied, that a single task became a site for learning *to* multi-task across multiple tools and task objectives. In heterogeneous home media ecologies, families have many options for equipping and jointly accomplishing routine tasks. Furthermore, their purposes for performing tasks vary and need to be negotiated amongst people and devices. Multi-tasking becomes necessary when task-objectives diverge, when tools are distributed, or when one person delegates their task to another. However, given the complexity of some tasks and new media, children often need support to learn to multi-task. Therefore, placing a multi-tasking lens on an activity can reveal how children learn to multi-task, surfacing the hidden sociotechnical work required to stabilize jointly accomplished tasks (Star, 1991).

Children's home-work often required collaborating with parents, and their division of labor involved idiosyncratic approaches to asymmetrically distributing media and materials within a single task (Stevens, 2000). We observed an example of this one Saturday afternoon, when Natalie, an eleven-year-old who lived with her grandmother and mother Gina near Chicago, helped her mom complete an Excel spreadsheet containing information from a survey Gina had distributed at work at the Urban League. Gina introduced the task to Natalie as work they could do together, enlisting her daughter in her own work as a valued coparticipant. Barron

and colleagues (2009) referred to this arrangement as “parents as employers,” a situation that arises when parents “entrust their technologically skilled children to perform technical services for them” (p. 69).

Later in a follow-up interview, Mom told Dionne, the researcher doing fieldwork in this home, that she often recruited Natalie in tasks for her job if technology was involved, in order to teach her daughter new technical skills. On this particular day, the entire family had gathered in the living room to watch the local TV news coverage of a tornado that had been spotted in the region, and the weather report remained on in the background while Natalie and Gina worked together to complete the spreadsheet for approximately twenty minutes. Through the large windows on either side of the house, trees could be seen blowing violently in the wind; Natalie had opted to wear a bike helmet, fearing the storm may send projectiles through the windows and into the home. Even in reviewing the video months later, an air of anticipation could be felt as Natalie and her mom commenced teaching and learning a new skill in such a charged environment.

Using multiple materials for multi-tasking

The families’ excitement about the impending storm set the backdrop for what otherwise might be considered a mundane technical task: creating an Excel spreadsheet. First Natalie and her Mom set about gathering multiple tools. Rifling through the questionnaires, Gina told Natalie that they needed to make a spreadsheet (Figure 4.4, line 3) and that Natalie could do the data entry (line 1) (see Appendix B for transcription conventions). When Natalie was unsure of what this meant (line 2, line 4), her Mom assured her by playfully smacking her arm and announcing that Natalie was going to learn something new (line 5). Playing along with her Mom’s mock punishment, Natalie feigned resistance, claiming it was a weekend and she shouldn’t have to

work. Meanwhile the two prepared themselves for the task; Natalie plugged in and set up the family's laptop while Mom continued to collate the paper surveys. What for adults may seem mundane (a storm, a spreadsheet) presents productive challenges and unanticipated possibilities for learning to do something new. The task ultimately became a means of learning to multi-task.

- 1 Mom: You can actually enter this data for me.
- 2 Natalie: Into what?
- 3 Mom: *((rifles through questionnaires))* We need to make a spreadsheet.
- 4 Natalie: What's that?
- 5 Mom: *((playfully smacks Natalie's arm))* You're going to learn something new today.

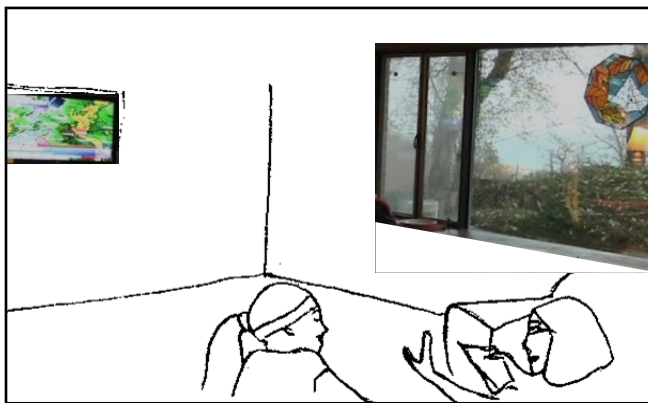


Figure 4.4 Mom presents the task to Natalie and they begin to arrange tools for the task.

In the first phase of the task, as they worked together on the couch in the living room, Gina held the paper surveys, while Natalie was responsible for computer data entry. Despite the proliferation of digital means of doing domestic tasks, or the fact that people can do so much on a single device like a computer or smartphone (Wacjman, 2015), there is continued need to mix multiple generations of tools together to accomplish a task (Silvis, Taylor & Stevens, 2018). Using the family's laptop, Natalie created columns and rows and managed which information she placed in various fields. Gina acquainted Natalie with certain application functions, for example, by indicating the feature for expanding a row in order to fully view its contents or explaining how the program would autosuggest category names based on terms previously

entered in cells. These technical details are not trivial for learners, and parents serve as vital resources for young people acquiring new technological competencies (Barron et al., 2009). Natalie occasionally looked over at the sheets of paper surveys her mom held; however, she primarily relied on Gina to verbally relay the information from the paper forms before transforming this into digital data.

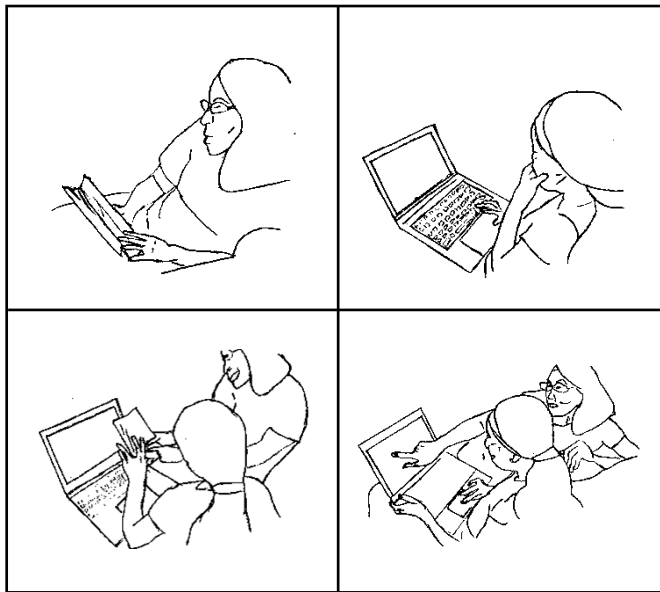


Figure 4.5 Mixing technologies within a task. Clockwise from upper left: Natalie’s mom reports information from paper-based surveys (upper left), Natalie enters data into Excel spreadsheet (upper right), they collaborate over the screen (lower right), they collaborate over paper (lower left).

Natalie assisted Gina with her work, redistributing the task across people but also across forms of technology. For the first phase of the task, they maintained a fairly strict division of labor: Natalie managed the computer-based work, and Gina handled the paper-based materials (Figure 4.5). At times, the distribution of the task was more fluid, and they used either the screen or the papers as a substrate for joint activity and mutual monitoring in order to construct shared meaning (Goffman, 1983; Goodwin, 2013; Goodwin & Cekaite, 2018). While we observed many instances of *single person* multi-tool multi-tasking, Natalie and Gina’s activity is notable for how

accomplishing the task required continued co-operative action (Goodwin, 2018), a learning arrangement made possible through the use of multiple tools.

Multi-tooled forms of work are essential to managing complex tasks (Clark & Fujimura, 2014), but the work of coordinating sub-tasks may nonetheless fly under the radar, overshadowed by larger task goals. For Natalie, learning to manage data through Excel required co-articulation of computer-based and paper-based sources of information through cooperative work with her mom (e.g. Stevens, 2000). Articulation work is that which is instrumental to any task because it binds different sub-tasks or material forms of work together. *Co-articulation* work, refers to the cooperative articulation of multiple material forms of work and is characteristic of multi-party activities (Stevens, *ibid*). Working together across tool sets to collaboratively accomplish the task served as the vital “joint” for joint activity, providing a way of keeping the task moving along across multiple tools in the workspace.

Learning to multi-task

In the beginning of the task, their work was primarily instrumental or technology-focused, oriented around coordinating multiple tools and related sub-tasks. As the task went on, Natalie developed sustained interest in and command over the broader task, and her mom took more of a backstage role. After Natalie had created most of the fields necessary for data entry and Gina had calculated the values by counting survey responses, Mom handed the surveys over to Natalie, telling her she was going to “do a load,” referring to doing laundry (Figure 4.6, line 6). Gina gave Natalie some guidance on the next question (lines 8-11) and then checked for Natalie’s understanding (line 12). Natalie noticed an error with her Mom’s instructions, and referred to the survey, correcting her Mom (lines 8-10). Gina agreed and told Natalie “glad you caught that” (line 16-17).

6 Mom: I'm going to run and go do a load.
 7 Natalie: Okay.
 8 Mom: And what you can do is you can type these
 9 *((points to labels on paper))*. And the next
 10 one do 'yes' and 'no' And then I'll go over
 11 the numbers with you when I get back.
 12 Okay? *((Mom gets up from couch))*
 13 Natalie: *((holding up the papers and pointing))* No,
 14 you mean [reading from the survey]
 15 'yes/no, are you a young professional'?

16 Mom: Yeah, that's what I meant. *((Walks out of*
 17 *room))* Glad you caught that.

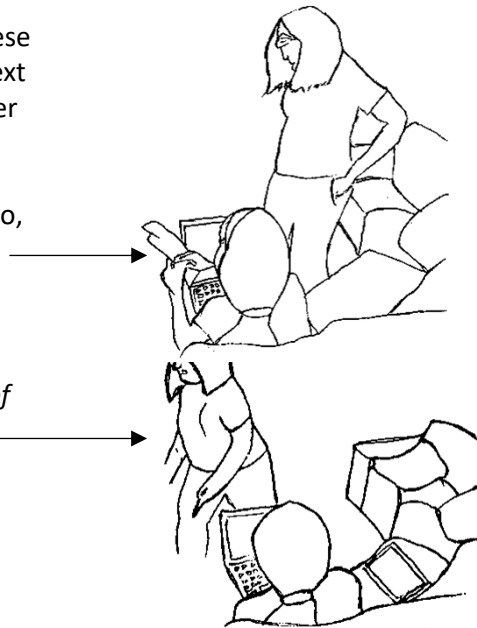


Figure 4.6 Gina prepares to hand over the task to Natalie.

After Gina exited the room, Natalie continued to rifle through pages, and in Gina's absence, she took full control of the task. Indeed, when Mom returned and attempted to repossess the paper surveys Natalie had stacked next to her on the couch, Natalie wordlessly refused to relinquish them, thrusting her arm forward to reclaim them from her Mom (Figure 4.7, Frame A). Natalie was now in charge of this task, having acquired not only the technical skills to build a spreadsheet, but the ability to multi-task by managing heterogeneous tools at once. Once Natalie had established her independence in the task, Mom took advantage of Natalie's newfound multi-tasking by using her mobile phone nearby on the couch, enjoying a brief moment where there was nothing pressing to do (Frame B).

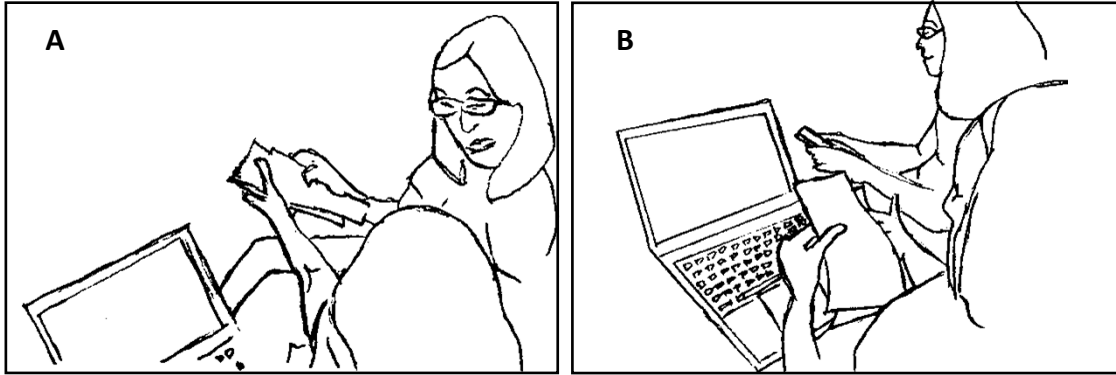


Figure 4.7 Natalie independently managing multi-tool multi-tasking. She insists on holding the papers (A). Mom disengages from task and uses phone (B).

Once Natalie completed the spreadsheet and they were both satisfied that the task was complete, Gina asked Natalie to send it to her work email. As we saw happen with many such tasks (and have written about elsewhere regarding Natalie’s attempts during a separate observation to connect with her father in California via Skype) a mangle of passwords, people, and networked sites suddenly elicited resuming multi-tasking (Taylor, Silvis & Stevens, 2018). A new array of sub-tasks was configured, with its own distributed network of tools. Similar to Katherine’s single device multi-tasking, what first seemed to be a single task splintered into sub-tasks, each with a separate purpose, requiring heterogeneous tools and resources. Configuring a task with multiple technologies, whether paper-based or digital tools, can support collaborative work and involve people who have different knowledge and skills (Stevens, 2000). Exchanges of knowledge within such learning arrangements can support learning to multi-task. Eventually, the spreadsheet was built, the data entered, the email sent, and this required multiple tools to be used cooperatively across an arc of work as Natalie learned to multi-task.

3. Learning *Despite* Multi-tasking as Domestic Complexity Multiplies

The complexities of maintaining everyday routines and organizing family life are compounded when multiple people employ multiple technologies across multiple tasks,

timeframes, and spaces. This was exemplified one day after school when nine-year-old twins Eddie and Oscar completed a homework assignment with their mother’s assistance. A family of three, with jobs, hobbies, school, and extended family who lived nearby, multi-tasking was typical in the Hernandez household. Compared to other homes in the study, the Hernandez’s exhibited a relatively high density of technologies and digital devices; for example, a large 24 inch tablet computer was available for doing research, each of the boys had their own (color-coded) tablet computer, and they had multiple gaming systems hooked up to a TV in their bedroom (Figure 4.8, frame A).

The twins were avid gamers and had recently won an award for their own video game at a local game design competition called Ludum Dare. Both boys actively sought to involve gaming in most aspects of their lives, including playing in the car on the way to the store, hanging out at their grandparents’ house a few blocks away (Frame B), or reading game-related books for school homework assignments. Their mom Steph strongly supported their interests by learning to code despite her personal apathy toward the activity and by advocating for the twins’ interests in technology at school, where their teachers often did not see the value in reading books about gaming.

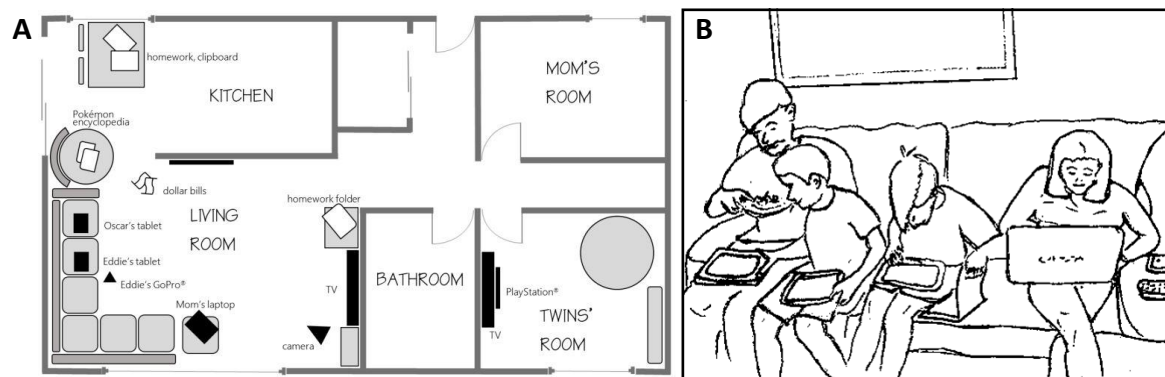


Figure 4.8 Floor plan of the Hernandez home, including paper-based and digital technologies used during observations (A). Eddie and Oscar (seated between Grandma and Grandpa) playing games at their grandparents’ house, similarly stocked with technologies (B, image courtesy of Steph Hernandez).

When I arrived to observe them one day after school, Oscar and Eddie were already immersed in their typical afterschool routine: watching TV, completing homework, and playing video games. Their homework assignment on this particular day was an ongoing project in their language arts class that asked them to create a book cover for their favorite book. Both Eddie and Oscar had chosen to create book covers based on *Pokémon Deluxe Essential Handbook*, an encyclopedia of over seven hundred Pokémon, thoroughly dogeared and annotated by the twins, who each had their own copy. While they worked, Steph completed multiple household chores (more on this in the next chapter) and helped them with their homework.

Rounds of working on homework, which the boys completed primarily while sitting at the kitchen table, were punctuated by “technology breaks,” a strategy their mom implemented in the afternoons and evenings each day after school. Technology breaks were designed as ten minute periods of free time during which the boys could play on their tablets, watch TV, go to their bedroom to play a game on a video game console, or some combination of these activities. However, because the TV remained on in the living room adjacent to the kitchen where they worked, homework and technology breaks were rarely entirely distinct; the boys tended to gaze at the TV throughout the observation, regardless of whether they were presumably in the “homework” or “technology break” phase of the activity structure. For example, about forty minutes into this activity, Eddie watched TV, while his mom organized the twins’ homework materials at the table (Figure 4.9).

A multi-party activity setting multiplies tasks

Eddie lagged slightly behind his brother in this assignment, and he was in the midst of a technology break from homework when I arrived. He sat on the couch and played *Angry Birds* on his tablet while simultaneously watching cartoons on TV. Meanwhile, in the adjoining

kitchen, mom verbally outlined his homework plan, creating a sort of “activity contract” that framed the possible parameters for future action (Aronsson & Cekaite, 2011). She told him he could take a 10 minute break and then get back to work (Figure 4.9, line 1-2).

- 1 Mom: Okay, you can take a ten minute break. Then you need to do more
2 homework.
3 Eddie: *((sits on couch, uses tablet))*
4 Mom: Got it? [Eddie]? Yes?
5 Eddie: *((watches TV, uses tablet))*
6 Mom: Okay, so it looks like the only thing YOU have left for today is your
7 book cover. *((straightens chair at the kitchen table))*. And I'll have
8 [Oscar] leave out all of the materials. I'm writing 'front' on here and
9 'back' so you know which one is the front and back and then we can
10 erase it once you're done, okay Eddie?
11 Eddie: *((using tablet))*
12 Mom: Yes?
13 Eddie: [softly] Yeah. *((clears throat))*
14 Mom: EDDIE.
15 Eddie: Ye::s.
16 Mom: Okay.

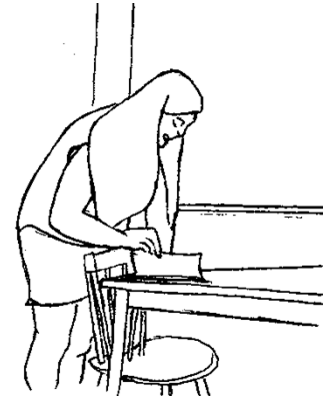


Figure 4.9 Mom organizes materials for twins' homework and orients Eddie to the tasks ahead.

Mom made multiple bids for Eddie's attention, attempting to orient him to homework, which he would complete in the near future (line 4). However, having just completed a round of homework, Eddie was focused on technologies he was using for recreating during his technology break, and repeatedly ignored his Mom while he media multi-tasked (lines 3,5, and 11), playing a video game and simultaneously watching TV. While Mom directed her talk to Eddie (and he directed his attention elsewhere), she was busy organizing materials for his brother to use later (lines 6-10). Eddie and Steph *both* multi-tasked, jointly managing separate, sometimes

competing activities. Eddie played a game and watched TV during his scheduled technology break, and Mom set up materials in anticipation of the twins' homework, bidding for Eddie's attention as she organized multiple plans of action. In this complex attentional ecology (Citton, 2017), media multi-tasking required designing material conditions across multiple ongoing activities and people so that learning could still take place.

Meanwhile, Oscar was in the midst of his own multi-tasking. One portion of their assignment was to create content for the back flap of the book cover, an area commonly reserved for author or illustrator information. At first, Oscar was put off by this, arguing (correctly) that Pokémon does not have a single author, but rather, represents content that has been created by multiple authors and illustrators over time and across media formats. Oscar pleaded, "it has to be about the author, but I don't know the author" (Figure 4.10, line 17-18). To address this technical point and clarify the teachers' expectations, his mom referred to the assignment description, a sheet of paper that Steph had strategically attached to the clipboard and initially placed at the kitchen table.

She read off to Oscar that the back flap could include *ideas* about the book, the author, or illustrator, a summary of the book, or illustration of the author or illustrator (19-22). Steph then presented Oscar with the option to use her laptop to research a Pokémon illustrator named Eric Nadal (lines 22-28). Receiving muted enthusiasm from Oscar (who was, like his brother, stealing glances at the TV), she asked whether he wanted to use the laptop at the table (which at the time was crowded by Eddie's front cover design work) or whether, instead he preferred to move the laptop to the living room couch to do this research. The living room was usually reserved for technology breaks, but she made an exception so that she and Oscar could sit comfortably

together in a side-by-side configuration to view her laptop screen, a prototypical configuration of bodies during JME (Takeuchi & Stevens, 2011).

- 17 Oscar: But I can't do the flaps because it has to be about the author,
18 and I don't know the author.
19 Mom: IdEAS for flaps. These are idEAS. You can do something else.
20 [reading the instructions]. 'Write a summary of the book.
21 You could draw the author or illustrator. The way he looks or
22 the way you think he looks.' So for example, the illustrator,
23 what's the guy's name who just died? The illustrator.
24 Oscar: Hm::
25 Mom: You could draw a picture of him. He IS a Pokémon illustrator.
26 What was his name, like Chris or something?
27 Oscar: Ye:::ah
28 Mom: You can look him up, do you want to look him up?

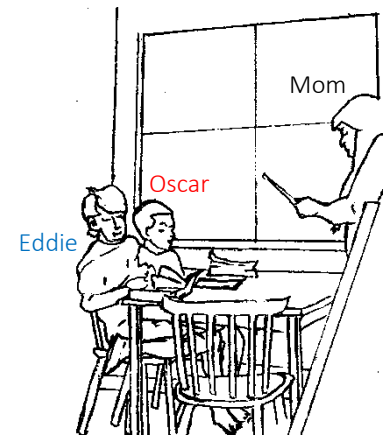


Figure 4.10 Mom and Oscar discuss the assignment instructions while Eddie illustrates his cover.

Later on, Mom helped Oscar locate information about this Pokémon illustrator on Wikipedia (Figure 4.11). Oscar took possession of the laptop to take the lead in his research activity (line 30), much like Natalie had done when she was learning to multi-task. Following this redistribution of tools and labor, Mom reoriented Oscar to the task, giving him tips and guidance on using the tool and finding more information (lines 31-33). She then presented another option for rearranging materials to continue to support Oscar's task: she asked whether he wanted to move the laptop to the table, or, alternatively, move the clipboard to the couch (lines 36-38). Oscar opted to remain on the couch and asked his Mom to bring the clipboard over (line 39). Meanwhile, Oscar and Eddie had a brief exchange about a discovery Oscar made researching Pokémon illustrators; he had found there was a Wikipedia for Pokémon called Blubapedia (Bulba is the name of a central character in the Pokémon game world). The twins chatted briefly about this finding, and Mom dryly expressed her lack of surprise, stating that

“there is a Wikipedia for, like, everything” (line 45). All three of them focused on the same topic, their divergent and multiple tasks converging, albeit momentarily.

- 29 Mom: So *((reads))* “Illustrator, Wikipedia, Pokémon...”
30 Oscar: Just let me read something [inaudible] *((moves laptop to his lap))*
31 Mom: So this will give you all the information about him. You can
32 scroll down with these arrows, and you can decide which
33 ones you want to write about. This is all the Pokémon games that
34 he worked on, where it says game credits? So, *Omega Ruby* and
35 *Alpha Sapphire, X and Y, Black and White, Ruby II...* *((read screen together))*. Do you want to take this to the table? Or do you want
36 to put that on a clip board and bring it over here? What do you
37 want to do?
38
39 Oscar: Hm:: bring it over.
40 Mom: Okay, so I’ll put it on a clip board and you can set that on
41 the couch and you can choose which information you’re
42 going to use *((walks to table))*
43 Oscar: I see some information about the new Pokémon game coming
44 out.
45 Mom: I’m not surprised, there is a Wikipedia for, like, everything.



Figure 4.11 Mom assists Oscar with homework, giving him options for arranging tools within the task.

Learning despite multi-tasking

While I have focused this example around the schoolwork the twins were completing, there were many more cascading tasks the Hernandez’s collectively achieved during this visit as their multi-tasking multiplied. For example, Steph also completed a number of household chores such as laundry, meal preparation, and fielding phone calls. One of these phone calls happened to be from movers, who were scheduled to deliver a new reclining couch to the twins’ room that evening. The couch was intended to provide a comfortable place to lounge while Oscar and Eddie played video games in their room. Like the TV on in the background or laundry being washed behind the scenes, the delivery of the couch represented a task that spanned the entire

observation, intermittently occupying both the twins and their Mom in the midst of their ongoing tasks. An incident that took place surrounding the delivery serves to illustrate how, despite what appeared to be tensions in maintaining shared attentional frames or topical floors (Erickson, 1982), or the apparent backgrounding of certain non-focal tasks, the twins were paying close attention to their Mom’s words and actions.

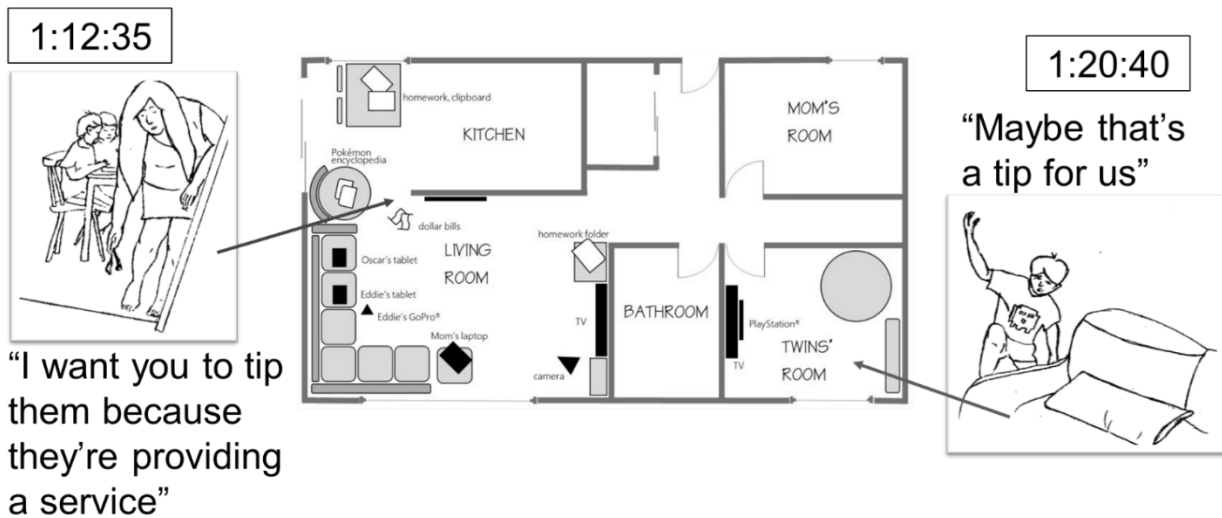


Figure 4.12 Floor maintenance in multi-tasking. Mom and Eddie discuss “tipping” the delivery men, spreading multiple tasks, people, and tools out over time and the home floor plan.

Earlier, while working on their book covers, Mom had told the boys that she wanted them to each tip the movers one dollar (Figure 4.12). She likened this to tipping the pizza guy, and she emphasized to them that “I want you to tip them because they’re providing a service.” The boys meanwhile remained relatively unresponsive and continued gazing at the TV from the kitchen table where they worked. Steph’s expectation was then underscored a moment later when she placed two one-dollar bills in the threshold between the kitchen and living room, directly in the pathway they would need to travel out of the kitchen to get to the bedroom where the couch was being assembled. This maneuver ensured that, although they were apparently distracted by

watching TV while doing their homework, the twins would not fail to discover the movers' tip en route to the bedroom.

A short time later, Oscar and Eddie ratified their mom's request when they raced down the hall after snatching up the bills and diligently tipped the movers, who subsequently departed. Mom immediately noticed that the movers had left their drill in the entrance hallway and chased after them down the driveway. Eddie, reveling in the new couch with his brother wryly commented "maybe that is a tip for *us*," referring to the drill. This re-voicing of his mother's task directive indicates how he had heard and understood her words in a way that allowed him to recycle them in an entirely different context (Goodwin, 2018). Eddie kept the topic of tipping going across ongoing fields of action and floors of interaction and across all their multi-party homework taskscapes.

Whereas, several weeks prior, Steph had reported to me how the twins were able to "soak things in" despite their multi-tasking, in this instance they demonstrated how this looks in practice. Despite their multi-tasking, they learned valuable lessons about what it means to contribute to the household's routines. While the multi-party nature of dynamic domestic task settings compounds media multi-tasking, learning still takes place, however unexpected and spontaneous it may be. This improvisational characteristic of learning is a key to understanding multi-tasking as a design approach that families take to learning with technology.

Discussion

Across these three cases, I have shown how media multi-tasking supports learning at home and some forms that multi-tasking can take, including single device multi-tasking, equipping a task with multiple tools, and multi-party multi-tasking. I have used these examples to elaborate how children learn *through* multi-tasking, learn *to* multi-task, and learn *despite*

multi-tasking. Across the three cases, I drew on the different elements or aspects of multi-tasking that make it a multiply configured form of work (Figure 4.13). It is important to note that these are often entangled in practice, and in many cases, multi-tasking will involve multiple sub-tasks, tools, people, *and* purposes all once. For analytic purposes, I highlighted what these elements looked like as separate aspects of multi-tasking, but they are not entirely distinct characteristics of what is an inherently heterogeneous phenomenon whereby tasks ramify in everyday life.

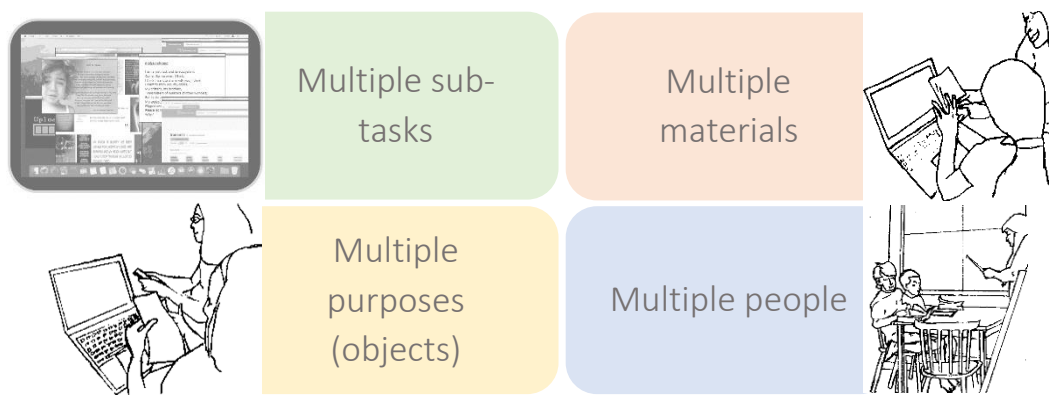


Figure 4.13 Multiple elements of media multi-tasking.

Across the cases and the elements of multi-tasking, I argued that learning and multi-tasking are co-implicated. I described three instances where multi-tasking and learning were interrelated. First, I examined how, even when confined to a single device in a circumscribed, *ad hoc* work arrangement, a task can splinter into multiple sub-tasks. Rather than causing unwelcome distractions, this fragmenting of tasks can support learning in unforeseen ways. When Katherine’s multiply sub-tasked poem writing activity led her to her favorite websites to explore new words and their meanings, she arguably learned more *through* multi-tasking than had she stuck strictly to the task at hand (however that was defined). In fact, the very delineation of task objectives is troubled by analysis of multi-tasking, because according to Engstrom, “the

object of activity is a moving target, not reducible to conscious short-term goals” (p. 136). There is no “task” only “task(s)” as people and objects mutually constitute them over time.

A second way multi-tasking and learning relate is that people learn *to* multi-task. It is simply not the case that maintaining multiple tasks, tools, or tabs at once comes easily for learners or is an innate characteristic of children’s learning in a digital age. This finding is aligned with multi-tasking research that points to the developmental differences in multi-tasking (e.g. Krampe et al., 2011) but departs from it in a major way. Where conventional multi-tasking research finds that adults are better than children at multi-tasking and then uses this to justify cautionary narratives about children’s media multi-tasking, I am arguing that children can benefit from working alongside more experienced multi-taskers. Simple exposure to multiply mediated learning environments is insufficient for learning to multi-task; Natalie was quite proficient using her laptop but needed her Mom’s assistance to learn to multi-task on it. As with children’s development of other technological competencies (Barron et al., 2009), learning to media multi-task benefits from parental support, and is a sociotechnical achievement.

Particularly as multiple people coordinate multiple tasks in complex media ecologies, the demands of multi-tasking can easily multiply. It is, therefore, significant that learning happens *despite* multi-tasking. Despite complex configurations of tasks, people, tools, and objectives, learners manage to “soak in” what is important (to them) in their surroundings, as Eddie and Oscar demonstrated during their afterschool time. The rhythms and routines of family life are replete with opportunities for learning despite multi-tasking, that is, despite the daily exigencies of balancing the many activities of multiple family members. Some environments encourage multi-tasking and are designed for learners to participate in multiple tasks simultaneously, and others do not. In the current analysis, I treated home environments as especially conducive to

learning while multi-tasking, and I focused on families' designs for multi-tasking that mobilized multiple tasks, tools, people, and purposes.

Doing collaborative work at home in the context of multiple contemporaneous activities is a hallmark of domestic routines across human history, and engaging with new media is no exception. Because media multi-tasking is a common form of collaborative activity (Lin et al., 2016), it can serve as a means of scaffolding for learners who are in the process of building technological competencies (Barron et al., 2009) or who are accomplishing a variety of tasks using older and newer tools (Rogoff et al., 2002; Mejía-Arauz et al., 2018). Supports can take the form of shared labor (i.e. Mom tallying the data and relaying this to Natalie to transcribe), simplification of the task (i.e. Mom giving Natalie direct instruction, such as what to name a column), or breaking a task down into sub-tasks (i.e. first we build the table, then we send the email). Thus, splintering of a computer-based task is part and parcel of teaching and learning, when one purpose of doing shared work is to help someone learn something new.

The three cases in this chapter reflect how families rely on multi-tasking as one design strategy that maintains daily routines like homework or housekeeping over floors of the house and floors of interaction. Graesch (2013) noted that “opportunities for parents and children to co-construct daily routines and achieve family-level cohesion are perhaps greatest when family members are within a thirty-second walk of each other in the home” (p. 29). This was true for the Hernandez's as they spread their activities out- though not too far- across the space of the home. Within the same floor plan, the twins and their Mom collaboratively distributed their work and attention, to multiple ends. For them, multiplying multi-tasking at home required *literal* floor maintenance. In this way, the family was able to maintain their positions on separate floors of interaction (Erickson, 1982), an arrangement significantly mediated by available technologies as

well as by Mom's support, but nonetheless an effective design strategy for learning despite multi-tasking.

Families are adept at maintaining multiple floors of interaction, and multi-tasking is one way that their interactional work leads to jointly achieving tasks. In home learning environments, multiple tasks must cohere across a physical floor plan as people coordinate activities and materials and as they jointly achieve routine activities like homework, chores, or recreation. According to Erickson (1982), floor maintenance, or the discursive work of staying on topic or switching topics, "is a sustained focus of cognitive, verbal, and nonverbal attention" (p.47). I have emphasized how multi-tasking operates in maintaining floors of interactions, where tasks serve as topics and activities orient attention, much as in conversation. Staying on-task and staying on-topic require work, and given that there are multiple tasks (and topics) available in the open floor plan of any home (or conversation), deciding how tasks will unfold is an open question and an on-going source of interactional effort (Goffman, 1983). Natalie and her Mom's mutual monitoring of their joint activity required that collaborative action be configured around an ecology of objects: laptop, papers, laundry, cell phone, email (Cekaite & Goodwin, 2018). The twins and their Mom's choreography of attention demanded that shared tasks be organized around an array of competing media and technologies: TV, homework, tablets, video games (Tolbert & Goodwin, 2011). Such interactional maintenance work- whether in homes or in conversations- is never done, and it is a collaborative temporal, spatial, and material achievement.

Because computers are connected to the internet, there are simultaneously numerous people one can interact with to accomplish any given task. Answering Erickson's question *where is the floor of activity?* is complicated by media multi-tasking. Media engagement in online

environments may collapse contexts (boyd, 2014), but someone must still maintain the floor of interaction. For example, Katherine literally worked on her bedroom floor in an *ad hoc* workstation where she managed shifting taskscapes online. However, while Katherine was interacting with me and with her laptop in-room, she contemporaneously interacted with her friends, her mom, and her dance teacher via email and she was also connected to her writing teacher through Google Docs. In terms of interactional floors, at any given time, a networked laptop gives young people multiple avenues for interaction, and who they choose to interact with shifts as the task environment changes.

Gina, like the other parents in this study, had many more tasks to do. Consequently, enlisting Natalie in doing a little of her work also served to distribute work among household members, holding together the task through their co-articulation work. Rather than working at cross-purposes, they cooperatively achieved the task, and this took skilled discursive and material co-articulations within their division of labor. Too often, this labor is backgrounded and we focus instead on the technical labor (of data entry) or the product (spreadsheets). Labor-saving devices (and daughters) have not eased the burden of working mothers, and there are still many tasks to be done at once (Hochschild, 1997). By holding the task together while her Mom did other chores, Natalie was holding the floor for interaction while her Mom momentarily switched tasks literally across the floor of the house. This instance illustrates how articulations are always concealing multiple forms of hidden work (Strauss & Star, 1999), and how children learning to multi-task makes possible the joint accomplishment of divergent and emergent aims of unfolding activities.

Articulation work is not all that gets relegated to the background during multi-tasking situations. Easy designation of focal versus background tasks is complicated by the dynamics of

learning through multi-tasking. Let's return again to the example of Katherine uploading a video and writing a poem (or writing a poem while uploading a video). Though it was the first task Katherine pursued and it persisted for the longest time, uploading the video did take place in the background of her more visible activities. For this reason, I analyzed her poem writing as a focal task that splintered into sub-tasks. However, it could be argued that uploading a video was the central object of activity (i.e. the reason she turned on her computer to begin with), though it occurred in the background while Katherine worked on other things.

Distinguishing background from foreground is a paradigmatic problem of perspective. What one person (i.e. a parent or teacher) thinks is important to do at any given time may not be valued by children and vice versa. It is also not simply the case that asking learners what tasks they deem important for learning offers easy solutions. Because technologies tend to unexpectedly disrupt daily activities, prompting the cascade of tasks and sub-tasks I have argued are characteristic of multi-tasking, it can be easy to lose one's bearings. I have tried to suggest that this is not an indication of a learning problem, but rather presents unexpected opportunities for learning with technology. When there are multiple possibilities for learning available at a given time, assigning them relative importance (for learners) is nontrivial.

Engeström (2001) has theorized the multiplicity of the object-of-activity within activity theory, pointing to how "multi-voicedness is multiplied in networks of interacting activity systems" (p. 136). Particularly in settings like homes where, mediating artifacts are increasingly mobile and wireless, multiple moving objects (i.e. smartphones or tablet computers) proliferate, and with them, objects of activity and activity systems likewise multiply. From this perspective, tasks are constituted as they dynamically unfold, and the multi-party nature of collaborative activity means that multiple aims or objects are intrinsic to activities. Or, as Erickson (2016)

recently commented, “in any human interaction, there is always more than one thing going on at the same time.” This view disrupts naturalized, Westernized constructions of *individuals* being “on task” and asks instead what other configurations of tasks are possible and how are people organizing *joint* activity?

This then raises further questions about whose perspective on task completion counts when learning is at stake. What is the object that should be followed in a collaborative activity, and who decides this? Furthermore, what tasks are important to do and who assigns them? The cases in this chapter showed how it matters where a task originates. Perhaps an element of multi-tasking worth exploring is how having multiple *starting points* for tasks bears on how tasks unfold over time. Katherine’s tasks- writing a poem, uploading a video, searching for places to go in Seattle, checking a reading list for the upcoming school year- all represent different points of task-origin. They were all assigned by different people. On the other hand, Natalie was recruited *by her Mom* to do this work, which is a different starting point for the delegation of young people’s computer-based work that typically originates outside the home in school. As opposed to homework assigned by a teacher (like Eddie’s and Oscar’s book covers), where a single task is undertaken for the putative purpose of completing an assignment (or earning a grade), building an Excel spreadsheet distributes the aims of activity more widely.

It may be that multi-tasking is so common in homes because there are many more starting points for determining what is important to do at any given time than in environments where tasks tend to be more structured or have a single objective (i.e. the teacher’s). Prevailing perspectives on multi-tasking caution against it, for how it distracts learners, divides attention (and families), and threatens successful task completion. As a response, this analysis contributed to a different perspective on multi-tasking (c.f. Turkle, 2011; Wallis, 2006): media multi-tasking

is a significant and pervasive sociotechnical practice, and children are engaging in many forms of multi-tasking at home in ways that contribute to their learning.

While school-like versions of attention often emphasize individuals staying on task, home media ecologies are rich sites for multi-party multi-tasking. My analysis supports the suggestion by Lin and colleagues (2016) that collaborative learning is enhanced by multi-tasking because of the excitement of engaging in more than one task at once, a learning configuration often forbidden in formal learning settings. Instead of barring learners from using multiple media and devices to accomplish tasks in school, designs for learning might incorporate more people, technologies, and tasks in order to simulate how children immerse themselves in dynamic home-based media ecologies and to stimulate interest-driven learning (Ito et al., 2013). Families have multiple strategies for multi-tasking, which make use of newer and older forms of technology, embody multiple goals, and require skillful interactional approaches and use of materials. School-like designs can learn from home settings as models of multi-tasking.

Furthermore, my analysis of multi-tasking suggests we should critically examine the cultural values behind doing just one task at a time. Many cultural repertoires of practice embed multiple activities in ongoing routines (Gutiérrez & Rogoff, 2003). Nonetheless, nondominant approaches (i.e. those originating outside Western, white, educated, middle class families) to learning, to raising children, to distributing labor, and or to organizing everyday life continue to be devalued and dehumanized in formal settings like schools. A number of researchers have questioned how the normative expectation of single task completion is aligned with individualistic frameworks on learning (Mejía-Arauz et al., 2018; Schwartz & Gutiérrez, 2015). While typical in dominant models of European-American schooling, this narrow view of staying on task is not the norm for all families. In many contexts where collective rather than individual

orientations to learning are more highly valued, the group may be engaged in multiple tasks at a given time, with consequences for who learns what and how.

My analysis has also suggested that multi-tasking is a skill that can be (and perhaps must be) learned. Despite evidence to the contrary, children are capable of creating and navigating media spaces made for multi-tasking as well as learning valuable skills required for managing multi-tasking. This observation also raises questions about what (and how much) young people pay attention to and the consequences of this for their learning. In other words, when the internet, mobile technologies, and streaming video services makes it ever more possible to simultaneously tune in to multiple channels, sites, and devices, where do families draw the line? When does “multiple” mean “too many” tasks? For whom, and who decides?

These questions are animated by the “always on” character of digitally mediated daily life. If, as Katherine’s multi-tasking suggests, there are few moments when nothing much is happening, what are the consequences of this for learning? What is the right balance between idleness and activity, between free time and structured time, between engagement and boredom? And what are the consequences of striking this balance on work and on learning? While I believe normative responses to these questions overreach my analysis, I think it is significant that all the children in this study identified home as the place they were most engaged in learning with technology. I would argue that this is tied to the great number of activities available to engage with media at home. Perhaps staying busy is an affordance of homes, where one thing leads to another... and another... and another. We might consider the density of and multiple (and multiply mediated), ongoing, and intersecting tasks at home when we design for learning in other settings.

This is not just a tired critique of boredom in school-like learning settings. It is a challenge to adopt multi-tasking *as a design principle* and to consider how material supports for learning enable learners to build practices suited to new attentional ecologies. In homes, as anywhere else, designs for learning (i.e. for writing a poem, building a spreadsheet, creating a book cover, or installing a new couch) are never able to perfectly predetermine how active users will take up technologies to achieve intended goals (Suchman, 2007), and we have seen how tasks and goals multiply in families. As families reorganize learning at home, multi-tasking provides a means of mobilizing technologies for learning across the floor of the home and maintaining multiple floors of interaction in everyday life.

CHAPTER 5: FINDING #2

Invisible Homemaking: Making Home “Work” for Learning in a Digital Age

In almost every home I visited, I was struck by just how much work families were doing during their discretionary time when they were not at their jobs or at school. Even during the summer, when I did field work in all of the Seattle homes, children were busy working on a range of assigned tasks. In the previous chapter, I drew attention to the density of tasks and routines that occupy families at home, and I suggested that an important consideration for understanding media multi-tasking concerns where exactly tasks originate. Conventionally, homework is assigned in school. Yet, a wide variety of assigned tasks occupy children working at home. Homework originating in formal school contexts represents only a fraction of all the tasks children are expected to do in informal environments. In contrast, what I refer to as “home-work” in this chapter, continues to occupy a sizable portion of out-of-school time (Kremer-Sadlik & Gutiérrez, 2013). Family routines have always entailed some version of children’s work contributing to collective endeavors (Heath, 2012; Rogoff, 2014; Rogoff, Najafi & Mejía-Arauz, 2014), yet the ways their media engagement plays into home-work remains largely unexamined.

What I am calling home-work includes housekeeping; household chores; children helping parents who are working from home; pet care; music practice; sibling care; and tasks performed at home that are required for activities pursued during discretionary time (e.g. for clubs, sports teams, faith-based groups, etc.). These everyday tasks serve as important sources of learning and also contribute to a household’s regular homemaking practices. Homemaking has always involved families performing important forms of work with technology (Cowan, 1983), and

mobile and digital devices are reconfiguring domestic labor. In this chapter, I analyze work as a site of learning in homes and consider how families jointly accomplish a range of homemaking activities using technologies. Out of the many types of home-work families did, I focused analysis on everyday activities like household chores or sibling care. While chores and caring labor are often overlooked compared to more valued forms of learning (like creative production or homework), families' caregiving routines can become a site of significant sociotechnical activity.

I found a number of (often invisible) sociotechnical practices take place during routine home-work and reflect ways children are learning with technology; I call these practices (*digital housekeeping, sound-tracking, and mobile work-arounds*). These background sociotechnical practices keep family life humming along in the midst of domestic tasks and make home “work” for learning with technology. In the context of the on-going up-keep of environments and interactions, children learn to navigate the daily exigencies of making home a place where routines run smoothly, tasks stabilize (albeit temporarily), and kids simply enjoy engaging with media and technology. I found that in addition to learning to navigate home-work, children are inculcating particular moral ideals through their domestic sociotechnical practices. Through analysis of children's home-work, I explore how families sociotechnical practices serve as a meaningful context for learning to care for each other and environments.

Dis-embedding Families' Designing Within Domestic Work

Homemaking has historically been a stratified domain of work, a site where women (particularly women of color) contribute disproportionately to household labor (hooks, 2015; Klein, Izquierdo & Bradbury, 2013; Rollins, 1985). Half a century and multiple waves of feminist scholarship have shed light on how maternal labor organizes household life (Ahmed,

2017; Collins, 2000; Friedan, 1963; Hochschild, 1989; O'Reilly, 2007); however, the ways in which children are not merely objects of this labor but *important sources of work in their own homes* has not received much attention. This is likely due in part to the perception that children are not substantial participants in household work. My observations of families' home-work contradict the notion that children are primarily cared *for*, not caring *about* their home environments, materials, and relationships, and actively working to maintain them.

Still, studies of domestic labor have consistently shown that children contribute far less than their parents to household work. In recent decades, some researchers have estimated that children's contributions represent between 13 and 20 percent of all household work in Western contexts like the US (Klein, Graesch, & Izquierdo, 2009). While these figures do point to marked disparities between the average contributions to household labor of mothers' (60 percent) or fathers' (27 percent) and their children (Blair, 1992), it is important to study changes in children's home-work in a digital age. As technologies evolve, so too does the nature of domestic labor. While the advent of domestic technologies- from the washing machine to personal home computers- promises to streamline family life, new technologies have paradoxically not eased the work load of women at home (Cowan, 1983; Hochschild, 1989; Wacjman, 2015). As mobile and digital technologies shift how family members participate in daily household routines (Taylor, Takeuchi, & Stevens, 2018), this then introduces new questions about the relationship between families' sociotechnical practices and distributed domestic work.

Ironically, while women's work at home has been characterized as a paradigmatic example of invisible work (Strauss & Star, 1999), types of work that typically go unseen and undervalued (and often unpaid), it was actually fathers who were typically invisible in the

families I visited. In their place, *children* were busy engaging in a variety of different forms of home-work. Star (1999) noted that

with any form of work, there are always people whose work goes unnoticed, or is not formally recognized (cleaners, janitors, maids, and often parents, for instance)... leaving out what are locally perceived as ‘nonpeople’ can mean a nonworking system... leave the work tacit, and it fades into the wallpaper (p. 386).

The walls of homes are papered with children’s work, though they are conspicuously absent from most accounts of invisible work. This series of contradictions raises questions about who or what is invisible in domestic settings. In this study, this means foregrounding the efforts, ideas, ingenuity, emotions, and intellect of women and children as well as the background sociotechnical processes that keep learning environments humming.

It is often difficult to see salient aspects of domestic work processes. Not only do these tasks take place in private spaces behind closed doors of home, but they also involve intricate backstage work that is often rendered invisible across the arc of larger work processes (Goffman, 1959; Star, 1996). In the previous chapter, I analyzed such articulation work, and I tried to understand how families were holding multiple contemporaneous tasks together in ways that were sometimes hard to see, for example through their talk or through cooperative action that had become sedimented in ubiquitous technologies and everyday practices. Like articulation work in general, a key characteristic of housekeeping is that it appears to get done by magic or slight-of-hand (Brody, 2017; Swamidas, 2014) and not the daily hands-on work of families.

In this chapter, I explore a relationship between the invisibility of domestic and sociotechnical work. The process of rendering housework invisible, or black boxing it, is closely related to how technologies likewise conceal their processes of production and obscure

maintenance work, without which, things tend to break down or fall into disrepair (Latour, 1988, 1991; Star, 1991). Even when working well, technologies can easily become sunken in to technical infrastructures (Star, 1999), making them hard to dis-embed from everyday practices. One parent we interviewed told us how, once she started tuning in to the technologies and media her children engaged with, she saw that all the media they used had sort of become “background noise.” This speaks to how much technology has saturated homes, to the extent that you do not even notice when TVs play in the background or when media engagement is part of the flow of routines (Pink & Mackley, 2013). What subtends everyday tasks for some is a “topic” for others (Star, 1999, p.380). In this chapter, I topicalize the hidden home-work of young people as an object of analysis that is crucial for making home “work” for learning with technology.

Analyzing Layers of Invisibility

If a characteristic shared by mothers’ domestic labor, children’s home-work, technological maintenance work, and sociotechnical practices is that they are typically *invisible*, how does one go about making them available for analysis? And what sorts of analytic sensibilities or sensitivities are required of this operation? Star & Strauss (1999) stress a number of complications that make analyzing invisible work particularly challenging. For one, invisibility is often multifaceted, a problem they refer to as “layers of silence.” A person and their work may be invisible for a number of reasons, all of which require excavation (see Figure 11). Secondly, shedding light on one thing casts shadows on another. What Star and Strauss referred to as a “matrix of visible and invisible work” (p. 25) reflects the tradeoffs of revealing hidden work, whereby making some things/people/work visible unintentionally renders others invisible. Another unintended consequence of analyzing invisible work is that sometimes remaining invisible is in someone’s best interest. In cases where work is more easily

accomplished in the shadows, analyzing invisible work is not always the right thing to do. It can sometimes reveal the underbelly of work processes or can do harm to people whose work was better left unseen. For all these reasons and more, analysis of invisible work is inherently fraught.

Like the sociotechnical systems in which work is embedded, invisible work at home typically became visible during breakdowns. When devices are working well or routines are running smoothly, it can be harder to see inside the processes that are making things run. It is at the moments when things get off track that analysts are able to then examine what brings them back to working order. Families' disagreements about technology (or home-work), difficulties getting things (or people) to work, or moments where routines or devices required repair were all key sources of insight into how invisible work contributed to their daily rounds. Focusing analysis on a number of instances of home-work and its breakdown, I attempted to get analytical traction on layers of invisible work through a series of questions.

Where and how does home-work take place over space and time? What kinds of material or interactional resources are people using in these work processes? What does it look like when routine breakdowns happen? What precipitates breakdowns? How does repair work then reestablish or stabilize routines? Who is working to take care of or repair technologies at home? What are they taking care of? What cannot be seen that is consequential for making things work or getting things done? While multi-tasking explained how multiple tasks can compete for family members' attention, this chapter explores how this then requires ongoing upkeep of routines and materials to effectively make home work for learning with technology.

As with multi-tasking, children's strategies' for homemaking involve ongoing reconfiguration of media ecologies; consequently, there is a significant amount of housekeeping involved in children's technology-based home-work, such as setting up or cleaning up activities

in which technology is used. In what follows I present three cases of homemaking, each exemplifying a different form of the process of making home work for learning with technology. These forms represent types of invisible work that often go unseen, either because they take place in homes, are performed by women or children, are historically undervalued and unpaid (like housekeeping), are taken for granted in mundane routines, or are part of the multisensory atmosphere of home.

In the first case I analyze, multisensory homemaking strategies contribute to making a comfortable or productive environment for learning with technology at home (Shove et al., 2007; Pink, 2009; Pink & Mackley, 2016). As one dimension of the multisensory aspects of routine domestic work, I highlight how playing background music, or “sound-tracking,” is a significant contributor to working and learning at home. I describe how Natalie used music and video sound-tracking to organize not just her closet but also her activity. I then point to how a feminist sensibility towards learning and towards care for everyday environments brings forth the multisensory dimensions of homemaking, making them temporarily visible.

In a second case, I introduce “mobile work-arounds” as an active and ongoing practice families design to cope with hidden infrastructures and develop new work strategies in- and often around- their homes and neighborhood on their daily rounds (Erickson, 2004; Taylor, Silvis & Stevens, 2018; Taylor, Takeuchi, & Stevens, 2018). I describe how Oliver and his brother Francis navigated networked infrastructures playing *Pokémon Go* around their neighborhood. I show how they mobilized their different knowledge and materials on-the-move (Taylor, 2017), eventually stabilizing their routine play in the context of the taken-for-granted work of sibling caretaking. I emphasize how working-around technical problems is not only a mechanism for coping with network infrastructure but can also be a mechanism for caring.

In a third case, I revisit Steph, the mom of Eddie and Oscar, who we met in the last chapter, as she engages in extensive rounds of routine housework. I describe a surprising discovery she made one day while cleaning up, and the sociotechnical trouble this surfaced, as well as the invisible work of the twins that this discovery disclosed. I then discuss how “digital housekeeping” (Tolmie et al., 2007) and physical housekeeping are co-implicated in processes of technological maintenance (or alternatively, disposability) within the context of families’ media ecologies. I suggest some ethical implications of digital housekeeping for sustaining broader ecologies in which home-work processes are embedded.

Within each case I (1) contextualize the activity setting by giving some background about particular families’ homemaking practices (2) analyze an activity in which children and/or their parents or siblings used technology within the activity to do some form of invisible homemaking and (3) relate this practice to learning vis-à-vis a technological ethic of care. Across all three forms of digital homemaking, I highlight how sociotechnical/work processes represent frequently hidden forms of families’ caring labor. In line with the larger argument across all chapters, I underscore how despite its invisibility, home-work represents essential forms of what I am calling “routine maintenance” that stabilize activities while creating unexpected opportunities for learning with technology.

1. Making Home “Work” by Sound-tracking Learning

Part of homemaking is making home a place that feels, smells, looks, sounds, and tastes “right” to families (Pink, 2006). Similar to multi-tasking, where a multiplicity of task elements contributed to accomplishing tasks (see Chapter 4, Figure 14), multiple senses are involved in families’ homemaking. Multisensory aspects of daily life pervade and saturate everyday experience, and yet, because they cannot be seen, they remain difficult to detect (Pink, 2009). As

one example, family routines often incorporate taking breaks and eating snacks, which invites unexpected opportunities for improvisational gustatory experiences during daily media rounds. For example, in our study, children's cooking frequently involved digital technology, such as learning how to seed a pomegranate or how to make lasagna (e.g. Paay, Kjeldskov & Skov, 2015).

In my observations of domestic life, acoustic conditions seemed to be particularly important for families when they arranged home environments for learning. Background noise in homes, including TV programs, street noise, or back channel conversations frequently constituted the ambient backdrop to children's focal activities. Star (1996) wrote that from a feminist perspective, the idea of home is of "that which is omnipresent, taken-for-granted and which enlivens the rest of life in a background fashion" (p. 31). Background noise serves this function. Acoustic dimensions of learning are essentially invisible and sunk into the background of everyday life, partly because they are audible. My observations in homes revealed rich acoustic environments that set a tone for learning, albeit invisibly.

When asked if her family's media or technology use had changed at all while they were in the study, one mother told us that she had begun to tune in to "little things, things you normally would not notice." She went on to explain how recently moving into a new home had changed their routines:

I almost always would have music playing constantly, but for the last three or four months I haven't had it. That's a big part of our normal life that seems like such a little thing. Like, 'so what, you don't have the radio on.' But, I MISS IT. I think it changes the setting and the mood of your house... That was the background noise, and sometimes it just changed the way that everybody moved. And now the background noise is silence, and talking, and arguing.

For this family and their five children, background music created a soundscape that promoted family harmony and wellbeing. It enlivened family life in a background fashion.

Across the families in this study, music was consistently part of daily routines, be it in the way they practiced musical instruments, played recorded music, watched music videos, sang songs, choreographed dance routines, or played video games like *Guitar Hero*. Playing background music emerged as one important way of using music at home to promote learning, leading to development of a sociotechnical practice I call “sound-tracking” that represents how background music enables listeners to organize and track actions according to acoustic surroundings. Whether in the context of emptying the dishwasher, completing a project for Science Bowl, or rehearsing for dance class in the living room, an important way of making home work for learning with technology was constructing soundscapes conducive to home-work. In what follows I describe how Natalie went about sound-tracking, a pervasive phenomenon across the families in the study.

Sound-tracking in “fast cleaning” videos

An avid dancer, Natalie was accustomed to not only choreographing dance numbers, but also choreographing other activities by choosing a soundtrack that created a particular environment for her media engagement or technology use. Natalie had a regular practice of playing background music while she worked on various projects, and she used a number of devices to accomplish this. A typical configuration involved tethering an external speaker to her laptop via USB, and selecting a song from you YouTube (e.g. Tchaikovsky’s “Swan Lake,” TLC’s “Scrubs,” or Katie Perry’s “Roar”). Using YouTube to listen to music has become a routine form of media engagement and one of the more common ways children consume and create music (Cayari, 2011). Because these songs are free and easily available, children frequently make use of this medium for their music listening. However, Natalie did not merely

listen passively to background music, tuning it out; rather, it actively motivated her to do homework and was a significant means of learning how to keep her house clean.

Like other children I observed, Natalie was interested in developing housekeeping skills, no longer satisfied to rely on adults to take care of her surroundings. Keeping bedrooms tidy and clothing wrinkle free was a point of pride for a number of participants, and their personal, private spaces were particularly important work sites that served such an organizational purpose. For Natalie, maintaining an organized bedroom did not come naturally, but instead was something that she wanted to learn how to do. These days, housekeeping can be learned online as well face-to-face through more formal channels (Brody, 2017). Besides getting instructions from her mom and grandma and observing them cleaning up, Natalie relied on YouTube's Fast Cleaning video tutorials.

We observed her watching an example of one such video, which was set to Rossini's "William Tell Overture," in which a woman cleaned her living room (Figure 5.1). For readers unfamiliar with this genre, it is a type of video similar to Unboxing and Grocery Haul video channels, popular examples of YouTube's extensive How To content. In Fast Cleaning videos, people are shown cleaning up kitchens, bathrooms, desks, or bedrooms in fast-motion. There are many thousands of YouTube cleaning video tutorials, attesting to the enduring centrality of housekeeping in social life; however the Fast Cleaning videos are concise and illustrate the steps to cleaning and organizing a room in broad sweeps, so to speak. These videos are typically set to music, and the soundtracks vary widely. Given her pastimes and practices- playing background music and watching cleaning tutorials- it is not surprising that Natalie decided to make one of her own.



Figure 5.1 Natalie listens to background music and watches Fast Cleaning tutorials.

Music organizes Natalie's actions (and closet)

Several children in our study used unsolicited reenactments of their daily media rounds as a way of showing us how they used media and technology at home (e.g. Pink, Mackley, Mitchell, Wilson & Bhamra, 2016). Natalie took this approach; on our first visit to her home, she spent over two hours familiarizing the researcher with her many technological practices. During a screen tour of her computer-based activities on her laptop, Natalie re-viewed a number of videos she had produced several months prior: music videos of herself singing using different video filters; a hairstyle tutorial; and a recording of cleaning her closet.

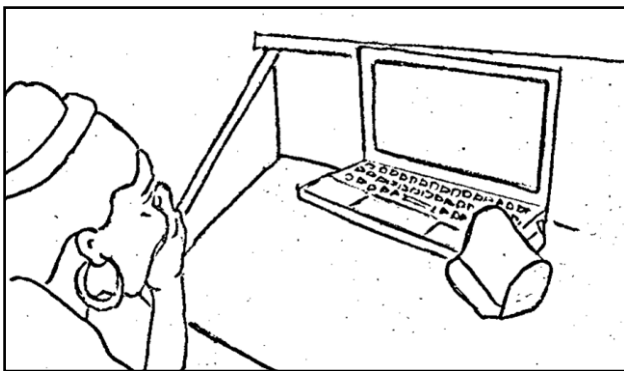


Figure 5.2 Natalie re-views her closet cleaning video. “I never want my closet to be that way again”.

As she watched the closet cleaning video, Natalie leaned in close to the laptop, at times covering her mouth, as if she could not believe what she was seeing. When asked by the researcher, who she had made these videos for, Natalie laughed self-consciously, “Nobody!” (Figure 5.2). Then she proceeded to explain how sometimes she would imagine that someone famous- like Justin Timberlake- was about to come over to her house. This motivated her to clean, so her room was not “junky” for her guest’s arrival.

As Natalie recounted her imaginings and re-watched her video, Justin Timberlake’s “Mirror” played in the video. She reported that listening to this song “really inspires me more to clean.” Later on, Natalie took us into her room to show how her closet still remained clean to that day, showing off her organized clothes and shoes neatly contained in boxes (Figure 5.3). She explained how now that her closet was clean, she was committed to keeping it that way, never wanting it to get away from her again. Sound-tracking, or the musical accompaniment to her cleaning routine, had choreographed a trajectory for her learning, and she was dedicated to staying on track and not falling back into disorderliness.



Figure 5.3 Natalie showing how she organized her closet and has maintained it.

Learning to care for environments

When children listen to recorded music in their everyday lives, it often carries meaning for them that extends beyond the musical content or lyrics (Batt-Rawden & Denora, 2005).

When Natalie listened to “Mirror,” she was compelled to clean her closet, partly because she imagined the singer might be coming over but also because the music literally choreographed her actions (Tulbert & Goodwin, 2011), allowing her to maintain focus on the object of activity.

Playing a soundtrack allows children to sound-track their routines, or stay on track during ongoing activities by creating acoustic conditions conducive to action. Furthermore, when Natalie reviewed her video, she reexperienced what it was like to clean her closet while listening to “Mirror,” helping her retrace her actions and recommit to caring for domestic space. In this way, sound-tracking also enabled her to keep track of her own responsibilities, once these were reconstituted by the acoustic environment of home. For Natalie, sound-tracking housekeeping routines was a significant means of learning to take care of her home environment.

The soundtrack helped her stay on track during- and long after- the task and to retrospectively retrace her work maintaining a tidy environment. Musicologists have theorized how music creates atmospheres or aesthetic conditions that organize action in particular ways. According to Batt-Rawden and Denora (2005) much of this is tacit, and how people set a tone for learning remains largely invisible. “Little things, that you normally wouldn’t notice,” like acoustic aspects of learning environments, affect learners, and with various consequences. Attending to multisensory dimensions of learning that are invisible- because they are audible- is important for supporting learning in everyday domains like home-work. To the extent that learning depends on multisensory experiences, sound-tracking is a key way that children make home “work” for learning with technology.

2. Making Infrastructures Work for Learning Around the Neighborhood

Another background process that subtends learning environments but is consequential for learning involves the networked infrastructures that underly sociotechnical systems. Networked infrastructures, what Star (1999) called “information infrastructures,” are difficult to see because they depend on historically constructed legacy processes that become deeply embedded in social life (Star & Ruhleder, 1996; Ribes & Finholt, 2009). Often the material components of such infrastructure are buried beneath the earth or far above the clouds in space. However, upon breakdown, infrastructures surface, albeit momentarily, and users grapple with them face to face in real time (Star, 1999, Star & Ruhleder, 1996). In mobile and networked workplaces like homes, the potential for such technological breakdowns- and the necessity of finding work-arounds- proliferates. Such was the case when I accompanied ten-year-old Oliver and his six-year-old brother Francis on a walk around their neighborhood one summer afternoon.

The brothers were on summer break, and during the weekdays, their teenage uncle, who was visiting for the summer from Florida, would take care of them, accompanying them to swim lessons at the Aquatic Center down the road or minding them while they played video games or while Oliver did homework for his tutoring sessions. Oliver excelled at math and was preparing to study Algebra, which he would not encounter in school for several more years. When he was not engaged with pre-Algebra homework, he played with his friends at the local parks, practiced soccer and, like all the children in our study, read books and watched TV. During these discretionary activities, he and Francis were virtually inseparable, and they spent almost all their summer hours playing together. Even in the midst of putative play time, children engaged in socially significant forms of home-work, and sibling care was a key example of this pattern.

Sibling care is an enduring form of distributed work in families which endures across cultures and generations (Goodwin & Cekaite, 2018; Rogoff, Morelli & Chavajay, 2010).

In the Irving family, sibling care was a regular part of everyday routines, one that is easy to overlook in studies of families' domestic work but nonetheless essential for making home work. When Oliver enrolled in the study, the brothers' favorite joint activity was playing video games together on their X-box upstairs. Within weeks, the hit AR game *Pokémon Go* was released, transforming the work of sibling care by reconfiguring the technical infrastructures undergirding Oliver's and Francis' joint media engagement. Both brothers had their own mobile phones (technically, Francis' was only provisionally his own, as it typically served as the loaner phone his parents provided when their extended family visiting from Columbia or California). Having their own phones meant that, without needing to borrow their parents' phones or wait for someone to take them out to play, the brothers could play *Pokémon Go* around the neighborhood together on separate devices. This was something that families all over Seattle were doing en masse that summer as the game ignited a firestorm of mobile media engagement (Sobel, Bhattacharya, Hiniker, Lee, Kientz & Yip, 2018).

Pokémon Go walk-along on the BPA Trail

Researching family walks is becoming a more common means of studying learning on-the-move (e.g. Marin & Bang, 2018), and some of this work places a focus on technological mediation of walks (e.g. Kullman, 2015). Following such methods, I accompanied Oliver and Francis during what I have come to call a "Pokémon-Go walk-along." One object of *Pokémon Go* is to find Pokémon (small creatures of different varieties) and to catch them by throwing different types of balls at them by flicking the screen, which, using the phone's camera, overlays an animated, live Pokémon on a real world background image. An important point to note is that

the closer one lives to a dense urban center, the more Pokémon they will catch and collect, and the more active and complex their game play will be. Playing *Pokémon Go* in Seattle is very different from playing the game in the suburban town where Oliver and Francis lived, as they were painfully aware. As they learned, materials and places matter a great deal when working around the designs of everyday infrastructures (Irani, Dourish & Mazmanian, 2010).

The 3.6 mile long BPA Trail we walked along, installed in their suburban neighborhood in the 1990s, was the first modern paved trail in the area (Figure 5.4, Frame B) (Myrick, 2015). The BPA trail is named after the Bonneville Power Administration, and it carves a path underneath the overhead high voltage transmission lines built by the power administration, which is one of the nation's largest high voltage transmission systems (BPA) (Figure 5.4, Frame D). About one third of all the power delivered to the Pacific Northwest region comes from BPA, which was founded in 1937 to sell power generated by the Bonneville Dam and the Grand Coulee Dams (Figure 5.4, Frame A). These dams transect the middle portion of the Columbia River, which serves as the natural boundary of Oregon and Washington (BPA). At a smaller scale, the subsection of the BPA trail we walked marks a boundary between Tacoma in the South and Seattle to the North (Figure 5.4, Frame C). Across scales, our *Pokémon Go* walk-along was embedded in an ecology of technical infrastructures (Star & Ruhleder, 1996).

Overhead high voltage lines are uncommon in urban environments, where power lines are typically buried underground; yet, they are a fixture of suburban life, where the lines direct and deliver power between large population centers (Mattern, 2017). When I first witnessed the massive expanse of powerline structures, crisscrossing the landscape lined thickly with invasive, yellow Scotch Broom plants, I was a bit daunted by their size. In addition, the power lines emitted an omnipresent, menacing buzz during our walk, and I worried that the unwanted noise

would drown out our talk in the video’s audio recording. Coupled with the high winds distorting the camera audio and the fact that this area was on a flight path to nearby Sea-Tac Airport, we coped with a challenging acoustic environment on our walk. Unlike Natalie’s background music, this background noise was decidedly *not* conducive to our work.

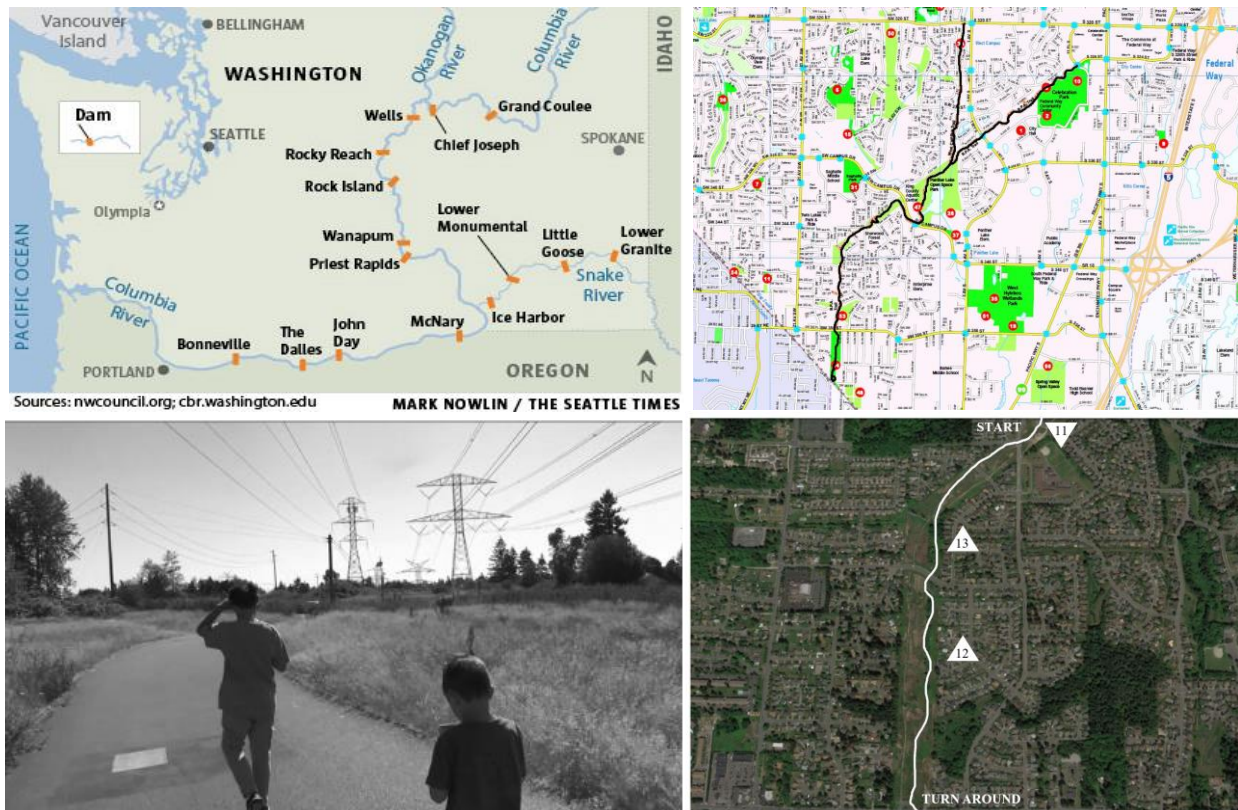


Figure 5.4 Home-work embedded in an ecology of infrastructure. *Clockwise from top left.* Map of dams from which the BPA draws power (A). BPA trail map (B). Section of the PBA trail they traveled on their walk (C, numbers correspond to physical locations of figures/transcripts below, direction of arrows indicate whether events occurred on the trip out or the return trip). Image of the BPA high tension wires and trail they traveled on their walk (D).

When I mentioned the powerlines to Oliver, he responded with vague annoyance, sighing and shrugging it off. He mentioned that you can sometimes hear the “static.” It was unclear whether he too was bothered by the lines or, rather had resigned himself that this was just a taken-for-granted part of a routine walk down the trail. Technological infrastructures have this

effect of being sunk-in to everyday life, forcing us to accept unquestioningly how they came to be and to cope with or develop work-arounds for the aggravating ways they disturb our daily rounds. A long history of technological development subtends infrastructures like the BPA power system that literally make so many things run (Mattern, 2017). Eventually, we cease to notice the existence of the very processes that make home work (Star, 1999). Soon enough, however, a parallel infrastructure became visible, compelling the two to develop work-arounds on this neighborhood walk-along.

Locating Pokémon meant locating work-arounds

Despite the convenience and freedom afforded by the independent use of their own phones, the brothers were hamstrung by slow cellular connectivity, a common issue for families' mobile technology use (Rideout & Katz, 2016). Oliver and Francis experienced what they called “laggy” gaming, when the game would freeze and they would need to restart the app. At one point on our walk, Francis informed me that “this game is very good, but it is very laggy.” When their game froze, Oliver and Francis would typically exit out and restart the app to try to work-around the lag. Other children I walked-along with referred to such problems as “glitching.” Children often develop particular vernacular for describing their troubles with technology; they also design inventive approaches to coping with breakdowns when technologies resists their agency (Taylor, Silvis & Stevens, 2018).

In addition to the game being laggy, the GPS feature of the game was particularly troublesome for Oliver and Francis. Throughout their walk, and even beforehand when they were gearing up at home, Oliver repeatedly attempted to assist his younger brother, whose game application inexplicably failed to geolocate him on the game map. An important feature of the game (subject to continuous app updates) is a map showing nearby Pokémon. Knowing which

Pokémon are nearby helps players navigate to find them and score points. In this state, they were unable to locate Pokémon; with Francis' map inoperable, he was not only unable to see Pokémon, the game was unable to "see" him. Sometimes invisibility cuts both ways (Star & Strauss, 1999). On the other hand, Oliver's GPS *was* working, leading them to try to leverage Oliver's functioning game and their shared knowledge of the networked infrastructure to work-around Francis' technical troubles.

To accomplish this, they attempted a number of work-arounds. First, still at home, gearing up for the walk, they sat together on an armchair and Francis whispered to Oliver to move his phone closer to Francis', his idea being that they could somehow transmit the GPS signal from Oliver's game map to Francis' (Figure 5.4a). This approach seemed akin to the "beaming" function once available on early Android phones that allowed content to be transferred from one device to another by tapping them together. Francis repeatedly asked Oliver to move his phone closer, until eventually Oliver informed him that "it doesn't work that way."

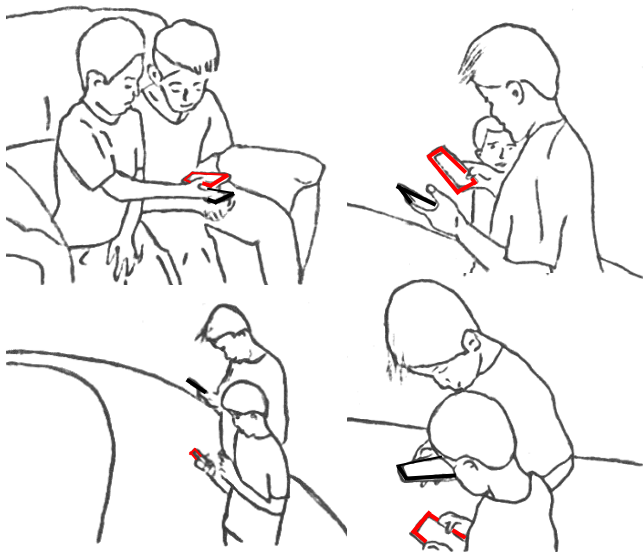


Figure 5.5 Multiple workarounds on Pokémon walk-along. Clockwise from top, left: (a) "Beaming" the signal by moving phones close together; (b) Modifying app settings; (c) Re-starting the app.; (d) Playing side-by-side to trick Pokémon into appearing on Francis' phone. *Phone cases are color-coded (Oliver's is black, Francis' is red).*

Once outside the house, Oliver supported Francis' play by devising mobile work-arounds: offering suggestions like restarting the game; fiddling with various game settings; and playing side-by-side in the hopes that a Pokémon would somehow appear on Francis' phone once Oliver was catching it (Figure 5.4 b-d). These attempted work-arounds involved a variety of configurations of technologies and bodies, "torqueing" the brothers' play even as they mobilized strategies to try to bend the technologies to fit their needs (Bowker & Star, 1999). On their way to the trail, Oliver caught a Pokémon, although this at first appeared challenging. He insisted that he was "hitting it, it's just not doing anything" (Figure 5.6, line, 2-3). When he finally caught the Pokémon, his brother, who had been playing next to him (in the hopes that he too would be able to see it), complained "there's no Pokémon for me" (line 6), "that's not fair" (line 14). Oliver attempted to keep his brother's spirits up as they continued looking for Pokémon.

1	Oliver:	There. Wait, why isn't it hitting? U:h-	
2		huh. I'm hitting it, it's just not doing	
3		anything. <i>((swiping screen))</i>	→
4	DS:	What's it doing?	
5	Oliver:	Okay, there. I caught it.	
6	Francis:	There's no Pokémon for me. [game	
7		music plays in background] Why's there	
8		no Pokémon for me?	→
9	Oliver:	Caught it!	
10	DS:	Got it?	
11	Oliver?	Yeah. <i>((turns and walks up the street</i>	
12		<i>towards the trail))</i>	
13	DS:	Cool.	
14	Francis:	That's not fair. <i>((walks after his</i>	
15		<i>brother))</i> I guess no Pokémon for me.	→

Figure 5.6 Oliver catches a Pokémon.

Caring labor as a context for learning to navigate infrastructures

Not indifferent to his brother's plight, Oliver continued to address Francis' technical difficulties as they commenced their walk, stopping to ask him multiple times if he was having any luck and giving him tips (Figure 5.7, lines 16-19). In the midst of all their trouble, Oliver couched troubleshooting in moral support. At one point he walked with his arm around his younger brother's shoulder, as if in solidarity. He commiserated with him, kindly assessing that it was "bad luck" that Francis wasn't finding any Pokémon and encouraging him to "stay by me." (line 20). Such "corporeal intertwining" (Goodwin & Cekaite, 2018, p. 5) was an intimate example of how the work of sibling care can get overlooked. Yet, it served an essential purpose in terms of working-around infrastructures.

As long as they were close together, the brothers could swap phones and ideas. On the one hand, caretaking served an important role in the forms of articulation work the brothers were doing as they troubleshooted their way around the neighborhood and its networked infrastructure. On the other hand, sibling care-taking served much more than an instrumental function; it provided significant emotional labor that is part and parcel of media engagement at home (Stevens et al., 2008). This recognition of the emotional labor of media engagement stands in stark contrast to portraits of kids as isolated and standoffish when they are immersed in game play (c.f. Turkle, 2010).

- 16 Oliver: [Francis], any luck yet?
 17 Francis: Hm-m
 18 Oliver: No? ((puts arm around brother's shoulder))
 19 Francis: (softly) Hm.
 20 Oliver: Here, stay by me. ((rubs brother's back))



Figure 5.7 Oliver comforts Francis.

As our walk progressed down the trail, it became increasingly clear that something was not right with Francis' game (or phone). Attempting to identify the problem, but not really understanding the game, I suggested a couple theories over the course of the walk. Once I joked that there was a "Pokémon conspiracy" against them; another time I suggested that the Pokémon were "running away" because they knew the brothers were looking for them. Neither of these explanations got much traction. A third time, on our return trip home, I mentioned that the game might not "know where you are" (Figure 5.8, line 21). Oliver and Francis laughed and exchanged knowing looks (as if sharing an inside joke about the hair-brained researcher) (line 22), but then my offhand comment about "signals" (line 23) gave Oliver an idea (line 25).

He traded phones with Francis (line 26), presumably to modify location services settings, and continued walking down the trail while modifying features of his brother's app. A minute or so later, this work-around proved successful and Francis was finally visible to the game map (line 29). However, no sooner had he happily returned his brother's phone to him, than Oliver exclaimed that *his* game was now frozen (line 31), at which we all laughed, recognizing the unremitting nature of infrastructural issues. Breakdowns in infrastructures have a way of

snowballing, and making one thing visible often renders another invisible (Star, 1999). Though the brothers' technical troubles were likely unrelated, multiple failures and contingencies of networked infrastructure forced them to develop ongoing work-arounds on the walk-along.




21 DS: Maybe it doesn't know where you are.
 22 Oliver: *((chuckles, smiles at his brother))*
 23 DS: It needs to have our signal to show us,
 24 right?
 25 Oliver: [to Francis] Do you- wait. Hold my
 26 phone *((trade phones))* (72.0) → 
 27 *((continues walking down the trail while
 28 he fixes Francis' phone))*
 29 Yeah, it's working now. → 
 30 Francis: *((takes phone back))*
 31 Oliver: Oh, now MINE is frozen.
 32 All: (laugh)
 33 DS: Oh no!
 34 Francis: Such bad luck with us. → 

Figure 5.8 Oliver fixes Francis' phone at last.

Strauss (1985) emphasized that caretaking labor was a common form of articulation work. When systems break down, it is often the unseen labor of secretaries, nurses, housekeepers, or childcare workers that greases the wheels and get social machinery moving again. Children are also important caretaking workers. Oliver managed vital articulation work as he guided his brother along the BPA trail, ultimately solving their Pokémon connectivity problems. Layers of invisibility (Star & Strauss, 1999)- not being “seen” by the game, navigating black boxes of networked infrastructure and energy infrastructure, as well as the intimate work of sibling care- were all involved in their learning on-the-move. While they were not at home but close by in the neighborhood, Oliver and Francis managed to make domestic routines like sibling care and playing video games “work” for learning with technology.

3. Making Digital Housekeeping and Physical Housekeeping Collide

Despite the ability of children like Oliver and Francis to make just-in-time repairs during moments of technological breakdown (Taylor, Silvis & Stevens, 2018), *parents* continue to contribute much time, energy, and resources to supporting children's technical expertise (Barron et al., 2009) and ordinary domestic labor (Klein et al., 2013). While I observed children doing a great deal of housekeeping (both digital and physical), their parents of course play a vital role in ordering and maintaining home learning environments. Children's chores are frequent sites of learning (Kremer-Sadlik & Gutiérrez, 2013), but they do not mitigate the long hours of work parents put in at home. And in today's networked homes, families' collective housekeeping involves more than tidying up rooms. Where expensive digital devices are concerned, it is important to families to keep machines and media in good working order, a form of work that has been termed "digital housekeeping" (Tolmie et al., 2007).

Steph, mother of multi-tasking twins Oscar and Eddie, stands as an impressive example of housekeeping in a digital age. In Chapter 4, when we last saw Steph, she was chasing down movers to return their drill to them after a busy afternoon preparing for the arrival of a new couch and coordinating the twins' multi-tasking during homework time. Across my observations in their home, Steph engaged in constant forms of conventional housework: she washed dishes; did laundry; prepped and cleaned up meals; tidied up the living room; cleared off tables and work surfaces; organized the twins' bedroom (taking armloads of items down to basement storage); made grocery and To Do lists; answered phone calls; and set multiple timers to keep housekeeping activities on track.

A former owner of a professional housecleaning service, Steph was skilled at ordering home environments, and this expertise showed in how she kept her own home and how she

organized daily routines. Housekeeping, sometimes believed to be “neck down,” and not “neck up” (Rose, 2004, p. xix), is not to be taken for granted, nor is the work seemingly ever done. As LeGuin (2012) poetically put it, “housekeeping, the art of the infinite, is no game for amateurs” (p. 315). It takes skill and practice, and Steph demonstrated her deep knowledge of housekeeping through her enactment of everyday domestic routines. Because her sons were deeply invested in using digital technologies, Steph’s scope of work now incorporated digital housekeeping. Housekeeping and technology are not separate elements of home life, they are co-implicated in everyday routines (Pink, 2004) and in making home work.

A surprising discovery

One day, as she tidied up the living room and the twins worked on their homework at the kitchen table, Steph made a surprising discovery. While closing the cover of Oscar’s tablet (the twins’ tablet covers, like their outfits, were typically color coded, Eddie’s blue, Oscar’s red) she glanced at the screen and noticed it was cracked across one corner. She interrogated Oscar about the tablet, directly asking him how his tablet broke (Figure 5.9, line 1). When he claimed not to have noticed it, she asked dubiously how this was possible (line 6). She carried the tablet over to the table and showed him how it was cracked “from here to here” (line 10). Not having received a satisfactory answer from Oscar, she redirected her next question to Eddie, asking if *he* had noticed it (line 11). In defense of his brother, Eddie presented the possibility that “the baby” broke it (line 12), referring to the child of a family friend. Quickly rebuking his explanation, Steph insisted that he not “blame it on the baby” (line 13). Reciprocating his brother’s offer of help, Oscar lent warrant to Eddie’s claim, explaining that the baby had been walking on his tablet on the bed the night before and presumably not paying attention (line 14).

- 1 Steph: How did your tablet break? *((picks up tablet from couch in living room))*
 2 Oscar: Uh:uh
 3 Steph: *((walks towards twins at kitchen table))* Did you not notice that the
 4 screen was completely cracked in the corner?
 5 Oscar: No *((looks down at homework))*
 6 Steph: You didn't notice this. How could you not notice this?
 7 Oscar: *((looks at tablet))*
 8 Eddie: *((continues working on homework without looking up))*
 9 Oscar: That's what it looked like
 10 Steph: Look-it, it's cracked from here to here *((shows Oscar the screen))*
 11 [to Eddie] Did YOU notice this was broken? How did that happen?
 12 Eddie: I don't know, maybe the baby?
 13 Steph: Do not blame it on the baby.
 14 Oscar: He was WA:LKING o:n it.

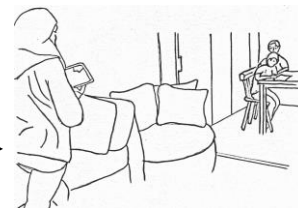


Figure 5.9 Steph discovers the broken tablet.

As these details of the broken screen emerged and the baby was scapegoated (Figure 5.10, lines 15-18), Steph resubmitted her initial charge that Oscar must have noticed it was broken (lines 19-20). He then hedged, suggesting that he “was laying down” (line 18) and “it was dark” (line 21). For Steph, these excuses did little to vindicate Oscar’s initial lack of transparency in accounting for his broken tablet. Shrugging, she proceeded to inform him that he “will just have to work with a broken one for a while” (line 22-23). Considering the fact that the twins almost exclusively used their tablets for playing games, it is notable that she referred to this as “work” and not “play,” suggesting how tolerating technological breakdowns is part of making home work. Then Steph began to bring closure to the charged exchange, by concluding that “you should have told me right away if you knew about it” (23-24). Oscar reiterated that it was dark (line 25), but in the clear light of day, this defense held little weight. Steph intimated as much when she reminded him that he had just been playing with it (line 26).

15 Steph: *((returns to the living room))* Where was it at? →
 16 Oscar: It was on the bed?
 17 Steph: Uh-huh
 18 Oscar: And I was laying down (2.0) using it
 19 Steph: [And wouldn't you notice if the baby broke
 20 your tablet? So did it happen last night?
 21 Oscar: [It was dark. Yes
 22 Steph: You're telling me it happened last night. (3.0) Alright, well you can
 23 work with a broken one for a while. (3.0) You should have told me
 24 right away if you knew about it.
 25 Oscar: It was dark anyway.
 26 Steph: It's not dark right now, you were just playing with it.

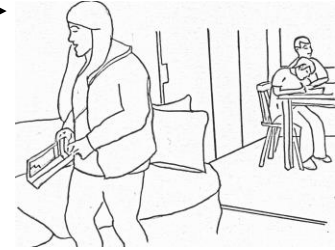


Figure 5.10 Oscar offers an explanation.

After a pause, during which he watched TV (and perhaps considered how to convince his mom that he was somehow justified in not noticing/reporting the problem), Oscar used exaggerated hand gestures to explain that he had been using it in landscape mode while playing, and not portrait mode (Figure 5.11, lines 28-29), reasoning that the orientation of the screen affected the visibility of the crack. Not buying Oscar's rationale, Steph short circuited him, reiterating that *she* noticed it right away (line 30). While Oscar continued his bid by using cycles of gestures to alternately index using his tablet in landscape and portrait modes (line 32), Steph placed a coda on their brief exchange. Making explicit what had lurked beneath the surface of their exchange, she said softly, "I think you knew it was broken and didn't want to say anything" (line 33). Implicitly accepting this assessment, Oscar quietly went back to doing his homework (line 34), and Mom continued sorting her own paperwork on the couch across the room.

27 Oscar: (4.0) I was holding it *((gestures in shape of landscape
 28 view, alternates hands and arms to portrait view))*
 29 Steph: I noticed it immediately when I looked at your tablet
 30 that the screen was broken.
 31 Oscar: *((repeats cycle of gestures indexing changing tablet
 32 orientations four times))*
 33 Steph: I think that you knew it was broken and just didn't want to say anything.
 34 Oscar: *((stops gesturing, goes back to homework))*



Figure 5.11 Oscar explains himself with gestures.

Later on, Oscar returned to the couch to play games on his tablet, and there was no further mention of the broken screen. Whether or not he had seen the crack prior to their exchange, for Oscar, visibility created unwanted trouble. Nonetheless, the broken screen showed what can happen when digital housekeeping and physical housekeeping collided: routine repair and maintenance of devices and conversations become visible. Whereas making sociotechnical breakdowns visible may be useful from one person's perspective, this causes trouble for people used to flying under the radar, or what Star and Strauss (1999) referred to as the tensions between "good invisibility" and "bad invisibility" (p. 24).

The significance of this exchange was put in perspective for me by a seemingly minor housekeeping moment in a subsequent visit. A number of weeks after the broken screen incident, Mom was straightening up the living room once again when she stumbled across Oscar's tablet, hidden between two throw pillows. This time, the tablet's condition was not made a topic of conversation, but rather, the tablet was simply set aside someplace more visible and less susceptible to being crushed. This is a common characteristic of work processes and the technical infrastructures that underly them: where a device becomes a topic in one instance of housekeeping, it can be swept under the rug in another (Star, 1999). But what was behind the change of heart, and what conditions made a device an object of concern for housekeeping one day, and not worth mentioning another? Under what conditions does work or technology become in/visible and for whom? To answer these questions, we must more closely examine the family's approach to digital housekeeping related to the twins' prized possessions: not their dogeared Pokémon Encyclopedias, but their tablets.

Learning to take care of technologies

As with any cherished possession within individual families, the Hernandez's had a storied history of using tablets, replete with personal meanings (Csikszentmihalyi, 1991). In our initial interview, Steph explained how it had all begun five or six years before, when she decided to buy her father the family's first iPad, the first generation Apple tablet. At the time, she recalled, the iPad was really expensive, and getting one with "all the bells and whistles," cost her much more than she would have spent on herself. Still, it was important to her that she get him the top of the line tablet, because "he does everything for everyone." Nothing but the best would do. When Steph's mother got her first iPad, the story was rather different. Steph explained that her mom traded a friend something for her friend's iPad because, for this friend, it was "sooo two months ago." Referring to her friend as "Mr. Technology Guy," Steph stated that what was nothing to him- just an old iPad- was valuable to her Mom, and that subsequently, her parents had splurged on iPads for the twins, too. However, these Apple tablets remained at the grandparents' house a mile or so away, where the twins could use them when they visited, which was often (Figure 6.8 B depicts this arrangement).

Thus, Eddie's and Oscar's "away" tablets were iPads, while their "home" tablets were Android. Steph rationalized that Android tablets are cheaper, adding that she always bought the warranty because tablets get cracked, broken, or spilled on. Replacement plans are reasonable insurance against the predictable disrepair that befalls many of our small mobile devices (Gabrys, 2013). As these ubiquitous technologies are carted around on family trips, spilled on, lost, and even stepped on by clumsy babies, they become increasingly disposable. Steph explained how she and the twins had gone through twelve or so tablets at this point, and they had all broken at least one. She readily admitted "I've broken some, I'm not gonna lie," after Eddie

was quick to remind her that he and his brother were not the only culprits. Because she cared for the twins most of the time, and they were most often with her, they were more likely to break one when they were under her supervision, knowing that they could just take them back to Best Buy and get another one.

Tensions abound in the tablet economy of this family, where multiple invisible forms of labor and technological maintenance sit in uneasy relationship. First, Steph discovered the broken tablet while cleaning house, and housekeeping is a paradigmatic example of invisible work. Second, Oscar claimed not to have noticed the cracked screen, however trouble ensued when the technological breakage became visible (to his Mom). Third, Oscar and Eddie had been caring for a friend's baby when the screen was broken, and the labor of children as caregivers of other children is often overlooked. Fourth, the family's pattern of replacing broken tablets reveals something else about sociotechnical systems: when exchanging broken devices becomes embedded in the daily media round, it becomes easier to devalue the hidden labor it takes to produce technologies in the first place. Such contradictions introduce critical questions. When even our prized possessions are disposable, what is the value of housekeeping in a digital era? Perhaps what is needed is for digital and physical housekeeping to come into better alignment, whereby tidying up digital devices and taking care of them is as routine as tidying up the house and taking care of it.

The twins' tablets acted as a vital site for teaching and learning local values associated with technologies, maintenance, and breakdown. Technologies are not separate from an ethics of care or conviviality, they are part and parcel of people establishing shared understandings of their responsibilities to each other and their environments (Illich, 1973). In a sense, the discussion about the screen actually acted as a smokescreen obscuring deeper moral questions

Steph implicitly posed to the twins about collective responsibilities to one another and disposability of technology. On the surface, it was broken screens that were at issue, but hidden in the technological breakdown were lessons about moral accountability for their actions that Steph wanted the twins to learn. And deeper still were complexities of living and learning in a sociotechnical environment predicated on obsolescence and replacement, where making home “work” complicates a technological ethic of care.

Discussion

In this chapter, I presented three sociotechnical practices for what I call invisible homemaking that are implicated in families domestic labor: sound-tracking, mobile work-arounds, and (digital) housekeeping. These practices support families maintaining traditional forms of homemaking, such as child care or housekeeping, even as these routines are being reconfigured by digital technologies. Invisible homemaking signals how the work of holding everyday sociotechnical systems together often goes unseen, either because it represents the labor of women and children or because it is actually not visible, it is audible. I have suggested that private spaces of home are particularly good at hiding such work, because although home is a valuable site of learning, domestic labor has historically been marginalized and undervalued. I have also emphasized how sociotechnical practices themselves are co-implicated in the invisibility of forms of domestic work, especially those performed by women and children. Finally, I have illustrated how these practices are part of developing a technological ethic of care.

These findings illustrate how invisibility is multiply configured in sociotechnical arrangements. In conceptualizing invisible work as “layers of silence” Star (1995) emphasized how “deleting the work” (p. 98) occurs across multiple aspects of work processes as these are black boxed. I represented each of the cases in this chapter in terms of multiple layers of silence

or invisibility (Figure 5.12). For Steph Hernandez, it is not only that she, a single mother of two children, was responsible for the bulk of her household's physical housekeeping. There was also invisible digital housekeeping that she performed to maintain routine sociotechnical practices that constituted her family's daily media round. Thus, her work is doubly invisible because maternal labor is often deleted from accounts of valuable labor *and* much of the work to keep sociotechnical systems in order is taken for granted. It is only when breakdowns occur or when screens literally break, that the hidden labor of digital housekeeping becomes visible.

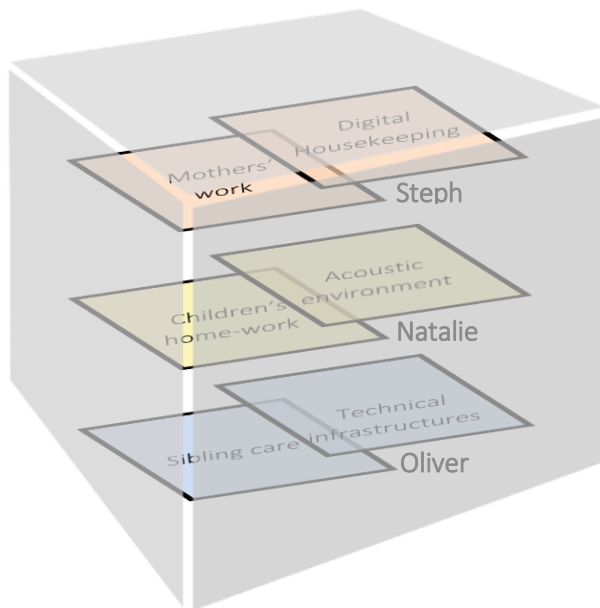


Figure 5.12 Un-blackboxing multiple layers of invisible work of homemaking.

Paradoxically, though amplified by sound-tracking and made publicly available in the acoustic environment of home, Natalie's housework also represents layers of silence. It is not only the case that children's chores are largely unrecognized as important forms of learning and contributions to family life. It is also true that the acoustic atmospheres that set a tone for learning are not well understood. Because they are literally unseen, multisensory aspects of learning, such as sound-tracking, often remain unaccounted for. However, music listening is an

important part of accomplishing tasks at home that support children's sense of responsibility for their physical environment. Insofar as music listening today is digital and embedded in complex sociotechnical configurations (Vestad, 2010), practices like sound-tracking are layered onto already marginalized forms of work at home.

Finally, Oliver's work to navigate his neighborhood's networked infrastructure is a prototypical example of Strauss and Star's (1999) layers of silence. Sibling care, an invaluable and invisible aspect of family life and learning has gone largely unexamined in studies of children's media engagement. Whether supervising his younger brother at home while they played video games or walking home from the aquatic center, this form of caring labor is easy to miss. However, this deletion of Oliver's work was significantly mediated by the technologies they engaged with while they walked down the trail together playing *Pokémon Go*. Their activities were inextricably embedded in networked infrastructures- systems, settings, and structures which they struggled to make visible and workable on-the-move.

These findings align with- and update- much work in the history of domestic technologies, from the washing machine to the television. Fortunati (2018) commented how "families, like any other organization, use machines to reshape their internal organization and division of labor in order to adapt to the changing rhythms of social life" (p. 267). I have emphasized how the introduction of new technologies in homes actually reinforces a *gendered* division of labor and additional work for women. Whereas the television in the 1950s stood in for mothers as an alternative form of child supervision, it nonetheless freed her up to do more work in the kitchen (Spigel, 1992). Today's mobile screen-based devices do similar work, in terms of displacing, but not replacing domestic labor. For example, there is now much digital housekeeping required of families, as we saw in the case of the Hernandez family. Technology

does not mitigate the second shift parents work once they get home (Hochschild, 1989), and in many ways, there is more to do than ever in a digital era.

I believe the concept of digital housekeeping is useful for understanding important sociotechnical work that families perform in their homes. Indeed, keeping devices in working order is essential for accomplishing home-work, and I observed many families performing maintenance work of this sort. However, in reconceptualizing housekeeping as digital, Tolmie and colleagues (2007) failed to recognize how *physical* housekeeping- tidying up rooms, dusting off surfaces, organizing work areas- still contributes to everyday household routines, even as these increasingly involve the digital (Pink & Mackley, 2013,2016). Moreover, theorizing of digital housekeeping has explicitly neglected the role of a gendered- and I would add to this, an age-based- division of labor in family life (Kennedy, Nansen, Arnold, Wilken, & Gibbs, 2015). While Tolmie and colleagues (2007) acknowledge how gender still structures the home, they qualify their perspective, writing,

We prefer to suspend the broad concerns with gender that occupy mainstream social scientists, and instead seek to inspect the particular demands of digital housekeeping from the perspective of *householders members*- particularly from the point of view of how members themselves, see, understand, and reason about the relationship between technology and the home in the course of situating within their ongoing domestic affairs” [emphasis in original] (p. 333).

In my view, a perspective on homemaking that remains agnostic to gender significantly undermines the power of their sociotechnical argument, because it fails to recognize how technologies are powered, both in the political and technical sense. Women and people from nondominant backgrounds often do not explicitly characterize their experience as one of

marginalization precisely because of the precarity of their labor within stratified social systems. It is the very nature of invisible work to not be spoken of or seen (Star, 1991). Therefore, waiting for our participants to render accounts of their housekeeping as patriarchal, sexist, or oppressive is as futile as waiting for a magic genie to pop out of your computer screen and tell you exactly why you are having trouble connecting to the internet. Black boxes lack transparency for very specific reasons, and it is incumbent upon social scientists to critically examine what is inside them, not wait for the boxes' contents to naturally reveal themselves. It is for this reason, that I have attempted to situate analysis in complex sociotechnical and sociopolitical circumstances, believing that in this moment, “studying action is far from enough” (Clark, 2005, p. xxx).

It should also be noted that, while all the families in this study were headed by heterosexual couples, this is of course not representative of all families, nor should a domestic history that centers heteronormativity necessarily be the starting place for understanding changing sociotechnical practices (Moore, 2007). Without essentializing gender categories or assuming a naturalistic distinction between mothers or fathers, I believe it is important to recognize that gender and gendered divisions of labor are socially constructed, an important contribution of the feminist theories I have drawn on in this chapter. Because we live in a patriarchal culture, I assume that this to some degree structures the expectations and experiences of men and women. Given this, who is excluded from digital homemaking and why? How do particular constructions of maternal labor, gender categories, and heteronormativity limit potential analyses of sociotechnical designs for home-work? There is important work to be done at the nexus of technical and domestic labor that disentangles gender from caring work and makes visible a technological ethic of care that is for everyone (Ahmed, 2017; hooks, 2015; Hochschild, 1989).

In addition, taking seriously Star and Strauss's (1999) original concerns about invisible work means interrogating the risks and exclusions inherent in making some people's work visible. Star (1996) recognized how making *home* visible, or what she refers to as "homing" (p. 40), positions *homeless* as a marked category. How are families who experience insecure housing navigating the daily technical work of living and learning? How can homeless families' designs for learning with technology be made visible or viable (e.g. Le Dantec, 2016)? As we uncover the conditions under which some people's work becomes invisible and critique social and technical structures that historically devalue caring labor, we must expand the types of places we consider worthy sites for caring labor or technical work. Saying that places are not only made (Taylor & Phillips, 2017), but made to work in particular ways then opens up questions about who we are not making place for or how the very notion of home-work unintentionally universalizes families' diverse experiences.

It is also important to consider the entangled ethical and epistemological ramifications of doing what I have come to think of as "visibility work," or the explicit dis-embedding and foregrounding of background work by researching and recognizing hidden labor. As Strauss & Star (1999) saw, rendering one thing visible can have unintended negative consequences for workers. Many people whose labor is marginalized or who have been oppressed in and through their work suffer more *after* their work comes into view. Such "bad invisibility" (Strauss & Star, 1999, p. 24) can happen either because visibility makes people's work subject to increased rationalization or because they come under heightened scrutiny (Suchman, 1995). For example, Oscar's caretaking for their friend's baby brought forth trouble (for him). It is also possible that invisibility allowed people a degree of freedom to subvert dominant ideologies without detection (Rollins, 1985). Visibility can inadvertently make people more vulnerable, and not all learners

will want their work to be seen. Even when they do, the downstream threats that visibility work poses for people's present work processes cannot all be known in advance (Hall, 2000). For example, in Chapter 3, I mentioned one study participant's refusal to consent to the sharing of her video data outside of our research team. Nonetheless, I believe understanding how families design for home-work within a matrix of visibility and invisibility is necessary for developing more equitable and ethical notions of labor and learning.

My analysis of home-work suggested some ways in which home-work supported developing an ethics of care regarding learning technologies. It is not inevitable that technologies must separate people from each other (c.f. Turkle, 2010). All of the families we visited were doing a significant amount of caring labor, which at times intersected with technology. I have illustrated three versions of this kind of work, which suggest an intricate relationship between technology, homemaking, and care. In Steph's case, this meant teaching her sons about ethical norms in the context of technology use; being forthcoming about broken devices was important so that the family could address breakdowns in the way they saw fit. In Natalie's case, developing a sense of responsibility for caring for her home environment was animated by sound-tracking and amplified by making- and re-viewing- a video of herself cleaning. For Oliver, the intimacy of sibling care was embedded in his mobile gaming, itself intricately entangled in networked infrastructure.

Furthermore, maintaining routine practices and material conditions of home is not simply a precursor to learning with technology. Caring for and maintaining sociotechnical relations is a central means of learning at home. As Brand (1994) put it, "maintenance *is* learning" [emphasis in original] (p. 127). As children went about learning to take care of their devices, they were also learning to care for each other and their broader learning environments. This requires them

developing intimate knowledge of time management, material practices, and emotional competencies that we have yet to find ways to value *or to make visible* in scholarship on learning (Hochschild, 1989; Rose, 2004). Children's home-work reveals hidden connections between children's learning and a technological ethics of care (Puig de la Bellacasa, 2011). Like Rose (2004) did for hairdressers, waitresses, and construction workers, we need to make more visible how children's and families home-work reflects their deep knowledge of care and of technology.

How is caring baked into domestic labor and how can we design technologies that more equitably distribute caring labor at home? I believe there are important design implications to be mined from relations between domestic work, technology, and caring. How people order their environments, and designs for making home "work" are culturally constructed, part of a process that is learned by participating in family life, for example through designing particular housekeeping routines (Daniels, 2001; Shove, 2003; Swan et al, 2008). However, as Brody (2016) noted, "the voice of the actual housekeeper who must contend with these design choices is missing" (p. 111). Making visible families' homemaking practices as design strategies points to what has been overlooked and undervalued: the improvisational ways that families are already making home work for learning with technology.

CHAPTER 6: FINDING #3

Re-newing Learning: Reimagining the Newness of Families' Sociotechnical Practices

Let's go backwards when forward fails

...

Don't throw the past away

You might need it some rainy day

Dreams can come true again

When everything old is new again

--"Everything Old Is New Again," *All That Jazz* (1979)

Narratives of technological obsolescence and innovation are founding myths of new media studies. As cutting edge technologies and new media become domesticated, or assimilated into everyday learning environments, they cease to be noticed and are no longer new (Silverstone, 2006). Meanwhile, this founding myth is likewise domesticated, consolidating conventional beliefs about the relationship between technology, media, learning, and history. According to this system of belief, new technologies and new media replace old technologies and old media, driving emerging possibilities for learning. This notion of "out with the old, in with the new" reflects deep set ideologies of progress and development, of history as behind us, and of technology as future-making (Acland, 2007; Suchman, 2011).

This is a tidy story. It fits well within broader discourses and social structures, for example within entrepreneurial paradigms of late capitalism that fuel domestic consumerist culture or within educational visions that aim to advance learning through advanced learning technologies. However, it does not adequately reflect family life as a site of domestication of media. It fails to capture important dynamics of learning in home environments, where multiple generations of people *and* multiple generations of technology coexist. This chapter addresses

how families' media engagement and technology use unsettles taken for granted assumptions about learning with "new" media and technological change.

Informed in part by these same pervasive narratives about new media, I had originally entered into my study of families' sociotechnical practices- and literally into their domestic spaces- wondering how new media and mobile technologies were reconfiguring family life and children's learning. This broad research question involved at least two unexamined assumptions: (1) that there would be new technologies at home and that I would recognize new things when I saw them; and (2) that these things were being used in ways that transformed people's practices such that their practices themselves would appear new.

Instead, two patterns I observed across families and homes presented an alternative perspective on families' approaches to designing around technological change. First, and most visibly, there was a surprising amount of paper-based media, and these media tended to be interleaved with digital technologies in heterogeneous ways. Second, while children engaged with many forms of digital media and technology, they also tended to use nondigital technologies, sometimes in unexpected or novel ways. These two characteristics of the sociotechnical arrangements of home complicated easy designation of either new media or new practices. Paradoxically, while I expected to observe *new* sociotechnical practices, what was more prevalent was families *renewing* older practices and materials. Renewing learning allowed families to make sense of technological changes in ways that still maintained prior ways of doing things. This chapter examines how older and newer technologies coexist in practice, and offers renewability as a key phenomenon for children learning in the context of family life.

Designing for the Long Now of Learning

Paradoxes surround new media and technology. Take for example, the paperless office paradox, a phenomenon whereby the introduction of digital technologies does not decrease but rather *increases* the amount of paper people use. Or consider the contradiction I described with regard to tablet economies in the last chapter, in which one family's first iPad was recycled from someone for whom it was "soooo old." What is new for one person, or from one cultural perspective, is old for another. Peters (2009) noted how "the novelty of new media is a function of our account of who is talking and who is remembering" (p. 19). Furthermore, what is now new is already on the way to being old. What is now old was once new. It is both the case that there is a "long history of new media" (Park, Jankowski & Jones, 2011) and that media are new all the way down. To analyze newness- of media *or* sociotechnical practices- is to call into question the notion of novelty as well as values associated with innovation.

The contradictions and recursiveness of new media prompt a number of critical questions about the reorganization of family life and the temporal dimensions of domestic technology design: How are new and older technologies coexisting in everyday learning environments? From whose perspective is a sociotechnical practice new? What counts as new media? How is technological innovation defined and by whom? What is the relationship between newness and technology or media? Between technological innovation and learning? And what are the value or the consequences of introducing purportedly new technologies or media into domestic learning arrangements? *Qui bono?* (Star, 1991).

This chapter addresses these questions. Analyzing the temporality of new media means reconceptualizing narratives of newness that circulate about media or the discourse of innovation that surrounds technology design. It also requires resituating families' changing practices within

such narratives of technological change. It means historicizing media and technologies as they intersect with people's everyday practice and empirically locating points of intersection in the present (or at least the present as I was observing it now several years ago). In essence, pursuing questions about "new" media means analyzing people's sociotechnical practices as historically constituted by a long arc of new media (e.g. Ribes & Finholt, 2009) and a "long now" of learning (Brand, 1999).

This approach to historicizing media and technology is itself not entirely new. Questions about the historically contingent and co-constitutive nature of technical and social orders have long framed perspectives on sociocultural theories of learning (e.g. Cole, 1996), science and technology studies (e.g. Pinch & Bijker, 1990), and new media studies (e.g. McLuhan, 1964). Nor is it particularly novel to state that social processes involve both change and continuity, technologies being but one manifestation of this dialectic (Erickson, 2004). Nonetheless, something can be learned from rehearsing these ideas in the context of a study of families' sociotechnical practices. There are several reasons for pursuing these questions in the current analysis.

First, my analysis responds to current questions within the learning sciences about new media and emerging technologies in everyday practice outside of formal educational contexts. There is heightened interest in the power of new media and technology to transform learning across multiple use contexts and knowledge domains (New London Group, 1996; Ito et al., 2013; Leander et al., 2010). Despite persistent *school* policies that police children's use of technology, informal learning settings often privilege perspectives and pedagogies that incorporate new media, mobile technologies, and digital tools. Yet, given that so many so-called older tools are still in use in homes, it is important to understand how and whether families are actually

adopting new media and adapting old practices. Therefore, home is a vital site for studying how (and whether) processes of learning domesticate new media (Morley, 2006).

Far from a deterministic, unidirectional process, it is not simply the case that new tools transform people and their practices; also, as people create new forms of cultural practice, they require new tools for their emerging ways of being, acting, and knowing (Herrenkohl & Mertl, 2010). As an organizing concept for sociocultural perspectives on learning, re-mediation captures this complex dynamic between people, technologies, and activities over time (Cole & Griffin, 1983; Gutiérrez , 2008; Gutiérrez , Morales & Martinez, 2009). Questions about the *digital* re-mediation of learning look to account for what is new about learning and teaching arrangements as they are reconfigured through virtual, mobile, digital means. These perspectives also emphasize broad cultural heterogeneity in historical uses of technologies, suggesting how accounting for re-mediation of learning involves analyzing historically contingent and ideologically structured relations among people and tools within activity systems (Barajas-Lopez & Bang, 2018; Vossoughi et al., 2016).

Second, the current analysis updates educational research on new media and technology. Just as technologies (are believed to) become obsolete, claims to their newness do as well. Therefore, it is continually necessary to update studies of new media, just as people update apps and devices to keep them serviceable. In other words, a theory of learning based on the importance of new media risks becoming outdated once it is in wide circulation. By renewing sociotechnical theories of learning by re-grounding them in fresh empirical material, theories retain their explanatory power in times of rapid technological change.

In this analysis, I extend the continual updating of studies of learning with new media by calling the very idea of new media into question. By historicizing technology and media, it is

possible to more adequately account for changes in sociotechnical practices and learning. For example, a historical account of television at home (Spigel, 1992) enriches understanding of how families tune in to watch content today (Takeuchi & Stevens, 2011). Similarly an examination of the history of print media (Mattern, 2017) offers insights into different families' shifting approaches to reading across devices and formats (Ballatore & Natale, 2016). In this chapter I specifically consider the history of books, filing systems, and pianos as keys to understanding contemporary sociotechnical practices of reading, researching, and practicing music, respectively.

Third, my analysis in this chapter provides a critical perspective on technology designs, and remains open to what counts as innovation in learning. At this historical moment, it is important to critically examine newness as a prevailing principle for learning and technology design. Narratives of technological development are very often oriented towards the future (Suchman, 2011). This perspective neglects how technological histories are still ongoing in the present. It glosses the divergent trajectories people pave for participating in sociotechnical practices and the heterogeneous technologies involved in these practices. As Jones (2006) stated, "today, for symbolic purposes, computers *are* technology" (p. 35). And yet, as I will show in this chapter, families vernacular uses of older and newer tools belies such simplistic definitions.

This tendency to conflate computers with technology is pervasive in research on learning. The influential call for multiliteracies research, advocated by the New London Group (1996) was premised in part on the particular promise of *digital* media for transforming learning. In response, others pointed to the enduring presence of paper-based technologies (Seeley-Brown & Duguid, 2000), suggesting how in order to understand how (or whether) workspaces or learning environments could become "paperless" in the future it is necessary to understand the

technological process by which they once became “paper-full” (Sellen & Harper, 2003). Still others argue that the digital/paper-based, old/new binary orients the question of technology around Western perspectives on technoscience and global development, neglecting how Indigenous people have long been designing advanced technologies (Barajas- Lopez & Bang, 2018; Mavungha, 2014).

In this chapter I advance these critical questions about what counts as learning with technology and new media for families. By analyzing the histories of technologies and practices, I am pointing to the inadequacies of currently available ways to talk about these terms as either “new,” “old,” “digital,” or “analog” within discourse on learning with technology. My point, as I hope will become clearer later through a few empirical examples, is less to try to nail down alternative, nonbinary terms for technologies as they age and are displaced. Rather, I aim to disrupt how newness comes to be either implicitly or explicitly valued as a design principle for learning and teaching and to interrogate accounts of learning that overlook media histories or the long now of technology (Brand, 1999; Ribes & Finholt, 2009). This is important for designing learning environments that historicize sociotechnical practices and learning arrangements- like homes- that are sensitive to technologies’ contingent and nonlinear contexts of use.

In what follows, I examine three cases where people’s histories and technological histories intersect and show how families made sense of new media and technology and through reorganizations of learning. I use interaction analysis and multimodal representations of families’ interactions with various technologies to elaborate an approach to design I call “renewing learning,” through families’ sociotechnical practices of “recycling,” “remixing,” and “reassembling.” Then, I discuss these findings in terms of technological innovation narratives and propose an alternative vision for technology design based in families’ perspectives on

technological change and grounded in the concept of renewing technologies. I consider what uncritically accepting technology as future-making means for theories of learning, and I reposition *the past* as a constitutive- perhaps the defining- element of sociotechnical practice.

Analyzing Families' Sociotechnical Histories

As opposed to accounts that assume new media are digital, I took a different approach to understanding the relationship between technological change and families' sociotechnical practices. In my analysis of families media engagement and technology use, I tried to remain agnostic regarding what counts as technologies and open to what might be perceived as new from within a family. It is worth noting that, like me, families were ambivalent about newness. When asked what they wished they could do with technology or what they would like to learn to do next, only a very few children had a clear future-oriented vision for their technology use or media engagement. Most reported being perfectly satisfied with what they did already. Rather than presuming what was old, (and so, in need of updating), about their media engagement, I tried to understand their technological visions in their own terms.

It is worth noting as well that parents and children were interested, like me, in how technology and media get defined or deemed important within processes of domestication. They were curious about how other families did things with technology. What are typical ways of engaging with media, they wondered? Do I have the right tools for the job? These questions- questions that, at times, families explicitly asked *me* while I interviewed *them*- were present for me in my analysis. Families' guiding questions about how and whether to adopt and adapt certain sociotechnical practices guided my questions analyzing these same practices. My analysis was also informed by perspectives in media studies that ask not about distinct time periods for technological development nor individual technologies as drivers of change, but rather "the

processes by which technological forms and related cultural practices age and are selectively revitalized” (Acland, 2007, p. xxiii).

For the analyses that follow, I constructed and drew upon technology timelines, the analytic tool I described in detail in Chapter 3. Some of the analytic questions I posed to timelines of activities were the following: What tools and materials are family members using? Are these digital? Paper-based? Some combination? What are families trying to accomplish? Does it seem to be working? When approaches or technologies do not work, what alternatives do families devise? What other technological means are possible and available here, and why use this tool? I also asked a number of historically-oriented analytic questions in order to situate a familiar practice within a broader perspective on media engagement or longer trajectory for technology use. What is the history of a particular technology or media form people are using, either in this specific family or more generally? How has this child used this technology in the past? How are they using it now? What sort of practice is this and how is it being consolidated or reconfigured by media? In this chapter I focus on three such practices: reading books; filing information while researching; and practicing music.

Finally, I asked historical questions from a prospective position, trying to imagine the current material culture of homes from some future perspective. This line of analysis sometimes required studying media or technological histories beyond the present (or the empirical record). If this technology/practice is “new,” what did it look like before? If this technology/practice is “old,” why is it still being done? If media archaeologists were to view the record in this home one thousand years from now, what layers of media and technology would be visible? What are the “strata” of media in this media ecology (e.g. Mattern, 2017)? What do these layers reveal

about contemporary sociotechnical practices? About the preservation of valued practices across generations (of people and technologies)?

Analyzing several key instances according to these historical and empirical dimensions, I found that families' current sociotechnical practices represent storied histories of their media engagement. I learned what some of these storied histories involved, how they were being transformed in the present, and how they intersected with broader histories of technologies. These points of intersection animated a sociotechnical process of people renewing learning with technologies and media. Rather than simply domesticating technologies and media into everyday practice, families are continually renewing technologies and practices, or incorporating and reincorporating technologies into their daily routines. Renewing refers both to this dynamic process of media adoption and adaptation and to a redefinition of "new" media that such dynamics engendered.

In homes, I observed a wide variety of heterogeneous approaches that families took to using older or newer technologies, to going "technology-free," or to integrating "the next best thing" into their daily routines. Broad access to tools and media (i.e. whether children had their own phones, how many computers were in a home, internet connectivity, proximity to local libraries, or parental controls on websites, etc.) certainly contributed to how families responded to technological changes; however, in micro-moments, deciding whether to use a digital tool or its paper-based predecessor was often left up to children's own discretion. At these times, it was not necessarily true that children opted for the latest, greatest thing. Children's media engagement at home is much more mixed than either those anxious about media consumption or enthusiastic about technological progress have claimed. At home, children are mixing together

different tools in new ways, and this points to a model of learning that centers a continued interplay of past and future in sociotechnical practices.

Parents also predominantly expressed mixed feelings about their children's changing technology use and demonstrated varied approaches to supporting their children's use of new media and technology. Some parents welcomed technological change *outside* the home, but were reticent about too many new gadgets *in* their homes. Often, they sited expenses or their desires for children to play outside more as justifications for avoiding adopting new technologies. Conversely, others prioritized family spending for new domestic technologies like computers and phones, but did not want their children using these at school (or in the car, or in a restaurant, or while walking around the neighborhood with friends). Parents I interviewed reported a wide variety of new technological skills they wished their children would learn, however many parents were completely satisfied with their children's technological knowledge and did not assign much importance to helping their children keep up with technological change, or, alternatively, to avoid such changes. A surprising number of parents were interested in their children learning typing, keyboarding, or word processing, a set of skills that, while useful for doing knowledge work, is arguably far from innovative.

Across all families, children tended to use a heterogeneous collection of tools and technology during their leisure or assigned activities. Some digital, some analog, the arrangement and use of these materials varied widely and was often as context-specific as home environments themselves, spaces uniquely reflective of families personal aesthetics and idiosyncratic approaches to learning. Despite this diversity, some patterns emerged; families all tended to incorporate different generations of technologies in ways that both presented new learning opportunities and harkened back to prior forms of practice, a process I call "renewing

learning.” In what follows I present three separate forms that renewing learning took that illustrate how this sociotechnical phenomenon looked in everyday practice: renewing learning by recycling, remixing, and reassembling media and technology.

1. Renewing Learning by Recycling Media: Everything Old is New Again

It is often thought that, like people, media die. According to this view, dead media represent technologies that are no longer needed, and their obsolescence is brought about by the celebrated birth of new media. However, the media archives in homes reveal a different life cycle. Media do not simply die off, rather they are constantly being recycled, or repurposed. By reusing media in new ways people can often reexperience beloved devices or technologies from a new point in time. An important consideration for how or whether media are recycled has to do with their affordances as well as the constraints of new media that come to take their place. Often the older tools are the right ones for the job (Clarke & Fukimura, 2014). In such cases, learners find ways of recycling old media to make them new. In this section I describe this sociotechnical practice and explain how children renew learning by recycling older media.

Making a case for books as technology

When I first interviewed nine-year-old Lara, she sheepishly admitted to only sometimes using technology. Her responses to my questions read like a litany of broken devices and unsatisfied desires. She pointed out how her e-reader was broken, and she and her father bickered lightheartedly about whose fault this was, his or hers. She did not yet own her own laptop, though she hoped to inherit one from her twelve-year-old sister Latasha once school started and the family updated their devices. And unlike Latasha, Lara did not yet have her own phone. It was not uncommon for children in the study to complain about technological troubles they experienced at home (Taylor, Silvis & Stevens, 2018). Often these frustrations were linked

to what they perceived as their family's overly stringent rules for technology use, to careless treatment of devices (by them or other family members), to technological breakdowns, or to the scarcity of technology-time in the context of hectic family schedules.

Lara's issue was slightly different and reflected a need to reconcile her particular technological practices with received definitions of media and technology. She grappled with the question of what even counted as technology worthy of (my) study. One evening, while I chatted with the sisters in Latasha's room, Lara mused thoughtfully, "what is technology?" She asked her sister whether Latasha thought that books were a technology. Latasha replied affirmatively, asking Lara if she had seen a video on YouTube that Latasha had watched about the process of making ancient manuscripts (Lara had not). Lara continued, still uncertain as to books' technological status, "I just don't get how books are technology." Her sister offered the idea that books supply you with information. Lara remained unconvinced. Defining technology and media is part of what is at stake in any debate about their relation to social life. As Peters (2009) wrote, "new media are, by definition, definitional puzzles" (p. 19). Unlike other children in this study whose technological troubles typically pivoted around *using* technology and media, Lara struggled over *defining* them.

As I became more familiar with her daily media round, I found that Lara's questions about books stemmed not from a lack of knowledge about books- or about technology- but from her persistent engagement with books *as* technology. Whereas many (though certainly not all) children in our study primarily read on tablets, computers, e-readers, or smartphones, Lara preferred to have a book in hand. It was not so much that she lacked digital technologies she desired (though her e-reader had fallen into disrepair), nor that she was a neo-Luddite learner, rebelling against emerging technologies. In questioning the technological status of the book, she

indicated ambivalence about whether she *should* desire new technologies, when her old books were perfectly serviceable, and unlike her digital devices, did not break down. Enrolled in a study putatively aimed at families' technology use, it was vital for Lara that she position herself as a user of some valued form of technology. Books being her favorite media form, she needed to build "the case for books" as technology (Darnton, 2009).

Lara appreciated multiple features of book technologies. For one, she was proud of her reading level, and used this as a standard for measuring a book's quality; if a book fell within a certain reading level then it was good (for her), if it was too easy, it was devalued. For Lara, books were technologies for establishing her expertise as a reader. They enabled her to know more and also to achieve a certain status as a knower. She carefully tracked how many pages she had read each day, which served as an important metric marking her advancement as a reader. She was also fascinated by the more mechanical and physical aspects of books, such as their dimensions, length, font, paper weight, and the relationships between these material features of books and how they functioned for reading. Related to this interest in paper's materiality, Lara had learned to make her own paper out of recycled scrap paper or receipts (Figure 6.1). This literal recycling of old paper-based materials to make something new out of the same old material reflected a broader pattern in Lara's approach to media engagement.



Figure 6.1 Lara's technique for recycling paper by moistening scraps (left) and reconstituting them (right).

Renewing media by recycling text

One evening, while reading on her sister's bed, Lara explained how she still had a lot of "picture books" in her room that she did not read anymore. She reminisced how they were all from a "reeeally long time ago." She told me that she did not need them anymore, explaining wistfully how she did not "live with them." She then suggested that these old books "would do better in the garage." She declared that what she really needed were chapter books, longer books that she could immerse herself in reading. Chapter books are "thicker," so they "last longer," according to Lara. Lara's definitive statement on the uselessness of her old books prompts a number of questions. What does it mean to live with media (or not)? Are books (or any media) old because they were written a long time ago, or because someone read them a long time ago? What counts as a "long time ago" or makes something "last longer?" Many media scholars have noted the *longue duree* of media, how their life cycles extend far back in the past and will leave footprints that stretch out to the future (Acland, 2007; Natale, 2016; Park, Jankowski & Jones, 2011; Parikka, 2017). For Laura long ago referred to her early days as a reader. As a nine-year-old, that may have seemed like a lifetime ago; the books she read then were no longer part of her

everyday life now, no longer important technologies to “live with.” These old books no longer enlivened her daily routines; for Lara’s purposes, old books were dead media.

In comparison, “thicker” chapter books lasted longer. They had a significantly longer life cycle, one prolonged by her particular approach to reading them. Laura had developed a specific method for renewing book technologies so that they were new upon each reading. One evening, while they were reading together in Latasha’s room- Lara on the bed, and Latasha at her computer desk- Lara leafed through a tattered copy of *Harry Potter and the Deathly Hallows* (Figure 6.2, Frame A). She was an avid Harry Potter fan, and Latasha wryly claimed that Lara had practically memorized all the books in the series. As she thumbed through the book, Lara briefly paused on random pages, reading or scanning; then she would flip to an entirely different part of the book, sometimes forward, sometimes backwards. Eventually, I asked her about this way of reading and she replied that, having read all the books in the series at least once, she liked to flip to a random spot and skim it, to refresh her memory of a scene or draw connections across the stories. This is not unlike what historical studies of reading have documented on reading habits (primarily of European men) during the Renaissance period; they pieced together stories segmentally, jumping between parts of books and across different texts, as opposed to sequentially, reading a book cover to cover (Darnton, 2009).

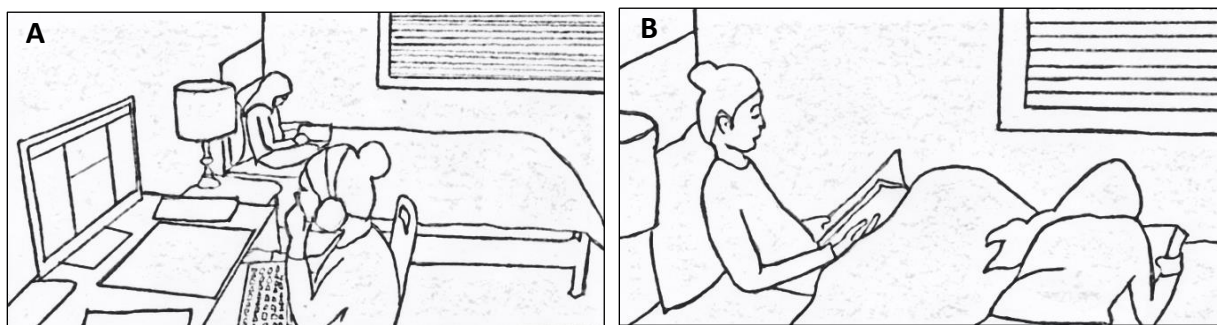


Figure 6.2 Lara rereads a favorite book on her sister’s bed while Latasha reads a PDF of a book on-screen (A). The sisters both re-read books (B).

Paradoxically, though her practice harkened back more than several hundred years, Lara's approach to reading enabled her to renew familiar reading material. Her way of reexperiencing books by recycling texts was in stark contrast to the way Latasha was reading nearby at her desk. At the same time that Lara was recycling *Harry Potter and the Deathly Hallows*, Latasha had begun reading a PDF version of *Gone with the Wind* that she had found online. At first it seemed that a strict division of Lara's paper-based tool use and Latasha's digital reading would persist. However, Latasha was soon drawn away from her PDF when Lara began describing *Aragon*, a new book she had started reading at school that day. Latasha was very familiar with the *Aragon* books, having read the whole series herself, and took the opportunity to showcase the box set she had lovingly displayed in her bookcase. She brought it over to the bed, turned it upside down, and hitting the box firmly on the spine, popped out three hefty paperbacks. Then, abandoning her computer-based reading of *Gone with the Wind* altogether, Latasha selected one of the *Aragon* paperbacks, covered herself with a blanket, and proceeded to reread the book, renewing this treasured text by recycling the story, in the same manner her younger sister had modeled earlier (Figure 6.2, Frame B).

Latasha abandoning her digital reading for her sister's paper-based method of recycling text troubles linear narratives- of reading *and* of the digital displacement of traditional media forms. Recently, the advent of the e-book has led many to hail the coming death of the book (Ballatore & Natale, 2016), though concerns about books' durability are not new. Preservationists have subjected books to stringent tests for decades, trying to determine how long they might last (Baker, 2001). Using acid testing, chemical combustion, extensive folding, and even animal testing methods, book preservationists wonder about the durability of these culturally vital artifacts (Darnton, 2009). And yet books endure in both material form and in

functionality for readers. Studies of e-book readers' experiences offer some clues as to why: digital devices are not as ergonomic as books; "tabbing" is more challenging than "paging" through a text; sensorially, e-readers' bells and whistles are poor substitutes for paper books' smells and rustles. Lara and Latasha's method of recycling text suggests that personal histories of media practice may also be important motives for maintaining old ways of doing things. Renewing learning is a vital mechanism for consolidating cultural memory, in this case through the recycling of cherished media like popular young adult fiction.

Nevertheless, it is true that PDFs (like e-readers) are not easy for readers to move around in. Ballatore & Natale (2016) noted that "e-readers favour an extremely linear mode of reading, making nonlinear access to long texts clumsy and slow" (p. 2385). Paper books, however, somewhat like online reading of hypertext, can be flipped through more flexibly. Readers of paper books can page through texts facilely, moving backwards *or* forwards through a story or document at their discretion. Whereas it would seem that Latasha's computer-based reading would allow for new, digital means of interacting with text, in actuality, Lara's older book allowed her more flexibility. As Darnton (2009) suggested, "the history of reading will have to take account of the ways that texts constrain readers as well as the ways that readers take liberties with texts" (p. 202). Improvisational re-readings like Lara's run counter to a linear narrative of technological change or a presumption that digital literacies promise to expand learning. Paradoxically, it was not a digital text, but an earlier progenitor that allowed Lara to experience a fresh reading every time she flipped through an old book, renewing her favorite book by recycling media.

Everything old is new again

By recycling books she had already read, Lara was able to renew this media in a new time frame. She could return to her beloved Harry Potter books again and again to reexperience scenes and reimagine how plots unfolded across the volumes. However, these returns were not mere repetitions. They were new every time, because she had devised an approach to renewing the content and keeping it fresh. By skimming sections in a nonlinear fashion, Lara made something new out of something old. Media archaeologists often point to the strata of older media or examine legacy infrastructures underlying new media in order to illustrate the construction of new media histories (Mattern, 2017; Natale, 2016). Lara's recycling of old media is another means of challenging the newness of new. As the lyrics of the song in the epigraph for this chapter go, "everything old is new again."

And yet, the renewability of books only held for books that she "lived with," like *Harry Potter* books, or for her sister, the *Aragon* books. According to Lara, books that she had read a long time ago could just as well be sent to storage in the garage, and it is likely that they were. In studies of domestic material culture, garages of US homes are chock full of discarded items that families have taken out of circulation (Arnold et al., 2012). These media archives in homes tell a story about how material technologies fall in and out of use. Observing the strata and substrata of home environments in a thousand years, it is likely that today's media ecologies will appear as layers of books and e-readers, computers and manuscripts blended together. This pattern signifies how new media do not simply or sequentially replace older media, but rather, involve the recycling of older things in new forms.

Lara's way of engaging with media appeared old compared to my many other observations in this study of children using e-readers to read books collaboratively with their

parents or even Latasha downloading a PDF of *Gone with the Wind*. However, perceptions of “old” and “new” in media studies can overlook how media are renewable, that is how they persist and are changed in the present through people’s recycling of prior practice and materials. Analyzing these renewable sociotechnical processes is a way of historicizing literacy and is ever more salient in the digital age (Gutiérrez , Morales & Martinez, 2009) How learners incorporate new practices into their old ways of engaging with media are heterogeneous, as are their personal histories of using (and valuing) different forms of media. With so many new tools and media available, it is easy to ignore how old media persist in the present.

Family’s sociotechnical practices reflect how their older, treasured technologies are still in use. This is not simply because some people are late adopters or that others lack access to digital tools. It is because in many cases, older tools, like books, are still serviceable for users (Cole, 2017). As Lara’s and Latasha’s reading illustrated, older tools may in fact be more useful than new technologies for many families’ valued activities. Is this as true for *writing* at home as it is for *reading*? Latasha’s use of computer and paper-based materials for researching offers some answers. It is to her sociotechnical approach to renewing learning that I turn next.

2. Renewing Learning by Remixing Media: The Myth of the Paperless Home

A second form that activities take in today’s home learning settings that illustrates the renewability of learning with technology involves families mixing media together. Within activities and tasks, paper-based and digital technologies coexist and intermingle. This mixing of media represents what is emblematic of changing media ecologies: it is far from the case that digital technologies have replaced older analog or paper-based technologies. Like the paperless classroom and the paperless office (Sellen & Harper, 2003), the paperless home remains a myth. What takes place instead is an ongoing mixing and *remixing* of temporally heterogeneous

materials that emerge in practice. Remixing media is a way of stabilizing historically older practices, such as note-taking, data entry, or researching, while the practice itself is simultaneously reconfigured through new technologies. Remixing alters the balance of different material components of a task. As opposed to simply mixing things together, *remixing* signals how sociotechnical systems have always entailed mixtures (Latour, 1988). Remixing reorganizes component parts in novel ways, renewing sociotechnical arrangements in changing media ecologies. As was true for recycling paper books, one question at stake in renewing through remixing is: which tool is right for the job (Clarke & Fujimura, 2014)? In what follows I describe how Latasha used multiple tools- both old and new- in developing an approach to filing and research that remixed media.

Filing in Google Drive vs. an “amazing journal”

As mentioned in earlier chapters, several children provided tours of their media ecologies or reenactments of their forms of media engagement when observed using technology at home. Sometimes these tours were in physical space. For example, children led us to their bedrooms or playrooms to show off DVD or trading card collections and shelves or stacks of books; alternatively, they would sit at desks, systematically explaining gadgets and papers arrayed across work surfaces. It was even more common for these tours to take place in virtual space, where children would lead us through their daily media round across their computer screens. They would show us their “digital daily round.” Latasha gave me one version of such a tour through her Google Drive. As she navigated through a series of approximately ten folders, she highlighted the place where she kept PowerPoints created for school, housed files for projects like the school bookmark contest, or study guides for learning to code. A well-organized filing system emerged from her digital drive.

The sociotechnical practice Latasha engaged in was *filing*, an important part of larger research projects. File organization and document management is a critical aspect of work processes and sociotechnical systems; filing consolidates and organizes information and knowledge within a system of artifacts. Issues such as file naming conventions, categorization, retrieval, archiving, and removal can ramify across an arc of work. As a material practice, filing has a history. From the library card catalog (Baker, 2001) and the phone book (Bowker & Star, 1999), to the steel frame file cabinet (Mattern, 2017), to the rolodex (Lublin, 2017), to the pedofile (i.e. a filing system used by soil scientists) (Latour, 1999), methods of filing away the world (usually but not always in written form), dominated analog work practices. Since work processes digitized, many filing systems are now housed online, and electronic filing systems have tended to mimic paper-based ones with variable success (Sellen & Harper, 2003). An iconic example of this is the organizing of Files (documents, images, software, etc.) in Folders on personal computers. At a larger scale, online databases now house nearly limitless amounts of data, once constrained by the physical dimensions of the ubiquitous manila folder or circumscribed within the footprint of an office building. However, the digitization of records has not led to the disappearance of paper filing systems. Sellen & Harper (2003) concluded from their study of paperless offices that “not all files are alike and that electronic filing systems may be appropriate for some kinds of files and not for others” (p. 109). Digital files may serve some tasks, but they are not ideal for others, as Latasha had found in the course of her inquiry.

Latasha’s practice of digital file-keeping reflects historical changes in the means of filing, transformations in form and functions that files can take. During one observation, Latasha took me on a screen tour of her Google Drive, revealing an intricate and well organized system for archiving and retrieving her school work and extracurricular studies of a range of scientific

topics. In parallel, for about a year, she had been in the process of building a physical portfolio for filing results of scientific research that she conducted online. Latasha referred to the portfolio as her “amazing journal” and presented it to me with humble pride. She explained how she had developed a method of research that combined digital searches and paper-based filing; she Googled a search term, for example “plasticity,” and then summarized the search results by transcribing a brief note on a lined index card or sketching a diagram on notebook paper. She would then glue or tape the small pieces of paper onto pages of the large portfolio book. The result was a remixing of older and newer tools. While she had an extensive file folder system in Google Drive at her disposal, for this job- filing the results of online research on science topics-remixing digital and paper-based tools worked better for her.

Construction of the portfolio had begun when her science class was studying a unit on the neuron. This inquiry process and filing system she had devised worked so well, that she had continued filling up new pages in the portfolio as her interests in different scientific topics, such as plants, genetics, optics, or systems of the body, emerged (Figure 6.3, Frame A). A year later, the book was literally papered with an assortment of hand-drawn diagrams, lists of terms, and short definitions or descriptions. In the case of the plant unit, index cards and dried leaves were interleaved in this portfolio, covering several pages (Figure 6.3, Frame B). While the paper-based and natural found objects represented older representational forms and file formats, the entire inquiry process hinged on access to digital search tools and the internet. As her research progressed, she had begun to regularly source information from Kahn Academy and include references to online retrieval sites on her paper notes and files. The overall effect was of a collage of collated notes, at once well organized and nonlinear. Latasha’s amazing journal remixed and filed information from newer online sources into an older paper portfolio.

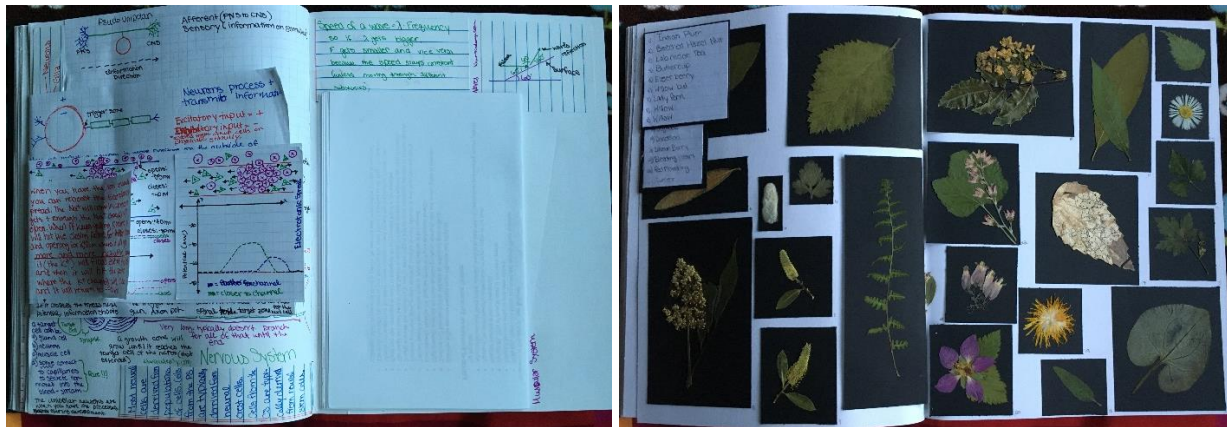


Figure 6.3 Excerpts from Latasha’s “amazing journal” on the nervous system (A) and on leaves and flowers (B).

Nonlinear remixing of digital and paper tools

Noticing that the most recent pages in the portfolio contained notes on topics that seemed a departure from her earlier inquiries into natural science, I asked Latasha to tell me about the emerging directions her research was taking. She explained that she had begun researching historical topics such as the Hellenistic period and Zoroastrianism (there were separate entries in her portfolio on these topics with references to history.com and bbc.co.uk, respectively). Then she resumed researching “the Berbers,” a term she was unfamiliar with; she thought she may have come across the word watching Crash Course, an educational YouTube channel. She hesitated on the Google search results for Berbers and then asked me if I knew “why they do the upside down e,” referring to the “schwa” symbolizing the pronunciation of “Berber.”

As I often did when I was curious how children would devise solutions to problems without the help of the convenient ethnographer, I feigned ignorance. However, I did offer a clue that I thought it had something to do with the phonetic alphabet. Wondering aloud if there was such a thing as a “phonetic language” she looked up the phonetic alphabet and searched through Google Image results until she landed on one with the schwa and reported that “the upside down

e sounds like an ‘a,’ as in America.” She told me the origin of the word and its etymology, reading from the Wikipedia page. She then proceeded to write the word Berber on an index card, including the schwa (Figure 6.4, Frame A). At one point, her mechanical pencil broke, and she struggled to get it working again. (It is easy to overlook “older” technical breakdowns like broken pencil tips; however, considering the emergence of everyday writing implements themselves as historical accomplishments, today’s mechanical pencil is as much “new” as “old”). Finally, Latasha positioned the note card in her magic book next to the entry for Zoroastrianism (Figure 6.4, Frame B).

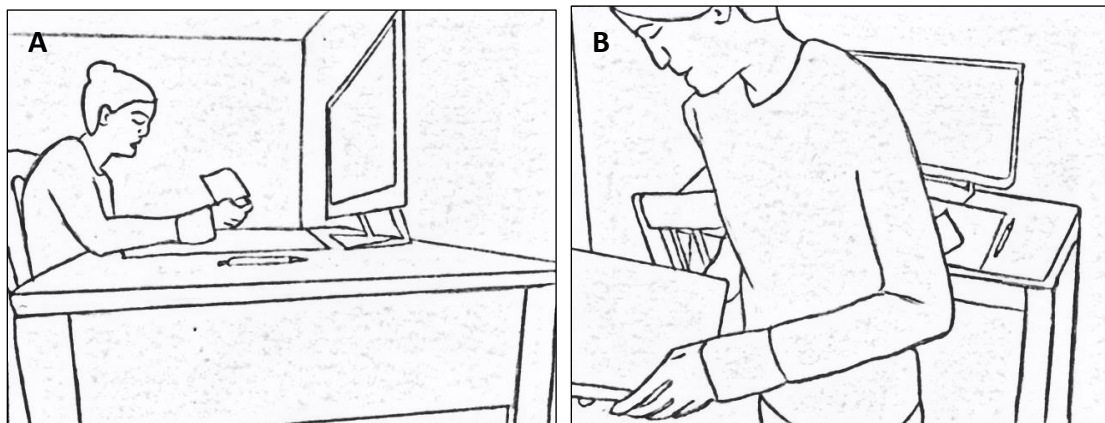


Figure 6.4 Latasha records results of online inquiry into the Berbers on a notecard (A) and adds the card to her portfolio (B).

Latasha’s search for information about Berbers took a number of turns and involved a heterogeneous array of materials, both digital and paper-based. She had to navigate multiple webpages to flesh out her understanding, including the phonetic symbols and pronunciation, and the etymology. This process was nonlinear and she made surprising discoveries along the way, including what an upside down e signified and how a word like Berber emerged over time. While research like this was of course possible using older reference materials, the internet expedites searches and multiplies the avenues of emerging interest. Online search tools lend themselves particularly well to such a nonlinear process of following links, during which

discovering something new hung in the balance and the object of inquiry was a moving target. Hypertext is often cited as a new form of associative indexing that displaces rigid filing rules and pathways and allows researchers to adopt a “method of storing and sorting information that is modeled on human consciousness rather than bureaucratic filing systems” (Gitleman, 2006, p. 99). Paradoxically, Latasha’s associative indexing and filing system relied on remixing older and newer text formats, and ultimately storing information in nondigital form.

The enchantment of renewable technologies (and myth of paperless futures)

The myth of the paperless office describes a process that attempted to convert paper-based work processes like filing, note taking, document retrieval, collating and categorizing data to electronic form... and failed (Sellen & Harper, 2003; York, 2006). The paradox of paper-less work is that while many knowledge processes now involve using digital filing systems and word processing, this has not managed to decrease the amount of paper files, folders, and documents in offices, schools, or homes. In fact, the opposite has actually been the case, and work sites and homes are more strewn with stacks of paper than ever. How could this happen? One reason that researchers who study paper-less-ness have suggested is that paper files and documents are irreplaceable in terms of what they allow users to do, the ways they are manipulable, navigable, sharable, and editable (Seeley-Brown & Duguid, 2000; Sellen & Harper, 2003). To the degree that filing information depends on making material the sorting and categorizing of knowledge, the actual material technologies appear to matter a great deal, and digital files prove inadequate for all tasks.

Mattern (2017) traced how the development of mundane technologies like the conventional steel frame filing cabinet paralleled nineteenth century urban industrial development. She explains how scaling product design up to the city scale allows for a

retrospective media archaeological study of urban environments as “enormous files” (p. 91). Skyscrapers were like huge repositories for file systems, made of many cabinets, housing many files, containing reams of documents, inscribing troves of data. Mattern suggests this change in technologies for filing reflected scientific interests in representing statistical knowledge in standardized paper form, organized systematically. What then do new means of researching and filing say about social norms of knowledge organization in a digital age and how is this reflected in learning designs at the scale of the home?

Latasha’s home filing system indicates how today’s sociotechnical practices embody a logic of renewing media, whereby learning takes place through the remixing of older and newer tools in ways that preserve prior practices in the midst of technological change. When the media archive of homes are exhumed and viewed in a thousand years, digital and paper files, lead pencils, the internet, index cards, sketches, paper pulp, dried leaves, and search terms will all be interleaved in the strata of home filing systems. Studying the material culture of children’s inquiry practices and the digital materiality of home is a means of seeing these futures as histories in the present, of understanding media as renewable and the value of newness as contested in everyday practice (Pink, Ardèvol & Lanzeni, 2016).

A mere two decades into the age of the internet, it is already easy to take for granted how truly remarkable it is that so much information is only a keystroke away. Digital media and services like CrashCourse, Kahn Academy, and YouTube are transforming learning, and in many ways, it is difficult to deny that the future of learning is digital. While other children in our study enjoyed playing video games online or emailing and Skyping friends, for Latasha, the internet served chiefly as a means of researching topics and ideas that were new to her. It is likely that Latasha may never open a paper volume of an encyclopedia. And yet, her practice of filing away

facts she found online into a paper-based portfolio points to an unpredictable pattern in media-based inquiry. At the moment, and in all likelihood, for a very long time into the future, paper-based research tools are still widely used in home learning environments. It is notable that Latasha chose to create a paper-based portfolio to preserve and arrange what she was learning online, when she could have used Google Drive. Why choose paper?

While digital tools are convenient, and the internet is an astonishing resource, Latasha viewed her portfolio as an “amazing journal.” For her, this activity- creating a carefully curated repository of notes and sketches across a range of subjects and knowledge domains- was best represented through remixing materials. It was the possibilities afforded by remixing that made the book amazing. The surprises of indexing an “intricate web of trails” and nonlinear associations (Gitleman, 2006, p. 99) across search terms, sites, and subjects online- and then the pleasure of seeing her knowledge building in tangible, physical form- enchanted Latasha. The magic of the digital age is not an exclusive characteristic of the limitless stores of knowledge filed in electronic folders or available through search engines. Remixing older and newer materials results in something new, something surprising, a source of amazement. Such novel and unexpected learning arrangements reflect how screens alone are insufficient for deep learning and immersion in a digital age. Learning by renewing media embodies this essential quality of remixing, of having old and new generations of technologies interleaved in sociotechnical practice.

3. Renewing Learning by Reassembling Media: Technologies Across the Scales of Time

As a third and pervasive sociotechnical process reconfiguring learning at home, families “reassemble” all manner of activities and tasks using emerging digital tools. As I am describing it, the sociotechnical process of reassembly involves using digital means of mediation to

transform a task, often one that has been predominantly paper-based in the past. Using a new form of media or trying out some new technology to accomplish a familiar routine is becoming an almost ubiquitous part of social life. Compared with recycling and remixing, reassembling is perhaps the most recognizable form of renewing technologies, as it involves uptake of new digital tools and (temporary) obsolescence of an older media form.

For example, fewer families than ever continue to make use of a landline, let alone a phone with a chord. Accordingly, smart phones travel across home settings as family members use them to reassemble all sorts of now-familiar routines, from looking up recipes, to enjoying background music, to Face-Timing with Grandma in another state. Nonetheless, revitalizing routines using new digital technology often maintains continuity with familiar practices, challenging the newness of new media. As I have illustrated through multiple examples across these chapters, home environments continue to support both older and more recently developed technological forms. Families must decide whether and how to replace materials with new ones- how and whether to reassemble routines- and how these choices play out is the subject of this section. In what follows I describe how playing piano presented an opportunity for one family to reassemble media, making the practice of timekeeping a site for the interplay of old and new.

Technological re-mediation of music at home

Music listening and playing is a central part of family life and a key cultural practice throughout history (Batt-Rawden & Denora, 2005). In Chapter 5, I discussed the role of recorded music in setting a soundtrack for learning at home. Another way many families engaged with music was to play and practice it. As is true for playing recorded music, there are many technologies available for practicing, producing, and performing music. Instruments and their parts, musical scores, sheet music, implements for tuning and timing, furniture and stands, all

constitute the technical apparatus of musical practice. As another version of technology subject to obsolescence, musical instruments are a relatively durable and stable form. Pianos may get tuned regularly, but they are rarely replaced compared to computers (Sterne, 2007).

Nonetheless, playing music is not unaffected by technological change and is subject to ongoing reassembly. Piano instruction and pedagogy had long been subject to technological changes. Berland (2007) traced the history of piano technology from the standing to mechanical player pianos, or pianolas, to the conventional upright piano of today. Along the way, multiple instantiations of “hardware and software” of piano practice were developed and fell into obsolescence (Gitleman, 2004). One of these was Bohrer’s Automatic Hand Guide, a device that attached cuffs to the players wrist and was bolted to the piano keyboard. A machine-operated slide or guide moved the cuffs along a bar to the time of the music, so that all the musician need do was strike the keys. In this example and many others, automating music practice has long been an objective for piano designers.

Given these ongoing reassemblies of piano practice, it was, therefore, not surprising to observe many families using digital technologies and new media to reconfigure musical practices (e.g. Taylor, Silvis & Stevens, 2018). In the Quinn family, piano practice was an important part of their collective daily media round. Ten-year-old Brittany and her twelve-year-old sister Kara practiced daily, and their mom Diane, an accomplished pianist and organist, served as their instructor. As an example of music pedagogy, practicing the piano in particular has often served as a site for developing learning theories (e.g. Bonus, 2017; Ericsson, Krampe & Tesch-Romer, 1993; Goodwin & Cekaite, 2018). As a sociotechnical practice, piano practice involved reassembling the media ecology and technologies for practicing in ways conducive to learning and teaching.

Reassembling piano practice

During a pair of piano practice sessions across two separate days, Brittany and her mom worked out a song's rhythm. On the first visit to the home, Brittany sat at the piano, reading sheet music and repeating several lines of music in one piece for approximately thirty minutes. Diane intermittently came to Brittany's side, clapping out the beat and circling notes and bars on the paper sheets using a pencil (Figure 6.5, Frames A, B). Brittany's mom encouraged her daughter's repetition and constructively critiqued her technique. Diane told Brittany she was annotating the music to remind her daughter which notes corresponded to which keys. Then they clapped out the beat together as another means of learning the rhythm. Later in this practice session, Diane told Brittany, "I just want to make sure you know how to do it, so I don't have sit with you when you practice it all week" and then pointed to each note as she counted them out to the beat (Figure 6.5, Frame C). During paper-based timekeeping, Diane remained nearby to provide assistance. She also embedded hints and reminders on the sheet music, as durable forms of assistance that could substitute for her when she was not on hand.



Figure 6.5 Mom provides assistance with sheet music during piano practice. Diane circles and annotates sheet music (A) Brittany and Diane clap out the rhythm (B) Diane taps her pencil to the beat as Brittany plays (C).

In a second practice session on a subsequent day, Brittany and her mom again worked on the tempo of a song, but this time using a digital tool, which reassembled their shared work. After Brittany closed her sheet music, Diane approached the bench and offered a new way to practice. She placed her cell phone on the piano's music stand, and showed Brittany how to use a

mobile app to play “When the Saints Go Marching In” (Figure 6, Frame A). In the app, a virtual image of the keyboard on screen indicated when to play each note, a built-in metronome feature held the beat, and the phone’s mic tracked the notes Brittany played. Diane told Brittany the app was in “practice mode” and walked into the kitchen while Brittany practiced the song, leaving the digital metronome to act as a virtual mentor (Figure 6, Frame B). In her history of the player piano, Gitleman (2004) describes how mechanized piano playing has continuously displaced people and made the act of playing piano at least partly a virtual achievement. Participating in this unfolding history, Brittany’s family imported a new form of technological assistance into piano practice that was virtual and remote, in the sense that technical help was not immediately contingent on Brittany’s activity.

In his account of the history of metronome technologies, Bonus (2017) humorously suggests that piano practice is a surprising location for the origins of modern psychology. He goes on to chronicle how Wundt, known as the father of psychology, was as instrumental in inventing the ideal of metronomic musical timing as Maelzel, the engineer who technically issued the first patent application for the technology. In the late nineteenth century labs of the emerging experimental study of mental life, psychologists examined the organization of the mind through rhythmic exercises of memorization of strings of words and actions. Metronomes were vital technologies for designing such studies; mechanized timing allowed for an objective study of behaviors that could be calibrated and measured down to the fraction of a second.

Turn of the century psychological studies likewise influenced music pedagogy, performance, and even music theory. Paradoxically, though the modern quartz crystal metronome was conceived during an era when classical music was still largely an interpretive art, the mechanization of rhythm and timing had a profound effect on musical notation. “Anti-

metronomic aesthetics” gave way to “technoscientific rhythm,” altering how people performed music as well as how composers and pedagogues instructed people to play music. As Bonus (2017) noted “once Wundt reduced all time signatures to a succession of automatically clicking eight notes while disregarding affective, melodic, harmonic, or formal structure... he notated a new precision-oriented quality for the time of musical performance” (p. 90). Brittany’s piano app was similarly organized around experimental psychology’s pedagogical principles.

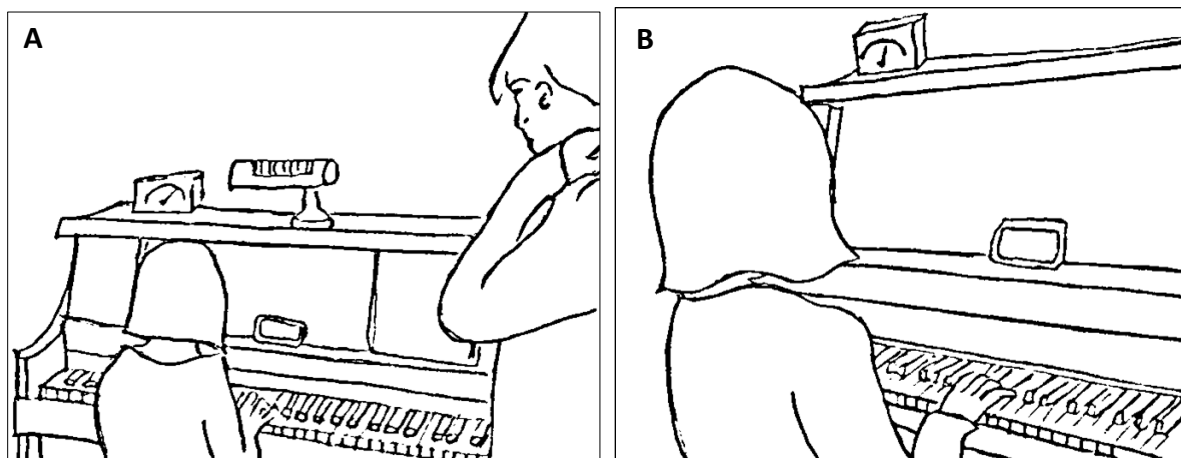


Figure 6.6 Mom sets up app during piano practice. Diane tells Brittany the app is in “practice mode” (A) Brittany plays a song using the app-based metronome (B).

Once the song was over, a round of enthusiastic applause played in the app, but despite this reinforcement, Brittany claimed that she “played the wrong rhythm, totally.” Diane then reappeared from the kitchen and placed her hands on top of Brittany’s while they played it together (Figure 6.7, Frame A). Diane counted off the rhythm along with the app. When they found that their rhythm was *still* out of sync with the app, Diane guided Brittany through the menu, trying to locate a feature that would adjust the tempo to play at Brittany’s quicker pace (Figure 6.7, Frame B). She spoke for both of them when she said under her breath “I don’t understand this timing.” Reassembling the sociotechnical practice using digital means of

mediation had failed to progress Brittany's understanding of timekeeping or to improve her playing. In this instance, musical progress simply did not follow from technological progress. If anything, the new technology introduced more problems than solutions.

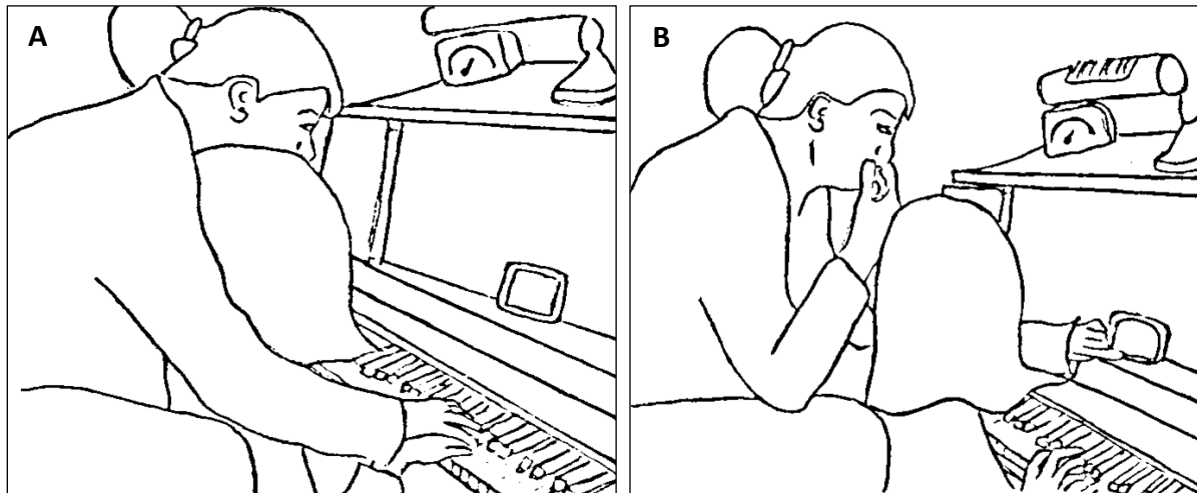


Figure 6.7 Diane assists Brittany with playing the song (A) and using the app (B).

The mobile app nonetheless maintained familiar aspects of piano practice to which Brittany was accustomed. For one, as was apparent during her prior paper-based practice, Brittany claimed that the app-based practice was something that her mom “made her” do (her objections were only halfhearted, and it was clear that she enjoyed playing and practicing piano with her mom). Despite designers’ optimism that digital technologies will entice or young people to engage in mundane tasks and will motivate learners, new technologies inherit some of the same resistance from young people accustomed to being assigned undesirable chores.

Another way the reassembled practice resembled paper-based piano practice was that her mom placed the phone in the same location and position on the piano stand used for traditional sheet music. Plus, her mom was still available to offer support. However, rather than standing next to Brittany, counting the beat, tapping the music with her pencil, Diane left her phone to act as a remote mentor and metronome; when she did offer support, it was mostly aimed at helping

Brittany use the app- not play the piano. This temporary exchange of traditional tools- like sheet music, pencil, and manually tapping out the beat- with a form of remote assistance, reassembled the task. The digital re-mediation of their piano practice represents a way of renewing media, by reassembling the material supports for learning, while holding stable many other important sociotechnical aspects of piano practice.

Keeping time across the scales of time

The Quinn's piano practice routines built upon- and reassembled anew- the ongoing history of the mechanization of music and the re-mediation of piano pedagogies. With the Hand Guide, movements were automated. With the metronome, rhythm was mechanized. Now, with the mobile app, timekeeping is virtual. Historically, piano practice has been continually reassembled by the development of new technologies for aiding learning and teaching, and yet the practice persists.

Manually tapping out the beat, using a pencil to annotate tempo, turning on a metronome, or using a mobile app are all examples of an established sociotechnical practice (i.e. timekeeping), differently mediated. In their family, learning and teaching timekeeping took place across scales of time (Lemke, 2000), including the timeframe of the task (spaced out across practice sessions), the temporal scale of family routines which are constructed across generations and ontogenetic time, and the historical time of the development of piano practicing technologies like the upright piano or the metronome. Even the content of what is being learned and taught (rhythm and tempo) contributes its own temporality to the piano practice activity system. A key question arises: Within these technological and temporal shifts, what gets maintained as technologies are reassembled?

While new technologies emerge that re-mediate the learning of timekeeping, important aspects of this practice remain unchanged. For example, Brittany's mom was still on hand to give support, although the app kept the beat while she was in the kitchen doing other things. Even if we read this instance of digital piano practice as an example of how reassembling work at home increasingly involves remote parenting practices, it has probably always been the case that adults were not constantly around to lend a hand. For example, Rogoff's (2014) model of intent participation, or learning by observing and pitching in, involves gradual and nonlinear practices of increasing task independence among children and their families in everyday, culturally valued routines. Brittany's Mom spoke to this enduring practice of establishing her daughter's independence in the task of piano practice when Diane explained that she did not want to have to sit next to Brittany while she practiced all week.

As a valued and culturally varied historical practice, music practice is an important site for learning at home. Most of the families we observed had music playing, played music themselves, or both. Like any other culturally meaningful activity, playing music involves changing forms of sociotechnical practice. Within the specific context of practicing piano, timekeeping serves to keep other familiar aspects of learning and teaching piano music moving across scales of time. While families keep some forms of practice, they obsolesce others. Time will tell if the Quinns continue to use cell phones for piano practice as well as how piano technologies themselves will continue to change and coexist in practice spaces.

Despite their outdated appearance, older tools and resources may intermittently continue to be used despite re-mediation of learning by newer ones. As Seely-Brown and Duguid (2000) wrote, "futurology is littered with the obituaries of tools that nonetheless continue a robust and healthy life" (p. 4) and furthermore, "obituaries are now regularly written not just for tools, but

for well-established practices” (p. 5). The current analysis suggests that intermittently reassembling practices may be more characteristic of emerging learning environments than stark ruptures or simple product replacement. This analysis has shown how sociotechnical practices get renewed in families through reassembly of materials and new mediational means, while at the same time sustaining and stabilizing historically older practices and maintaining familiar activities across scales of time and forms of technology.

Discussion

In this chapter, I articulate some of the complex temporal and social dimensions of using technology to support learning. There were many examples across families I studied where children’s media engagement reflected temporal tensions in technology design, disrupting the received newness of media. For example, Katherine whose single device multi-tasking I described in the first chapter, watched trailers on YouTube in 2016 of film adaptations of *Animal Farm* (both the animated version from 1954 and the live action remake from 1999) of the book *Animal Farm*, written by George Orwell in 1945, which she was preparing to read in school in 2017. Technologies and media represent complex temporalities, and children’s learning is tangled up in these tensions between old and new, between digital and analog. If learning occurs across scales of time (Lemke, 2000), then this is partly because new media do too.

In presenting families’ temporally tangled sociotechnical practices, I described a design process whereby families renew their learning with technology through three different sociotechnical practices: recycling, remixing, and reassembling media in the context of everyday routines. In the case of Lara, the sociotechnical practice of reading involved recycling media, using an old, well-read book in new ways. In the case of Latasha, the sociotechnical practice of filing information while researching involved remixing digital and paper-based tools together. In

the case of Brittany, the sociotechnical practice of practicing music involved reassembling media, temporarily exchanging old paper-based tools for newer digital ones. These reconfigurations renewed learning both in that they expanded possibilities for how learning could happen using technology and also in the sense that they called into question what is really new about new media and the inherent value of novelty in design.

The process of renewing is generative in terms of producing new ways of learning, and it is regenerative in terms of reusing or repurposing historically older tools. I presented the notion of renewability of learning with technology as a conceptual tool for understanding how children's media engagement at home involves the continued coexistence of familiar and novel mediational means. I also suggested how renewability provides a conceptual alternative to inadequate framing of media as either "old" or "new," "analog" or "digital," "physical" or "virtual." As Cole (2017) recently suggested, prior tools are still being used, not because people have not yet developed better (i.e. digital) ones, nor simply because they may not have access to upgrades, but because older tools are still serviceable for many users. Because mediational mixing will likely continue for generations, it is prudent to consider how learning is being supported by multiple means today as well as what the consequences are of continued development of digital technologies, when many existing technologies may still suffice. A perspective on how people are constantly renewing practices is a way of historicizing the mediational means of learning by contextualizing it within broader, sometimes contested media histories. This perspective, in turn, interrogates how these histories are ongoing in the present and gesture towards the future in sometimes unanticipated ways.

The notion of renewing learning at home suggests how families' sociotechnical practices take place across scales of time: the time of the task; the larger routine or media round in which

it is situated; the longer family history through which routines were constructed; the technology’s own history of invention and redesigns; and even longer geologic histories of technological transformation in which all of cultural development can be understood to take place. An analysis of mundane practices across these time scales is a way of accounting for the long arc of new forms of media and the deep time in which all learning is situated. This has not been intended as an exhaustive historical account but as one version of telling a technological story about learning that is open to historical contingencies and attentive to heterogeneous temporal frames through which learning processes operate (Figure 6.8).



Figure 6.8 Seeing everyday sociotechnical practices across heterogeneous timescales

Ultimately, renewing learning in the ways that they did enabled families to maintain familiar practices and to make sense of technological changes in the context of ongoing routines of everyday life. Family life is a site of continuity operating through the renewal of intergenerational practices (Rogoff, cite). Erickson (2004) summarized how, “human history is a story of change as well as of stability” (p. 162). Barajas-Lopez & Bang (2018) have pointed to a process of “collective continuance” (p. 10) by which culturally valued social and material practices are shared across generations of learners. Through their recycling, reassembling, and

remixing materials at home, families manage to pass on important ways of learning and to maintain the social order.

In order to accomplish this, their ideas and practices become sedimented in material means of mediation acting in the present (Cole, 1996; Goodwin, 2003). According to Daniels (2008), “the idea of meaning embodied or sedimented in objects as they are put into use in social worlds is central to the conceptual apparatus of theories of culturally mediated, historically developing, practical activity” (p. 9). Social life is continually reconstituted through the reappropriation of materials, and human interactions make use of material from prior interactions (Goodwin, 2003; Goodwin, 2018; Goodwin & Cekaite, 2018). As such, prior (i.e. older) media and technology can serve as substrates for subsequent (i.e. newer) forms, maintaining- and reconstituting- valued social practices over time.

Design decisions regarding what is a valuable or viable practice in their particular family are often made on the basis of the introduction of a new device but just as often involve negotiating the continued use of older ones. Meanwhile, the availability of new technologies at home tests the continued viability of older ones, reconfiguring practices. These new practices tended to incorporate old media in the improvisational ways I have described more often than they entirely obsolesced old media because a new tool was so radically innovative. Indeed, the very idea that innovation and novelty should drive families’ designs for learning was disrupted by their ways of renewing learning, with implications for design, for pedagogy, and for social theory. It is to these implications that I turn in Chapter 7, as I offer the idea of routine maintenance as an approach to families designing that explains how they preserve familiar sociotechnical practices.

CHAPTER 7: CONCLUSIONS AND IMPLICATIONS

Routine Maintenance: Understanding Families' Designs and Technological Change

Repair and maintenance have long been organizing ideas for social theory, vital processes through which discursive work leads to shared meaning making (Schegloff, 1992) and sociotechnical orders stabilize (Graham & Thrift, 2007). Whereas repairs in conversation are necessary to keep communication flowing, repairing technology is also frequently required to maintain systems and social structures that underlie daily routines. These processes of repair and maintenance are ongoing in human-technology interactions, routine aspects of our day to day life in a digital era without which, things literally fall apart. Repair and maintenance often take place in the background of everyday routines, presenting a paradox that has led a number of theorists of repair and maintenance to pose the incisive question: “how can something be at once both essential and invisible?” (Henke, 2000, p. 69). In this dissertation I have examined this puzzle in the context of families' sociotechnical practices in their private homes. I now conclude by pointing to the ways in which families do significant maintenance work through their designs for domestic technology use, and I argue that this is important for learning.

Across these three chapters I have showed how, despite anxieties about pervasive technologies dramatically altering learning or family life, families are adept at using technology to maintain valued routines. In Chapter 4, such maintenance work took the form of multi-tasking, whereby increasing the density of sociotechnical work actually enabled people to collaboratively maintain interactional floors across dynamic task environments. In Chapter 5, maintenance work was often invisible, undertaken by children and parents whose backstage activities kept life humming along when humdrum chores needed to be done or when domestic activities (or

devices) broke down. In Chapter 6, maintenance work involved adapting to technological change by incorporating prior technologies into household routines and renewing familiar ways of doing things.

Taken together, these findings illustrate how families are doing *routine maintenance* as they design for learning at home with technology. Routine maintenance refers to a number of different aspects of sociotechnical practices, such as those that families enacted across the empirical examples I presented. These aspects of maintenance work occur across scales of human interaction. First, families are staying on task- or on topic- by collaboratively maintaining floors of interaction during conversations that occur in the context of media engagement. Second, families are doing routine maintenance to keep technology working well or learning environments in good condition. Third, they are using technologies to maintain their relationships with each other and with extended family. Fourth, they are maintaining routines of daily life through their use of these technologies and forms of media engagement. Finally, and at the longest temporal scale, they are collectively maintaining a historically constructed sociotechnical order, even as this order is transformed through technological developments.

In the remainder of this concluding chapter, I will specify what I think routine maintenance entails, elaborating on the forms it takes across scales. I will make connections between these forms of maintenance and the empirical examples of family life and children's learning in preceding chapters. Then I will explicitly describe how each of the three key findings (regarding multi-tasking, invisible homemaking, and re-newing learning) not only enable or support routine maintenance, but are ways of *designing* for it. Drawing a through line between families' sociotechnical practices, designing, and doing routine maintenance then presents a number of implications for future design work. In the last section I point to how understanding

families as designers of routine maintenance might contribute to reorienting theories of learning and design around an ethic of care.

Doing Routine Maintenance Across Temporal Scales

At the shortest timescale of human activity, routine maintenance represents the regular repairs that must be done when interactions or technologies break down. Doing routine maintenance is a vital part of keeping sociotechnical systems in good condition (Graham & Thrift, 2007; Star, 2001), and home environments were replete with moments of repair and maintenance. Replacing broken tablet screens (e.g. Steph, Ch. 5), restarting a mobile app to establish (and reestablish) GPS connectivity (e.g. Oliver, Ch. 5), and staying in sync during joint activity (e.g. Natalie and her mom Ch. 4) are all instances of regular repair and maintenance located in moment to moment interaction at home. These maintenance activities- within conversation or sociotechnical work- are ubiquitous in design spaces like homes, where staying connected to the home network is part and parcel of staying connected to family members and larger family goals and routines.

There is an intimate relationship between the discursive maintenance of interactions in conversations and the material maintenance of families' devices and domiciles. The accomplishment of routine maintenance- of talk, tasks, or technologies- in complex media ecologies like home environments involves coordinating the use of materials and talk in ways that conform to design constraints but also make use of these constraints as resources (Erickson, 1982). In the example of the twins' multi-tasking in Chapter 4, recycling the idea of "tipping" across the floor of the home literally maintained floors of interaction, whereby people stayed on topic despite divergent task objectives (ibid). Recycling is an apt metaphor for maintenance more broadly, as repair and maintenance entail improvisatory recombination of materials and

restoration of prior action. Later in Chapter 6, recycling took a more material form, as paper books were reused in novel ways, a practice that maintained a prior media form and simultaneously created novel learning opportunities. In all these cases, when tasks, talk, or technologies broke down, interactional maintenance work was required to get things back on track.

And yet, the examples I presented across these chapters highlighted the paradox that, essential or commonplace as maintenance work may be, it goes largely unseen (Graham & Thrift, 2007). In Chapter 5, the routinization of digital housekeeping and the organizing power of background music both illustrated how essential backstage processes operate invisibly to keep family life in operation. Graham and Thrift (*ibid*) refer to this backgrounding of maintenance work as the “carpet of ongoing maintenance and repair,” an apt metaphor for describing the foundational characteristic of maintenance work in domestic settings. Because, as these authors go on to explain, maintenance work is “always on,” it constitutes the background of task environments and can be hard to see unless or until something breaks, for example when Oliver improvised repair of his brother’s *Pokémon Go* GPS connectivity. Just as multi-tasking represents a form of activity where background and focal tasks are a matter of perspective, maintenance work likewise shadows some important sociotechnical processes that may be consequential for learning.

At moments of repair, the invisible work of doing routine maintenance becomes visible and takes place out in the open until devices (or discourse) can be repaired and daily rounds resume their normalcy. Placing analytic focus on routine breakdowns and the work it takes to get them back on track is a means of recognizing and revaluing vital work of repair and maintenance, or articulation work, that holds routines together (Strauss & Star, 1999). This is

particularly important in private spaces like homes where what is consequential for learning is harder to access (or assess) or where the embeddedness of technologies in everyday routines or infrastructures makes their significance transparent (Star & Ruhleder, 1996).

It is precisely because such interactional maintenance work is regular or routine, that routines are maintained at a longer time scale of days or weeks. Whereas routine maintenance in the first instance is accomplished through ongoing moment to moment interactions with people and tools, there is also a sense in which these moments of repair and maintenance add up to something larger, something families are able to maintain over space and time: *everyday routines themselves*. The findings presented in the preceding empirical chapters illustrated just how much there is to do during the course of a family's day or the average work week; nonetheless, families manage to hold routines together despite the press of technological change and constant time pressures (Wajcman, 2015). The cases I presented were snapshots of what some of these routine activities were like, empirical examples of how families organized materials and collective labor to maintain ongoing, regular, or weekly rounds of their *daily* media rounds.

Maintaining the ongoingness of routines is not a given in rapidly changing technological environments like homes. With so much going on in family life- and so many new technologies for families to consider incorporating at home- there is a risk of needing to reinvent a new routine each day, or worse, of finding no effective means of organizing for everyday activities and learning (Crabtree & Rodden, 2004). That was simply not the case for families in this study. The instances I described were not only representative of larger patterns across families, they were typically *daily* activities for the particular families whose routines I described. Playing music during household routines, scheduling technology use around homework time, and playing

video games with siblings during discretionary time were regular, ongoing activities in their particular family lives. In other words, families worked to maintain the “every” in everyday life.

And yet, there is no denying that homes have changed in recent decades, and that the density of materials and intensification of labor and leisure time can threaten to destabilize family activities (Wajcman, 2015). Ongoing transformations of housework, homework, and leisure are certainly taking place, and technology is of course implicated in such change. However, what the cases I analyzed illustrate is less that routines themselves are changing to accommodate these pressures and more that families are still practicing many historical forms of homework and leisure, albeit at times using novel tools. For example, a routine leisure activity like TV watching is still very common, and in many families, this sociotechnical practice remains virtually unchanged from a generation or two before; the TV is still a fixture in most living rooms (even the Yu family, who I quoted in the opening chapter, ultimately incorporated this normative element into their home technology design). It was not even the case several years ago, when I undertook this fieldwork, that streaming TV on separate mobile devices had become more pervasive than the traditional configuration of gathering around the TV set to watch a program (Takeuchi & Stevens, 2011). Despite competing demands on time and attention, “making room for TV” watching remains a signature way of maintaining family life (Spigel, 1992). This was true for many of the routines I observed and speaks to the significance of maintenance in everyday activities.

Furthermore, my study of families’ technology use suggests that their reticence to alter daily routines does not reflect an anti-technology stance, nor does it mean families were late adopters. They were neither ambivalent about using new tools, nor particularly troubled by perceived lack of access or equipment. Families indicated positive interest in innovations such as

smart home technologies and mobile augmented reality apps. They adopted technological practices that were novel at the time, such as creating separate Netflix profiles on a single account, modifying selfies on smartphone apps, or upgrading to the newest iPhone (the iPhone 4 for the Midwest families and 5 by the time the study transitioned to the Northwest). However, these new media and technology have not radically changed routines at home in ways that signaled a new sociotechnical order. Technology features and media forms changed, but the underlying practices maintained their earlier functions (boyd, 2014). Home environments and the routines that took place within them were still recognizable as their earlier versions, and families had worked to maintain this order.

At the scale of social orders, families' designs for routine maintenance exemplify what we know to be true of technical infrastructures: technical infrastructures preserve social conventions and forms of human activity as they simultaneously reflect (and conceal) their complex process of construction (Star, 1999). As families reorganized domestic environments or reassembled routines using new equipment, the family unit itself, as an index of social order, was not dramatically reconfigured. As one example, with few exceptions, mothers- and not fathers- continued to support much of children's work and leisure time at home. That homemaking in a digital era should be powered (in both the literal and figurative sense) is not surprising. Graham and Thrift (2007) suggested that there is a "politics of repair and maintenance" (p. 17). Despite the fact that women hold fewer technology jobs *outside* the home (Wacjman, 2015), they continue to do much of the digital and physical housekeeping inside it, maintaining a gendered division of sociotechnical labor that has persisted despite technological developments. This is not or not only because the family is a site for the reproduction of social norms and so is resistant to

ideological change, like any other powerful institution. It is also because families are skilled keepers of social order, and maintenance is a delicate business (Henke, 2000).

In addition, family members continued to stay in touch with each other over time, space, and generations, and technology played a significant role in maintaining this continuity. And in spite of my analytic focus on older tools and technology, families did buy many new devices, maintaining enduring patterns of consumption that fuel social organization in capitalist society (though I think the Hernandez family's reliance on local exchange in "tablet economies" which I analyzed in Chapter 5, troubles simplistic market models of technological consumption). These types of social processes persist and are maintained across generations, and families are important agents of re-inscribing these social processes at intergenerational time scales. If, as Latour (1990) famously suggested, "technology is society made durable," then the social order is durable indeed, and families have worked to maintain it.

Histories of domestic technologies provide classic examples of how relations between people and tools become sedimented and how this process is powered, the results of ongoing contestations about what counts as technology, when and how it should change, who gets to engage in technological practices, and for what purpose. Legacies of learning at home are not neutral with regards to who works to maintain social orders, nor benign with regards to what such maintenance holds in place (Ribes, 2017). We need to ask what the consequences are of maintaining the domestic status quo. Alternatively, what are the possible consequences of continual generation of new technologies for everyday activity and social life?

The consequences of engaging with media or adopting a technology are not only potentially consequential insofar as they support meaningful learning (or not). Consequentiality of learning also implicates the "long now" of technology, its uses, and its disposal. This means

considering what the long term effects might be of designing particular learning arrangements or sociotechnical systems across scales of human interaction. To say learning is consequential for someone is to open up the question of that person's connections to other humans and more than humans, to the environment, and to the whole media and natural ecology that ultimately sustains learning. How might learning designs become more attuned to consequentiality across scales of time and interaction (Jurow et al., 2016; Lemke, 2000)? I believe that designing for routine maintenance represents one such approach.

From Repair and Maintenance to Care and Maintenance

The idea of routine maintenance across scales offers insights about families *desires* to stabilize the everyday- and about their *designs* for doing so. Though everyday life is sometimes so routine as to appear natural- the result of the normal course of things rather than of active efforts and interventions- families are very actively working to design situations in which their everyday life is situated. Because the everyday is not only situated in but saturated by technology and new media (Pink & Mackley, 2013), these tools are implicated in everyday design, or the design of everyday life (Shove et al., 2007). Families' routine maintenance of everyday life is not meant to suggest that they are planning or intentionally engineering their lives (although sometimes their activities do resemble formal design work, for example when they build robotic tools or create a spreadsheet together).

Family life is not organized around preventative maintenance or anticipatory repair (Sims, 2017), like professional engineers. Instead, families' designs for everyday learning are situated in their improvisatory ways of making home work for learning with technology through situated actions (Suchman, 2007). As such, I am not implying that families are like professional designers. Rather I am suggesting that families' design thinking reflects- and is an important

version of- a way of reframing design that is aimed at maintenance, not only innovation, at improvisation, not professional engineering, at continuing traditions, not always progressive development. Families' tendency to hold together routines of homework, chores, or leisure time reflects their designs for routine maintenance. Multi-tasking, invisible homemaking, and renewing media all act as design strategies that make the maintenance of routines possible. These three approaches to designing for learning embody and enact families' visions for what they want family life to be like, what that they want home to be like, and what they want learning to be like.

Families designing through multitasking illustrates how families desire home to be a place where the action is, where there is a lot to do, and where many activities can take place contemporaneously. It is perhaps this busyness that makes home such a meaningful place for children's media engagement, the reason why they all identified home as the singular hub of technological activity. The density of tasks and technologies created conditions conducive to designing for learning through multi-tasking, learning to multi-task, and learning despite multi-tasking. As learning designers, families made it so they could maintain their interactions and routines despite the pressure of the everyday, actively adapting to the technological intensification of labor and leisure.

Families designing through invisible homemaking reflects how families desire to take care of one another and their environments and how technology is involved in their caring labor. As they enacted routine maintenance, families demonstrated how they keep family life humming along in the face of change. Home is an important place to notice an ethic of care built into designing, not only because that is where our loved ones live, but because family life is a primary site for learning the sorts of values and ideals children carry through life, values which

they carry on and maintain across generations. That technology is implicated in propagating particular values is a principle contribution of feminist technoscience, the primary perspectives I have taken in this study (Cowan, 1983; Wajcman, 2015). It is, therefore, fitting that one approach to families' designing should center on making home a certain kind of place where people and things are taken care of and kept in working order. As designers oriented towards the human-centered aspects of the material world, we can look to families as models for how children learn to be stewards of their environments and caretakers of material culture, an implication I address in the last section of this chapter.

Finally, designing through re-newing learning reflects how families desire to embrace technological changes, but in ways that still maintain prior ways of living. As families reassemble, remix, and recycle their media around the home, they are designing sociotechnical practices anew, though ones that are not motivated by a logic of innovation and progress. Rather, families keep one foot (or plug) planted in technologies of the past, enabling them to preserve much of what they hold dear about family life and everyday routines as they incorporate new tools and media. On the one hand, this tendency to use a variety of tools and media reflects late capitalist tendency to stockpile material resources and reveals an overabundance of consumer technologies at home (Arnold et al., 2012). Yet on the other hand, it points to ways that maintaining traditional tools might disrupt cycles of designing for replacement, curtailing planned obsolescence as a driver of consumption. Families' ways of caring for their learning ecologies signal how we should design for maintenance and repair rather than development and continuous cycles of production (Graham & Thrift, 2007).

Families' Improvisatory Approaches to Designing for Routine Maintenance

As is by now abundantly clear from my perspective in this dissertation, I question the telos of design as innovation. At the same time, I agree with Jackson (2014) who wrote that “worlds of maintenance and repair and the instances of breakdown that occasion them are not separate or alternative to innovation, but sites for *some of its most interesting and consequential operations*” [emphasis added] (p. 227). It is not so much that we need a moratorium on innovation, but rather that understanding routine maintenance as potentially consequential opens up different possibilities for learning and for designing. This reoriented version of design centers nondominant perspectives- such as those of families and young children- on what we should design for, what counts as design, and who is capable of doing design.

Based on my study of families learning at home, a more adequate design theory takes improvisation, not innovation as a primary design objective. This underscores what some designers of technology already know about repair and maintenance: that it is not or not only in their original conception, but in their spontaneous day to day use and reuse that designs take on meaning in everyday life (Norman, 2013; Shove et al., 2007). People have always been improvising with the tools they have on hand in ways that are underdetermined by formal designs (Ingold & Hallam, 2007; Suchman, 2007), and this is as true in learning settings like homes as it is in design studios. In contrast to innovation as a driver of change, improvisation responds to the constant tensions between conservation and transformation that fuel social life and sociotechnical change. “Improvisations are the openings by which change comes about from generation to generation” (Holland et al., 1998, p. 18).

My historicizing of families' sociotechnical practices presents a counter-narrative to linear stories of technological progress and learning that often overlook how people conserve or

maintain familiar practices even as new and desirable technologies come into fashion, or as they come into fashion, and so become desirable. Nonetheless, new technological forms and practices *do* emerge in homes, often prefigured by older sociotechnical practices, and family life is an important site for noticing these dynamics. In this dissertation, I examined how technological change- both processes of transformation and conservation- interact in families' everyday practice. When designers attend to this dynamic interplay of technologies' histories and people's histories, they can establish the grounds (and the need) for newness when older ways may more adequately support collective continuance (Barajas-Lopez & Bang, 2018).

Russell & Vinsel (2017) argue that “while innovation — the social process of introducing new things — is important, most technologies around us are old, and for the smooth functioning of daily life, maintenance is more important” (n.p., para. 5). Given this perspective, it is puzzling that the idea of innovation should drive technology education, learning design, and even discourses of learning and development. There are many reasons for skepticism regarding “this quest for the new” (Deb & Homes, 2015). For one, technological innovation is a major contributor to the current ecological crisis (Gabrys, 2013). As a critical site contributing to more ecologically sustainable futures, education has a stake in how and for what purposes technologies get developed. For another, novelty does not necessarily imply improvement. There are many examples of innovative tools that have done little to advance older models. Third, prior knowledge significantly contributes to future learning, particularly insofar as what people learned in the past represents legacies of home, of family, and of communities' ways of knowing (Gonzalez, Moll & Amanti, 2005).

I started out by questioning how families were designing for learning, how new media and technology contributed to reconfiguring their sociotechnical practices, and how this related

to learning. Having studied families approaches to doing routine maintenance, I now see their way of designing as improvisational, not as innovative. This insight is both a testament to the continued usefulness of old media *and the ingenuity of learners* (Gutiérrez , Cortes, Cortez, DiGiacomo, Higgs et al., 2017). Take Lara’s recycling of paper books in Chapter 6. In her case, it was not only that e-books may fail to respond perfectly to the needs of today’s readers, nor that readers themselves are failing to learn new competencies associated with digital technologies. Her reading points to another explanation for the continued use of paper books: paper book technologies are adaptive to new uses, and readers like Lara are improvising new ways of using old things. This example illustrates how, in a world driven by designs for new things and increasingly inundated by e-waste, young children are skilled at sustaining both everyday practices and learning ecologies. What are some other implications of orienting a theory of learning around the improvisations that take place during routine maintenance?

What Designing for Routine Maintenance Means for Learning

Designing for maintenance has a number of implications for learning. First, technology and learning designers have a responsibility to think not only of the learners we design for and with, but the world we all design in. Families’ approaches to design provide excellent blueprints for how sustainable learning and technology design could look, or at least the sorts of questions we might ask if our primary goal is to conserve and preserve rather than develop and consume. How can we do more (for longer) with designed tools, as in multi-tasking? Or how we can keep devices in good repair, as in digital homemaking? How might we recycle old media in new ways, as in renewing learning? These are important questions that animate families’ designerly ways of thinking about learning at home with technology.

Following from the first implication, we can reorganize learning opportunities so that an ethic of care and environmental stewardship are the goals of learning designs. Learning designers should support learners to see themselves as connected to their media ecologies in more ways than through the internet. Internet connectivity- or connected learning programming aimed at creative production as an end goal- are impoverished versions of being connected, when the stakes are not only individual and collective, but geologic. How might we design a science of learning that centers the vitality of ecological systems as the primary goal of learning? What are the possibilities for a theory of learning that takes media ecologies not, or not only, as disruptions of “natural” ecologies, but as grounds for reimagining broader ecological futures? How might families’ domestic designs dissolve arbitrary distinctions between the environment we care for and the tools we use to care for it, thereby establishing mutual accountabilities and expanding opportunities for learning?

In addressing such questions, learning scientists should consider how much of the history of technology (or history in general) we design for learners to encounter across settings. Doing so can render visible the invisible infrastructures structuring social orders and place renewed value on the work of maintaining them and the ecologies with which they are co-constitutive (Star & Ruhleder, 1996). Historical studies of technology also open up questions about how and why media ecologies or sociotechnical systems operate as they do (or fail to do so). We should cultivate attention in our learning designs to learners’ astute abilities to question why something breaks down (Silvis et al., 2018a) and learn from their inventive strategies for managing the mangle of technological practice (Taylor, Silvis & Stevens, 2018). Grappling with technologies’ contingent and contested histories of development can create pivot places for interrogating

dominant social orders, opening up new possibilities for learning and technology designs (Taylor, Silvis & Bell, 2018).

But there is another sense in which a perspective on routine maintenance can inform theories of learning that has more to do with what learners are doing when they are engaged in repair and maintenance and less to do with what repair and maintenance produce as design strategies. Put simply, “maintenance *is* learning” [emphasis in the original] (Brand, 1994, p. 127). Because when we repair we are always making adjustments based on knowledge of the problems at hand, maintenance represents “one of our chief means of seeing and understanding the world” (Graham & Thrift, 2007). This radical view of repair and maintenance *as learning* is based in the same notion of design as improvisation that I have been advancing and locating in empirical examples throughout this dissertation (e.g. Holland et al., 1998). It is now time to take improvisation seriously as a way of thinking about design, and I have given many examples of how children are already adept at doing this. As such, design is not necessarily something they must learn to do, it is how they learn all the time. And maintenance and repair are observable instantiations of their learning, which we ought to learn to see better. Doing so is not only politically important because the work of maintenance has historically gone unrecognized, it is epistemologically important because maintenance *is* learning.

Maintenance, then confers specific epistemic affordances. But what is the way of thinking that maintaining things engenders? Some have argued that people who know how to fix things or to make regular repairs think differently than those who create things, going so far as to argue that they may even know how to occupy entirely different social worlds (Jackson, 2014). Others have characterized the differences between design thinking and maintenance thinking as a teleological matter: maintainers desire very different outcomes than innovators (Russell &

Vinsel, 2018). Jackson's notion of "broken world thinking" (ibid) encapsulates this orientation toward the epistemic in thinking about repair and also reorients the concept towards larger ecological concerns. Jackson's figuring of the world in the 21st century as already broken and in need of repair is not uncommon. However, based on my study of families designing for routine maintenance and from a feminist epistemological perspective, I see a different possibility for maintenance in human knowledge systems.

Towards Cherished World Thinking

It is true that many things around the houses I observed were broken. Cell phones' charging ports had been fried. Game controllers contained dead batteries. Tablet screens were cracked. Broader network infrastructures were also continually breaking down, and children contended with unreliable Wi-Fi connections, "glitchy" GPS signals, and slow broadband speeds as they went about their daily media rounds. Indeed, beyond their homes and neighborhoods, the world itself is decaying in many ways that bear on how children learn and how they might learn to care for and maintain the widely distributed media ecologies in which their media engagement is situated. However, mostly things were in *good* repair. Families are skilled at taking care of things. I believe this is because families care deeply about each other, and they cherish the material and social ecology of home.

What if instead of fixating on fixing what is broken, we put our energies into caring for what is still working and to keeping it running as long as it can? This introduces an important set of ethical considerations for doing maintenance and repair. First, it takes caring as a positive starting point for more responsible action, rather than anxieties over breakage. Second, caring for things is technically an easier operation than dealing with them when they fall into disrepair. Consider how much more time it takes to clean up (a room or data or anything else) after

maintenance has waned, then it does to tidy up just a little on a daily basis. Third, it foregrounds the significance of the objects we deem important in motivating action. People are more likely to want to take care of something that they, well, care about than something that is already not as useful to them. In homes, there are so many things that people cherish and want to hold onto for a long time. What if we began to think of disposable technologies as possible family heirlooms? How might families' ways of caring for their most prized possessions help us develop "cherished world thinking?"

Cherished world thinking reflects how families are not, in their day to day lives, overtly concerned about how the world is broken. Their daily routines do incorporate important social activities like recycling, pet care, or yard work- or digital housekeeping. However, they do this maintenance work because they care for their cherished objects. Caring for something you feel responsible for requires a different orientation to the world than fixing something that is broken. Children and their families are important models for how caring labor looks and how it plays into people's day to day maintenance of technologies. While I began this dissertation study wondering about families' design thinking, analyzing families' approaches to domestic designs for learning with technology revealed how their thinking is oriented towards an ethic of care. What does it mean to view design thinking in terms of "cherished world thinking?"

These questions resonate with theorists of maintenance and repair who are concerned with care, and who ask what taking technoscientific problems as "matters of care" then allows us to create or to think possible (Puig de la Bellacasa, 2011, 2017). Puig de la Bellacasa (whose ideas are ideal end points for this dissertation, because her name literally derives from the Spanish for *the beautiful house*) reminds us that "caring is not an option but a vital necessity in our technoscientific world... nothing holds together in a livable way without caring

relationships” (2011, p. 100). Houston (2017) asks, “How might repair enable us to live more carefully with the things and worlds around us? And how might we reimagine and redesign devices whose material parts and “social lives” can more closely align?” (p. 41).

Caring is a situated practice, and it is equally important to ask what we should cease maintaining because it is no longer (or maybe never was) a part of convivial systems as it is to ask for whom or what we should care and of course “at whose expense (Ribes, 2017, p. 56). In bringing design closer to caring and families’ everyday practices further from a world where things are broken, I am, like Ribes, wary of “a danger of magnifying the already positive valences of maintenance and repair” (ibid). However, in including family life and young children’s learning as vital sources of repair and maintenance, I am attempting to shed light on a perhaps lighter side of maintenance, one that incorporates families’ mundane daily routines into the sociotechnical imaginary of maintenance. If maintenance and repair are “tendentiously sunny words” (ibid), maybe we ought to let this sentiment resonate in order for young children’s cherished world thinking to flourish.

My argument for designing for routine maintenance should not be read as a nostalgic wish to return to some unmediated past. This past, if it ever existed, is paved over and plugged into in ways that make the present appear natural. One lesson that learning theorists, designers of learning, or technology designers should take away from this study and its findings, is another reminder that things could have been otherwise (Haraway, 1988; Suchman, 2011), and they still can be. Families heterogeneous and contingent designs for learning at home illustrate just how many ways there are to make home... or to make home work. What sorts of designs or designers can support more equitable forms of work- or technology- at home and beyond? How can people who do housework or homework have more of a say in how technology gets designed?

Understanding the powerful relations between technology, design, maintenance, and learning through a notion like “cherished world thinking” begins to address these questions.

There are a number of ways this might happen, with implications for future study and learning designs. One future direction learning designers might take is to support families to make connections between the devices and the world they care for. Prompting families to think historically about their media practices and media themselves might be best realized in homes, where stabilizing networks for domestic technology use is the daily responsibility of local actors (as opposed to school administrators or other more distal authorities). Families could be encouraged to think about the impact of their connectedness to the grid from a longer view. For example, what would it mean to remake home climate control through a perspective on global climate change? This could involve projects for families to work together with learning and technology designers to rethink home maintenance through a socioecological lens. In such a project, interventions like smart home technologies or mobile devices and screens could be organized around their “artful integration” (Suchman, 1994, p. 34) with familiar household technologies, rather than wholesale replacement that creates unintended waste.

I think there is also an opening for designing with families around their replacement strategies. Asking families to open up their garages, attics, desk drawers, and closets to examine what technological objects have fallen into disuse could consequently open up new possibilities for disposal of unwanted technologies. In the technological graveyards of homes, there are likely new untapped solutions to broader ecological issues around responsibly recycling technologies. Alternatively, could families find ways of sharing and redistributing their unwanted items in local networks with other families? Considering that, as I argued in Chapter 6, what is new from one perspective is old from another, one families trash may be another’s treasure.

Furthermore, what follows from cherishing our world and our technologies is that, while many devices and media are beloved by children and families, how these items came to be and where they will ultimately go is largely invisible. I believe that bringing to light the immense “shadow work” (Star & Strauss, 2001) that contributed to making Katherine’s cherished MacBook Air or Lara’s Harry Potter book available in their homes will be important for families taking account of their own roles in sociotechnical systems and socioecological futures. Future work with families and technology could design for them to make visible all the work that takes place downstream of their media engagement that makes YouTube, Google, or their local library stacks available resources for their ongoing and unlimited access.

At the same time, some families do have limited access to some technologies and media, and this is important to surface as well. In this study, one limitation was that the range of socioeconomic resources families used to equip their home environments was relatively narrow. Most of the families in this study lived in single family homes and had multiple means of media engagement- multiple computers, smartphones, TVs, etc. The pure density of devices and media I was able to observe families using is not a universal characteristic of all families (Rideout & Katz, 2016), and it will be important in future ethnographic studies of families and children that we continue to broaden the perspectives and possible locations from which sociotechnical knowledge becomes visible. Had we conducted the study with less affluent families, families that did not live in technology centers like Seattle, or families who do not live in the US, practices and design processes would likely look different; for continuing to create more equitable learning arrangements and ethical studies of learning, understanding these differences is paramount.

Finally, my study prompts questions about how it would be possible to study and observe invisible work or to recognize new practices as they emerge in the future. Beyond the local, moment-to-moment interactions in homes, how would we know if and when the social order is being reproduced or alternatively transformed? I believe this requires analysis at a timescale that is difficult to study empirically, at least at the grain size we are typically accustomed to focusing on in studies of learning. Cole (1996) has posited what actual ruptures of the cultural-historical level of development might consist of and some forms this may have taken in the past: the car, the phone, the computer. While I do not believe I witnessed observable examples of stark changes in the social order during my fieldwork, my findings do point to all the unseen and contingent changes that take place in and through sociotechnical practices. It is likely that these micro changes could add up over time to transformations in the social order. Perhaps advances in AI, smart home technologies and connected homes, or some smartphone of the future will eventually generate “newness” at this scale.

The diversity of home environments and domestic learning designs gives a window into the emergent possibilities for sociocultural reorganizations, sociotechnical relations, and social-ecological responsibilities. With all these old, new, and emerging tools on hand, what will we turn to next to keep life and learning humming along? It may just be that the best tool for the next job is one we already have, or some mixture of the old and the new. If families are the ones designing for learning, it is likely that their designs will improvise with what they have on hand rather than innovate to develop something brand new. Designing for routine maintenance engages such improvisatory approaches that reach back into the technological toolkit of home to sustain learning and living together into the future.

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APPENDIX A: FAMILIES AND HOMES

Phase I: Focal Children and Homes in and Around Chicago

The Carrs

The Carrs are a family of four. The focal child in the study was the eldest child, Theo (9). His little sister is five years younger. Mom and Dad are married and the family lives in south Chicago. Theo rode a bus to and from a public school in the area that is for gifted children. He was intensely interested in Pokémon, a passion that crosses several platforms of media, including TV, desktop computer, plastic figurines, trading cards, iPhone, and a Nintendo 3DS. While Theo was participating in the study, he received a Nintendo 3DS and a refurbished iPhone from his grandmother as Christmas presents. Mom stayed at home with the children, but also taught exercise classes in the evening. Dad was an accountant who worked downtown and was usually arriving home as Katie was leaving her observation in the evening. The Carrs were often on the go during the hours after school as both children attended lessons and Mom also had various commitments and classes in the evenings. Mom was also an avid blogger and Facebooker, but talked about how she understood very little of what Theo did with technology.

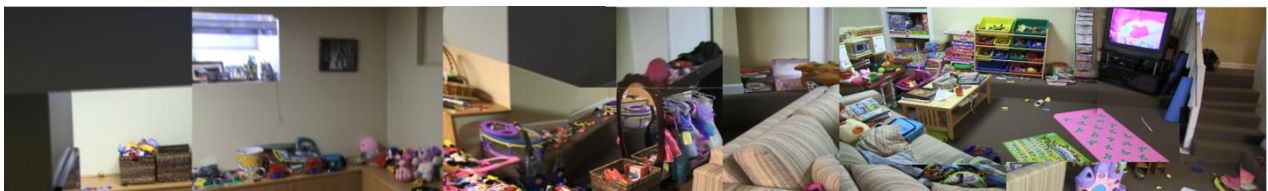


Figure A.1 Nearly 360-degree panoramic view of the Carr's basement media ecology.

The Cramptons

The Cramptons are a family of four that live in the northwest suburbs of Chicago. Leah (11), the eldest child was the focal participant in the study, but her younger brother was almost always around. As a family, they highly valued technology for learning. Much of their

afterschool time was spent around media for Leah and her brother. The both read books (in print), but also played Minecraft together across a Kindle and an iPad, did homework and other games on Leah's laptop, and texted, emailed, and/or played Words with Friends on Leah's iPhone. Halfway through Katie's observations with this family, Leah received a new laptop for Christmas (which she was instrumental in testing out, having purchased one at Costco and then returning it for one with a touch screen), and Mom purchased an iPad for herself to share with the family. Mom went back to work at a fulltime job in downtown Chicago, and dad worked full time and was home doing house and yard work for much of the time Katie was observing. Leah and her brother walk to the public school in their neighborhood and have a lot of autonomy in the afternoons because Mom and Dad are still at work.



Figure A.2 Panoramic view of the Crampton's living room.

The Ehretses

The Ehretses are a family of four: two sons, Mom and Dad. They lived in northern Chicagoland and the two boys walked to and from the public school in their neighborhood. At no time during observations did Katie see Dad. Mom worked full time and was usually home by 5:15 in the afternoon to cook dinner for the kids. The oldest son, Nate (13), was the focal participant in the study. Nate and his younger brother were autonomous during the couple of hours after school, before Mom gets home. They usually watched TV together upstairs in a family room of sorts, and ate snacks (lots of them). While they watched TV, Nate played with his

phone and listened to music on his iPod, while his brother managed the remote control. They had a couple of go-to TV shows that they DV-R, *Shark Tank*, *Beat Bobby Flay* on the Food Network, and *Sponge Bob*. During Katie's observations with this family, Nate broke his phone so was without one for several weeks. Mom eventually replaced it with another flip phone. After a couple of weeks with that phone, Mom took it away from Nate because of a bad grade in school. Of all the kids in the study, Nate appeared to Katie the most disconnected from technology. Mom, on the other hand, was an avid blogger and used a lot of different digital media for her work.

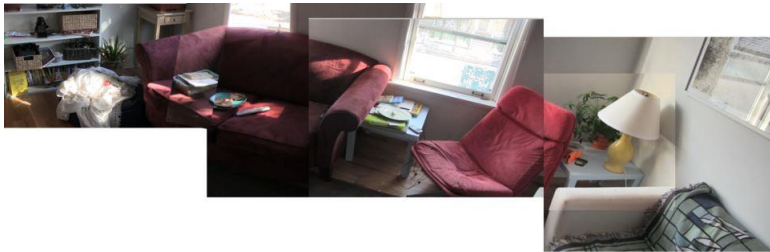


Figure A.3 Composite image of Ehrets' TV room.

The Ichabods

The Ichabods are a family of five: Mom, Dad, and three daughters. The two youngest daughters Mary (10) and Tanya (12) were focal participants in the study. Mom and Dad both worked, though Dad was between jobs during the study, and was doing some freelancing. The Ichabods lived in northern Chicagoland. The girls walked to their neighborhood public school and, after school, they usually walked home or to the YMCA where Mom worked. This family had no television, Mom had a smartphone, and the middle daughter had a flip phone. A desktop and a laptop computer sat in a common room off of the kitchen, and these were the machines that the girls used for homework when necessary. When Dad suggested that they watch a movie together, they moved the laptop from the common room to the living room at the front of the

house; Dad rested the laptop on his lap where they watch DVDs he had checked out from the library. Mom also had a Kindle that the girls used for games, but not for reading. During the study, the family adopted two puppies from the animal shelter, so there was a lot of energy from all five family members devoted to caring for the new additions.



Figure A.4 Panorama of the Ichabod's family room and kitchen.

The Quinns

The Quinns are a family of seven people. The two focal children in the study were the two eldest children, Kara (12) and Brittany (10). They lived in the southwest suburbs of Chicagoland and attended a public middle school in their neighborhood. At the time the study was taking place, the Quinns had one smartphone in the home that belonged to Mom, a television, a desktop computer, and a laptop that was around most of the time, but was a loaner from Kara's school. Mom stayed at home with the kids and taught piano lessons out of the house on occasion. Dad was a professor at the local state university and was never around during times of data collection. The Quinns are Mormon and spent every Sunday completely "unplugged" from technology as part of their religious observance and spending time differently as a family. During the time they were enrolled in the study, the family took a road trip to Alabama to visit Mrs. Quinn's sister, where they played Dance Dance Revolution in their cousins' basement.



Figure A.5 Panorama of the Quinns' living room.

The Uticas

The Uticas are a family of five people and lots of animals; Mom, stepfather, two daughters, and one son lived in northern Chicagoland with three dogs, two cats, and a bunch of chickens that stayed in the backyard. The son, Keith (10), was the focal participant in the study and the youngest of the three children. Keith's interest in basketball permeated most of his discretionary time after school. During Katie's observations with him, he was either playing basketball in his backyard with school friends that had stopped by on their way home (Keith's house was the first one to pass on the route from school to the rest of the neighborhood, so often served as a stopping point for up to ten boys), shooting hoops upstairs with a Nerf ball and goal attached to his parents' bedroom door, playing *NBA2K14* on his gaming console in the basement with a friend or sibling, or getting ready to go to the Y for basketball practice. Toward the end his time in the study, Keith broke his arm playing basketball in the backyard when he fell down and a friend landed on his arm after coming down from a rebound. This accident was a major disruption to Keith's recreational (physical) basketball play, but he still figured out ways to continue digital play. Mom was an elementary school teacher and was open to having the neighborhood kids in and out of the house between the end of the school day and dinner time. Katie's general impression of their home was that it was incredibly busy- almost frenetic- with the large family, all of the animals, and multiple friends coming and going.



Figure A.6 Panoramic view of the Utica's basement.

The Xanders

The Xanders are a family of three that consists of a single mom, mom's grandmother, and the focal child, Natalie (10). This family was visited by Dionne Champion, then a graduate student at Northwestern. The Xanders live in Gary, Indiana. Natalie spent most of her time after school with her great-grandmother (Nanny) because her mother often worked late into the evening. Her great-grandmother supervised her homework and most of her after school screen time, however, she gave Natalie almost total autonomy over her time and technology use. In the house, Natalie had access to her own laptop (used to belong to mom), her own tablet, and her own iPhone, which was not working at the time of the study. The family also had a television, video game console, and desktop computer. The desktop belongs to Nanny, but Natalie often showed her how to use it and did things like adjust the screensaver for her. Mom and Nanny also each had their own iPhones. The family had a pretty busy schedule of activities during the week. Mom was usually home on Sundays, and she and Natalie spent quality time together, often around technology. Mom had Natalie help her with "work things" as a way of teaching her how to use programs like Excel on her laptop.

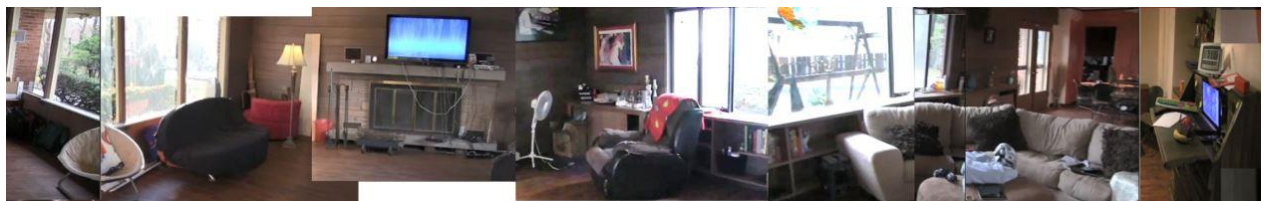


Figure A.7 Panoramic view of Natalie's living room.

Phase II Focal Children and Homes in and Around Seattle

The Hernandezes

The Hernandezes are a family of three: twin boys Eddie and Oscar (10) and their mom.

They live in a neighborhood adjacent to downtown Seattle, a short drive from the twins' elementary school. Mom is a graduate student at UW in the College of Education and is pursuing her master's degree in Special Education. She works full time in a practicum teaching position. The family also spends at least several evenings a week at their grandparents' house, where they have access to iPads (these stay at Grandma's) and like to watch movies and TV. Eddie and Oscar are avid technology consumers, and mom reports that they have cycled through a number of tablets (they each have one). In fact, during one observation, mom discovers that one of their tablets has a cracked screen, and is not pleased. The twins are active gamers and have designed their own game, for which they won an award at a local gaming convention. They spend a lot of time during observations playing mobile games side-by-side on their tablets (they each have one, with color coded cases to differentiate). They also watch cartoons and play video games on one of the consoles in their bedroom. During the time they were enrolled in the study, the twins took a Spring Break trip to CA to visit their uncle who has been a big influence on their technology-based knowledge and interests. Mom professes to not really care about technology, a stance she attributes to her Mexican-American heritage, but teaches herself skills like coding so that she can support the boys' interests.

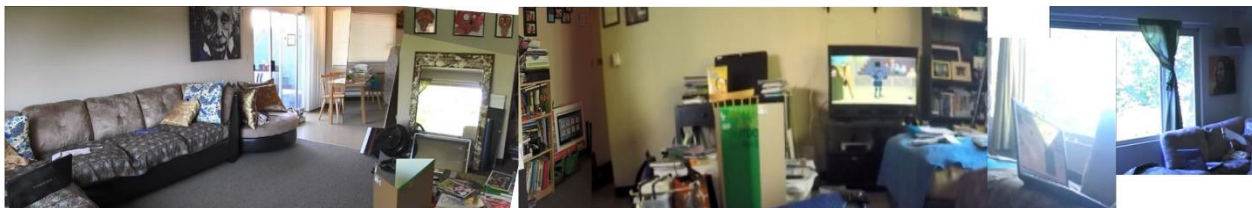


Figure A.8 Panoramic view of Hernandez twins living room.

The Hogarths

The Hogarths are a family of four: a boy Xavier (10) and his sister Emily, who (to her disappointment) is one year too young to participate in the study. Xavier's family lives in a

neighborhood close to the university, and his mom works for a nonprofit organization in the health care industry. Xavier's father Xavier Sr. is between jobs during the time they are enrolled in the study and had been in the tech industry. Xavier's maternal grandparents are from England, and they visit for a week during the study. Also, during this time, Xavier takes a family summer trip to a nearby popular vacation spot where their family reunion is held. There he plays with cousins and is introduced to the hit mobile game *Pokémon Go* in the week following its release. Besides playing *Pokémon Go*, Xavier also attends an enrichment program where he takes a class on Mythology and a summer camp where he kayaks on nearby Lake Washington. Prior to being in the study, Xavier had his own blog, was heavily invested in his Magic the Gathering card collection, and an avid reader. He also spends time playing *FIFA Soccer* on X-box in his basement and occasionally watches TV with his family. He is interested in politics (his father freelances for the local Democratic party), and his favorite YouTube video is an animated history of the Republican Party, which he watches on his iPod. Near the end of the study, his parents have a heart to heart with him and his sister about curbing their technology consumption.

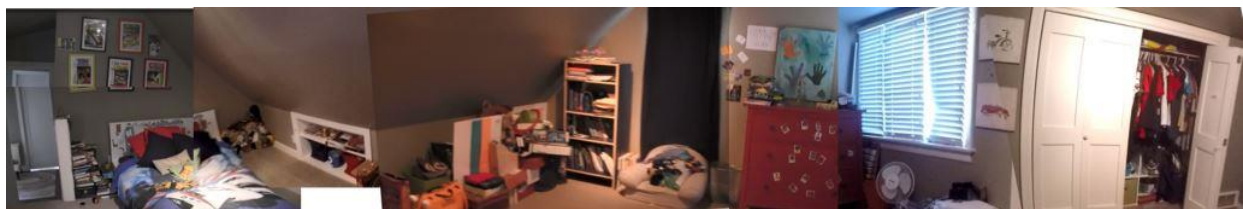


Figure A.9 Panoramic view of Will's bedroom.

The Huberts

The Huberts are a family of four: two girls Lara (9) and Latasha (12). The Hubert family lives about one hour east of Seattle in a forested suburb near a lake. Both parents work in the tech industry, and their father is also in the process of getting his teaching credential. He has an interest in teaching and designing learning technologies. The girls' grandmother lives in the

home with them. We delayed my visits after they enrolled in the study because (a) Lara’s 9th birthday was in a few weeks and she wanted to participate in the study with her sister and (b) the family was taking an annual trip home to India to visit their aunts, uncles, and cousins. Lara is an avid reader, and compared with her older sister, consumes far less digital media. Though she has her own tablet and laptop, she and her father frequently banter about whether these devices work, and if not, why. Latasha, in comparison, uses multiple devices on a daily basis. She has a desktop at her bedroom desk, where she completes her homework and works on multiple projects. She also uses her own smartphone and listens to music apps on various devices. While she is enrolled in the study, Latasha designs a robotics project along with a few friends and with her father’s help. She is interested in training as a professional scientist (in what discipline, she is not yet sure) and is learning to code. A white board installed in her bedroom has some coding language scribbled on it when I arrive for one observation. The two sisters have separate interests, separate bedrooms, and separate media, but occasionally, Latasha will lend Lara a non-fiction book to read for assigned nightly reading for school.



Figure A.10 Panorama of Latasha’s bedroom.

The Isaacs

The Isaacs are a family of five: three boys and their parents. They live in a suburb south of Seattle near Tacoma. The middle child, Owen (10), is the focal child in the study, although his six-year-old brother is present for the entirety of observations and is extremely interested and engaged in many of the same activities as Owen. Owen is active in soccer, swims daily at the

Rec Center down the street, and is busy taking advanced Algebra tutoring lessons during the summer. He is also an avid reader and won his school's Battle of the Books, which his mom helped him prepare for by utilizing the local library's app to reserve books before others could. Mom is curious about the "right" way to support technology use in their family, especially in light of her own very different experience growing up in Colombia when the only form of digital media they had available was watching *Sesame Street* every day after school (a memory she shares more than once). Isaac and his younger brother like to watch TV together, play video games in their nook on the upstairs landing. During the time he was enrolled in the study, Owen (and his brother) learned about the new game *Pokémon Go*, and the two boys played this on a regional trail during one of the observations.

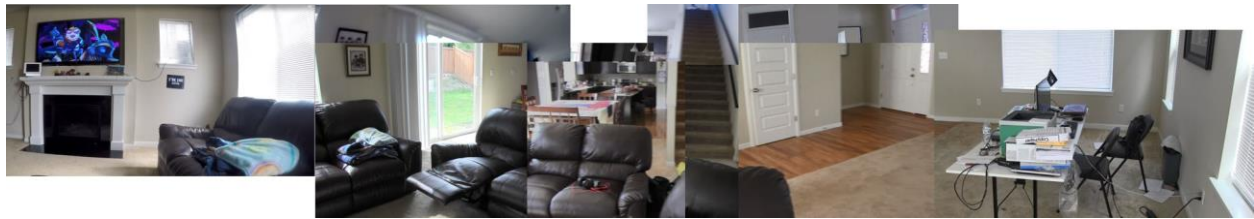


Figure A.11 Panoramic view of the Isaacs' living room.

The Kiangs

The Kiangs are a family of four: a boy Luke (14) and a girl Katherine (11), and Katherine is the focal child in the study. They had recently moved to their neighborhood in a suburb east of Seattle across Lake Washington before enrolling in the study. Katherine's father Mr. Kiang had stayed back home to run his business in China, while her mother moved with the children so that they could start school in the fall. They were in the process of furnishing their new house during the time they were enrolled in the study. Despite being new to the area, Katherine was involved in a number of summer activities and classes and was busy preparing for a placement test for her new school that would enable her to take advanced classes. She enjoyed ballet, chemistry,

cooking, and online shopping, but her primary interest was writing. She was enrolled in a summer writing course and was invested in vocabulary building, a daily activity which also intersected nicely with her placement test-prep. Katherine also hoped the family would adopt a puppy, and the family was negotiating the terms of this agreement. She was rarely seen without her MacBook Air, a prized possession which she had acquired while attending an International School in Shanghai, where parents are required to purchase their own laptops for their children.

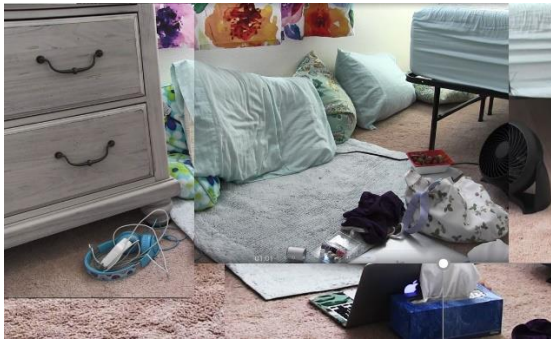


Figure A.12 Composite image of Katherine's bedroom.

The Yus

The Yus are a family of four: two boys Mark (13) and Brad (11) and their parents. They had lived in a suburb east of Seattle across Lake Washington for only three weeks before enrolling in the study; prior to that they had lived in Cincinnati for the boys' entire lives. Mom and Dad are both in the tech industry. Dad had taken a job with a leading software developer in the local area, and Mom found a job in IT during the course of the study. In the beginning of the study, they did not have a TV because they sold it before moving. Mark and Brad were both interested in technology, science, and math. While they were enrolled in the study they took classes in a summer scholarship program run out of the University of Washington; Mark takes a Chemistry class and Brad takes a pre-calculus class (because the Robotics class was full). The boys like to play video games, watch YouTube channels devoted to gaming and also to "pranks,"

and roam the internet on various fan sites. During the course of the study they learned about *Pokémon Go*, and their Mom took them to a nearby park where hundreds of people meet nightly to catch Pokémon. Mom is explicit about her hopes for their technology learning, and she has arranged the open floor plan kitchen/living room space with a long desk and two work stations, where each of the boys has their own computer.



Figure A.13 Nearly panoramic view of Yu's family room and kitchen.

APPENDIX B: TRANSCRIPTION CONVENTIONS

Talk and action are transcribed using a modified version of Jefferson's transcription system (Sacks, Schegloff, & Jefferson, 1974).

- [indicates where an overlap starts
- (0.0) numbers in parentheses indicate elapsed time in seconds
- (.) a tiny gap between utterances
- :: indicates prolongation of the immediately prior sound
- indicates a cut-off
- . indicates a stopping fall in tone
- , indicates a continuing intonation
- ? indicates a rising intonation
- CA capital letters indicate loud talk relative to the surrounding talk
- () single parentheses contain analyst's description of utterances in italics
- (()) double parentheses contain analyst's descriptions of non-verbal behaviors *in italics*