Theorising the Design-Reality Gap in ICTD:
Matters of Care in Mobile Learning for Kenyan Community Health Workers

by

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A dissertation submitted in partial satisfaction of the requirements for the degree of
Doctor of Philosophy

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Declaration

I declare that this thesis is a presentation of my original research work and has not previously been submitted for a degree from any university. To the best of my knowledge, this thesis does not contain any material previously published or written by another person except where duly acknowledged in the text.

Where appropriate, I have acknowledged the nature and extent of any work carried out in collaboration with my supervisors and others. With the exception of material that has been designated as “secondary data” in this thesis, I certify that all research work submitted here is my own, including but not limited to activities related to: (1) study design; (2) data collection; (3) data analysis; (4) interpretation; and (5) writing.

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Abstract

This thesis examines the sociomaterial relations of “design practice” in order to advance new perspectives on success and failure in Information and Communication Technology for Development (ICTD). I conduct an ethnographic case study of an academic research intervention and update the widely-cited theory of design-reality gaps (Heeks, 2002). Using methods from classic actor-network theory and post-structural material-semiotic tools, the analysis: 1) disentangles the entwined sociomaterial practices around design, production, and use of technology; and 2) integrates these insights into more elaborate conceptualisations of gaps, sustainability, scalability, and project failure. In doing so, my study answers the research question: What are the sociomaterial relations of “design practice” in a globally-distributed, multi-stakeholder, and technologically-mediated ICTD project for poverty alleviation?

My research narrative describes how an array of humans and non-humans participated as designers in a transnational, interdisciplinary Participatory Action Research project to train Kenyan health workers using mobile phones. At least six different patterns of sociomaterial relations operated through a given set of people and things, enacting the material-discursive apparatuses (Barad, 1998) of educational research, healthcare, the market, the state, and the local community. I assert that in this Participatory Action Research project for mobile learning, the design-reality gap was not so much a matter of geographic or socio-cultural divides, but was instead constituted as fluid space (Mol, 2002) separating the educational researchers’ designerly practices from the multiplicity of ways in which health workers, mobile phones, and other actors lived in relation to one another.

I conclude that these ontological politics enacted design as an empirical matter of care – an affective and morally-charged sociomaterial practice with an ethico-political commitment to the marginalised (Puig de la Bellacasa, 2011). I therefore present a conceptual model of success and failure in participatory ICTD projects that explicitly incorporates the affective and material dimensions of care, and conceptualises social justice – not solely in terms of universal claims or global standards – but as embodied, sociomaterial enactments.
Impact Statement

This work aims to contribute to three areas of academic research activity. In the domain of Information Communication Technology for Development (ICTD), my thesis addresses the need for well-developed social theory that explores the relationship between digital technology and global development practices. My work also draws upon and contributes to Feminist Science and Technology Studies (STS) by focusing on Matters of Care. Finally, this empirical study contributes to field of material-semiotics by generating new methods that integrate post-structural concepts with classic Actor-Network Theory. Findings in this study can serve as a roadmap for designers seeking to integrate new digital media into traditional public health information systems. This study of ontologies in design practice puts forth a creative methodology for applying philosophical reflection to address the pressing trans-national, multi-sectoral challenges of the contemporary moment.
for

Ella, Alexandre, Victor and Fabrice

love’s knowledge
Acknowledgements

In our inquiries we receive in good grace what is given rather than seek by subterfuge to extract what is not, and we are at pains to give back what we owe to others for our own moral, intellectual, and practical formation.

Tim Ingold, 2017

I am indebted to Niall Winters, my subsidiary supervisor from the University of Oxford, for so willingly bringing me into the mCHW mobile learning project to conduct this praxiography of design. Through his open spirit and ready intervention, I was welcomed by a globally-distributed team of dedicated researchers, NGO administrators, and Kenyan health workers who so graciously shared their time with me. I also thank Martin Oliver, my principal supervisor at the UCL Institute of Education, for helping me navigate the methodological and ethical considerations of my research. His expertise in technology and learning, combined with his unflaggingly incisive feedback and patient guidance have been a source of immeasurable motivation and inspiration. This thesis also benefitted from the close reading and candid critique of Lesley Gourlay and I am grateful to her for acting as an internal reader. Finally, I feel very fortunate that through its policies, procedures and facilities, the UCL Institute of Education has made it possible for international part-time students like myself to complete a doctoral thesis. It is my sincere hope that this thesis might serve as but one example of the many rigorous research contributions that have been made possible through this inclusive and visionary organisational ethos.
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1 Introduction

This thesis examines the sociomaterial relations of “design practice” in order to advance new perspectives on success and failure in Information and Communication Technology for Development (ICTD). To generate this analysis, I draw from the methods of material-semiotics within the disciplinary field of Science and Technology Studies (STS) (Law, 2017). My research illustrates how an array of human and non-human actors participated in design work during a mobile learning research intervention for Kenyan community health workers (CHWs), thereby enacting the messy “laboratory life” (Latour & Woolgar, 1979) of a transnational academic project. In deconstructing such “messiness”, my aim is not to evaluate whether prescribed methods and materials of technology design were implemented effectively. Rather, I critique the methods and materials themselves, and thereby demonstrate that designing mobile phone technology to train CHWs was a matter of care (Puig de la Bellacasa, 2011) – an affective and morally-charged sociomaterial practice with an ethico-political commitment to the marginalised. Accordingly, I argue that a conceptual model to describe the success and failures of ICTD projects must explicitly incorporate the affective and material dimensions of care, and conceptualise social justice not only in terms of normative claims or universal standards, but as embodied sociomaterial practice.

In this opening chapter, I establish the rationale for conducting my research. I begin with a brief overview of the origins of the ICTD movement and then describe the range of initiatives that have been implemented to date. Concerns over project failures are discussed before introducing the theory of design-reality gaps (Heeks, 2002). I propose to extend this influential model of ICTD project failure by elaborating the sociomaterial practices of designers and the human-machine interface. It is then argued that this conceptual work helps to address widespread calls for additional theoretical research that unpacks the relationship between ICTs and global development objectives. Finally, I present the overall structure of the rest of the thesis, outlining how this empirical case study in STS will answer my research question: What are the sociomaterial relations of “design practice” in a globally-distributed, multi-stakeholder, and technologically-mediated ICTD project for poverty alleviation?
1.1 Background: The origins and growth of ICTD

At the start of the century, the promulgation of the United Nations Millennium Development Goals, coupled with the proliferation of novel digital technologies, launched a flurry of policy-making, funding, and research aimed at leveraging computing and telecommunications for socio-economic advancement in developing countries (Heeks, 2008). This movement, referred to as Information and Communication Technology for Development (ICTD), mobilised funding from hundreds of bilateral, multilateral, and voluntary donors. These funds supported the design and deployment of myriad ICT initiatives in developing countries. One of the largest multilateral financiers of ICTD initiatives, the World Bank Group, proclaimed:

If ICT is appropriately deployed to take into consideration people’s differing needs, it can become a powerful economic, social and political tool for the poor, and for all those who work to eradicate poverty. (2003, p. 10)

Such assertions were accompanied by substantial financial backing. The World Bank reported that between 2003-2010, it provided more than US$ 4.2 billion for ICTD projects in over 92 developing countries, with private investment in the telecommunications sector totaling US$ 401 billion for those nations (2011).

Prior to this phase of accelerated growth, ICT activities were mostly implementations of office information systems for large government and private organisations in developing countries (Heeks, 2016; Walsham, 2017). Described by Tongia and Subrahmanian as “trickle down” solutions (2006, p. 4), these early efforts were aligned closely with a “transfer and diffusion” approach to innovation that involved importing artefacts and organisational practices from industrialised economies (Avgerou, 2010). Diverted by the compelling political agenda of the eight overarching Millennium Development Goals and the promise of emerging digital innovation, ICTD activities shifted dramatically away from implementations of “business solutions” towards the deployment of technologies where the poor were envisioned as direct users and beneficiaries. Leaders of these ICTD projects responded to heightened pressure for tangible and rapid results by continuing to rely on quick, ready-made solutions from Europe and North America (Heeks, 2008). “Bridging the digital divide” as rapidly as possible entailed continued reliance on “transfer and diffusion” approaches to innovation, with the telecentre emerging as an early, albeit unsuccessful, archetype in the effort to increase access to technology in underserved areas (Avgerou, 2008; Heeks, 2008).
While profit-seeking motives of the private sector may have aligned readily with the preferences of the poor in the case of mobile phones and digital cameras, ICTD work often revealed market failures and barriers to innovation that proved more intractable (Tongia & Subrahmanian, 2006; Heeks, 2008). Obstacles in the application of “best practices” or standards in developing country settings highlighted the necessity for localisation and the limitations of the “transfer and diffusion” push towards globalisation (Walsham & Sahay, 2006). Confronted with the early challenges of deploying office systems and community-based telecentres, project leaders took on a situated view of ICTD that considered innovation as contingent on local context (Avgerou, 2008). With this “socially-embedded” perspective came the proliferation of in-situ design activity that focused on promoting direct interactions between digital devices and poor users, and on understanding how those interactions could bring about social change (Ho, Smyth, Kam, & Dearden, 2009; Toyama, 2010).

Efforts to embed telecentres and computer-based information systems in the social context of developing countries were now part of a larger and more varied range of computing activity that aimed to elicit locally-constructed meanings at various stages of ICT project life-cycles. For example, local context in rural India was addressed at the initial stage of project definition by researchers who switched the problem domain to agricultural production after locals deemed it the community priority, rather than addressing microfinance issues, as originally envisioned by funders (Dearden and Rizvi, 2009). To specifically address the physical conditions of developing country settings, socially-embedded approaches to hardware engineering led to the production of new devices, such as low-cost, energy-efficient “rugged” terminals powered by hand cranks or solar batteries (Tongia and Subrahmanian, 2007). Computer scientists worked on enhancing connectivity in remote areas, improving user interfaces for non-English speakers and the illiterate, and developing applications in domains that included microfinance, health, agriculture, education, and small business enterprise (Ho et al., 2009; Toyama, 2010). By 2010, a vast array of hardware and software solutions had emerged to address the aspiration of “making a better world with ICT”, with mobile phones emerging as the most visible and promising device for global development (Walsham, 2012, p. 89).
1.2 ICTD research and project failures

The formidable political and financial support for these ICTD initiatives led to a considerable body of experience and research related to the design and deployment of ICTs in developing countries. The emerging, multi-disciplinary academic field known as ICTD drew from a range of academic disciplines that include Information Systems (IS), Human-Computer Interaction (HCI), Participatory Design (PD), Communication and Media Studies, and Development Studies, as well as Anthropology, Geography, and Community Informatics (Avgerou, 2010; Walsham, 2017). Work over this period evolved from determining whether ICTs were relevant for developing countries, to addressing how such artefacts could deliver on their high potential value for socio-economic development (Walsham & Sahay, 2006). Building on a foundation of experience that had been limited to organisations in the business sector, academic efforts in ICTD brought new insight into the provision of digital technology in public institutions and civil society, generating novel research contributions that examined how contextual factors such as culture and politics influenced innovation (Avgerou, 2008).

In spite of such massive global investments of time and money, early enthusiasm for ICTD was tempered by widespread acknowledgement that whether they adopted a “transfer and diffusion” or “socially-embedded” approach, the majority of ICTD projects could be characterized as total or partial failures that were never fully implemented, abandoned within a year of implementation, or were unable to meet most of their own stated goals (Heeks, 2002). Avgerou (2008) discerned an “acute anxiety about failure” in research on ICTD (p. 137), and attributed this discourse to heightened concern with the great opportunity costs of investing in technology, a perceived urgency to bridge the digital divide, as well as over ambitious expectations for the developmental potential of technology. While these projects did generally succeed in demonstrating a wide range of uses for ICT in developing countries, they mostly failed to operate beyond the “proof-of-concept” mode, prompting Walsham and Sahay to call for more research on understanding two specific aspects of such project failure: (1) failures of “sustainability”; and (2) failures of “scalability” (2006).

Ali and Bailur’s review of the ICTD literature (2007) revealed five distinct but inter-related types of failures related to “sustainability”: (1) financial, (2) social, (3) institutional, (4) technological, and (5) environmental. ICT projects that were not “financially sustainable” were seen to lack the long-term ability to generate enough funds
to meet their operational and maintenance costs. ICT initiatives that could not operate continually without major shifts in hardware or software were viewed as having limited “technological sustainability”. “Social sustainability” entailed securing user participation to incorporate community traditions or the sharing and alignment of goals with local people. Projects leaders that did not gain endorsements from key political actors compromised the legitimacy or “institutional sustainability” of their efforts. Finally, ICTD projects that were implemented without plans for the disposal or reuse of equipment were not considered “environmentally sustainable”.

Even in situations where ICTD projects attained a degree of sustainability, they often experienced failures of “scalability” (Walsham & Sahay, 2006). “Scaling up” is described by Baduza and Khene as:

> The expansion, adaptation, replication and sustaining of desired policy, programme and practice changes […] Implied in the definitions of scaling up is the assumption that we scale up in order to expand valued outcomes. (2015, p. 1)

This expansion may occur by rolling out ICTs across multiple levels of society, spanning wider geographical areas, as well as by increasing the range and complexity of services (Puri, Sahay, & Lewis, 2009). Failures of scalability in ICTs refer to the “difficulties of going beyond limited implementation in terms of functionality and geographic spread” (Avgerou, 2008, p. 137). These challenges reflect the tensions between embedding ICTs in their contexts of use while accommodating “trans-local knowledge flows” that promote deployments beyond initial pilot sites (Braa, Monteiro, Sahay, Staring, & Titlestad, 2007, pp. 1-3).

### 1.3 ICTD as a design challenge

The limitations of ICTD projects led to a growing recognition that ICT projects in developing countries could be explicitly framed as “design challenges”, whereby multiple stakeholders participate in an ecosystem that includes project goals, design variables and design space, as well as monitoring and evaluation (Tongia and Subramanian, 2007; Plauché, de Waal, Grover & Gumede, 2010). Tongia and Subrahmanian’s case study analysis of several ICTD projects led to the conclusion that failures were largely due to flawed design processes that neglected to solicit participation from all relevant stakeholders (2007). Arguing for multi-stakeholder design in Uganda, Ho and her collaborators asserted that while ICTD projects have generally consisted of “closed loop” systems that focus primarily on users, these models do not correspond to
the financial and political realities in the developing country context and limit the sustainability and scalability of such deployments (2009). This view is consistent with empirical research from the business sector in developed economies, where the design of information systems has been characterised as “complex […] political, subjective, and negotiated”, as well as “improvisational and adaptational”, rather than “driven by the pursuit of a clear set of early goals” (Gasson, 2003, p. 3).

Increasingly, ICTD scholars have reassessed the methods and motivations of user participation in the design and implementation of interventions (Heeks, 1999; Dearden & Rizvi, 2008; Haikin & Duncombe, 2014). In their review of the literature, Ho et al. argue that although the concept of user participation is frequently featured as a central element in the design of many ICTD projects, the construct remains poorly defined and operationalised (2009). This may be because participatory approaches in ICTD draw from three parallel streams of thought and activity related to “non-technical” or “lay” knowledge and its role in technology design and implementation. For example, industrial design notions of participation emanated from North America during the 1980s, with the “concurrent engineering” and “simultaneous engineering” movements emphasising the role of “user” input to reduce information asymmetries, secure “psychological buy-in” of solutions, and assure better conformance with ISO quality standards (Tongia and Subrahmanian 2006; Bailur, 2008; Dearden, 2008). During the same period, a second more socially activist strand of user participation emerged from work to defend and promote the interests of Scandinavian workers through technology design. This work eventually evolved into the Participatory Design approaches championed by IS and HCI scholars alike (Braa and Hedberg, 2002; Dearden and Rizvi, 2008). Meanwhile, a third and separate notion of community participation evolved within the field of international development which embraced methods of Participatory Rural Appraisal (PRA) (Chambers, 1994) and was endorsed by the World Bank as a way of promoting its priorities and countering a decade of failures in “top-down” development approaches (Bhatnagar and Williams, 1992; Bailur, 2008).

These traditions of user participation in industrial design, participatory interactive design, and international development have converged to constitute a rich toolbox for ICTD researchers and practitioners. However, these sets of techniques are the products of distinct “values, principles, and political commitments” which range from “workplace democracy” and “empowerment” to “enlightened management” and “increased sales” (Dearden & Rizvi, 2008). The conflation of methods and motivations from these distinct
traditions has subjected ICTD projects to the countervailing demands of two masters. On the one hand, initiatives that lean more towards the industrial design tradition and adopt participatory approaches to ensure desired program outputs are often criticised for “instrumentalising” local perspectives to further an external agenda, and marginalising “the constitutive role of participation in promoting empowerment and democratization” (Puri, Sahay, & Lewis, 2009, p. 66). At another extreme, when participatory methods are motivated by notions of empowerment, rights, and social transformation, such outcomes can be considered second-best – as a sort of parachute for projects that fail to generate economic benefits and or other measures of usability commonly associated with the interactive and industrial design traditions (Dearden, 2008; Foster 2011). Drawing indiscriminately from these three traditions of participatory design has also led to the misleading application of terminology that may contribute to sub-optimal design. For example, projects often used the development term “beneficiary” synonymously with the technological term “end-users” when the two may not necessarily constitute the same group of individuals. For this reason, Lie developed primary user and mediated user models to illustrate how the optimal end-users for a weed-identification software were the agriculture extension officers, and not the farmers who stood to benefit most directly from the software (2004).

In short, ICTD does not lend itself to straightforward design solutions because of uncertainty over: 1) who should participate in design, 2) who are the optimal end-users, 3) who are the beneficiaries, and 4) what benefits should be conferred. These complex, “ill-structured” socio-technical design projects in ICTD have been characterized as “wicked problems” (Rittel and Webber 1973), in that: the problem domain changes over time and cannot be formulated definitively, there is not a well-described set of potential solutions, and there are no stopping rules to constrain iterations on design solutions. Jenkins (2010) argued that while donor institutions may stress the need for “outcomes research” and objective evidence of success, such imperatives of efficiency and control “are largely irrelevant and meaningless in the context of wicked problems.” Instead, “careful engagement with a diverse set of stakeholders, [...] local knowledge and the capacity to adapt one’s approaches to accommodate diverse cultural situations and end users” (p. 13) are all required to “generate and communicate useful knowledge in a fluid, non-linear, culturally-diverse world” (p. 25).

In a review of 40 papers reporting project failures, Dodson, Sterling and Bennett identify “close relationships among ICTD, ‘wicked problems’, and failures” and cite
supporting research that explores factors associated with such project outcomes (2013, p. 21). Of those studies, Heeks’ work on the design-reality gap model (2002) is particularly relevant to understanding the complexity and nuances of success and failure because it conceptualises design as a part of a contingent and adaptive socio-technical system; that is, “a recursive (not simultaneous) shaping of abstract social constructs and a technical infrastructure that includes technology’s materiality and people’s localized responses to it (Leonardi, p. 42). Derived specifically for ICTD, the model is cited widely in the IS literature and has been used to understand failures in the deployment of government office systems across a range of domains, including health, education, agriculture, transportation, and administration (e.g., Heeks, 2006a, Lungo, 2008, Ala’a Hawari & Heeks, 2010; Dasuki, Ogedebe, Kanya, Ndume, & Makinde, 2015; Rugchatjaroen, 2015). Masiero has recently asserted that the design-reality model “is upheld as the one core paradigm to study IS failure in developing countries” (2016, p. 488).

In brief, Heeks’ theory conceptualises failure as a gap that persists between a design – or “representation of an intentional future” – and the reality of “the local actuality of the users” (2002, pp. 104-105). The model treats design as a projected configuration of information, technology, processes, objectives and values, staffing and skills, management systems and structures, and finally, other resources. These envisioned socio-technical arrangements explicitly and implicitly inscribe the cultural, political, technical, and economic context of the designers, as well as their assumptions about users and their local environments. ICTD projects are said to fail when large gaps between designs and reality persist, or else widen due to changes in either the designer’s strategy or in the context of use. Project success, it is argued, is more likely to be achieved if initial gaps are small, and/or when designers make local improvisations to reduce or eliminate gaps between their designs and the reality of the local context.

Heeks describes the theory of design-reality gaps as a “model […] that has analytical strength in helping to understand IS failure in developing countries [and is] informed by ideas of situated action and by the interrelationship between context and action” (2002, p. 111). The next chapter examines these theoretical constructs in greater detail, as part of laying out the theoretical foundations of this thesis. In this chapter, the discussion of the design-reality model will remain oriented around its adoption by ICTD researchers. It is argued here that while the model has been used to explain deployments of existing technology designed for the poor (e.g., Ayoung’s analysis of telecentres in
Ghana (2016)), ICTD scholars have not applied the model of failure to study the design and production of ICTs by poor users themselves.

1.4 ICTs, poor users, and understanding failure in HCI research

The transition of the global policy agenda from the Millennium Development Goals to the post-2015 Sustainable Development Goals (SDGs) has reinvigorated political and practical commitments to “poverty alleviation” and heightened attention to the role of the poor as designers, users, and beneficiaries of ICTD (Heeks, 2014). It is broadly recognised that dramatic gains in connectivity and the sweeping uptake of technological devices have largely benefited middle and upper income users in developing nations, often to the exclusion and detriment of its more vulnerable populations (World Bank, 2016; Unwin, 2017). Concerns over widening disparities have intensified efforts to include the poor as designers and as direct or indirect users of ICTs to improve economic livelihood (e.g., income-generating activities) as well as social well-being (e.g., health, education, or government services) (Heeks, 2014). There has also been a surge in activities to promote “inclusive innovation” – interventions which focus on “the structures and processes required to develop and deliver innovative technologies (goods and services) incorporating the needs and interests of the poor” (Foster & Heeks, 2013, p. 333). Approaches to inclusive innovation can be traced back to the “appropriate technology” movement articulated by Schumacher in Small is Beautiful (1973), but differ notably in their emphasis on global private-sector value chains, connectivity, the uptake of ICT devices, and the involvement of the poor as consumers in mass markets (Heeks, Foster, & Nugroho, 2014).

As discussed earlier, the theory of design-reality gaps has been applied by IS researchers to explain the success and failure of a range of government office information systems, as well as later deployments of telecentres in marginalised communities. However, in reviewing papers citing Heeks’ seminal 2002 work, I found no studies of failure that addressed ICTDs designed with or exclusively by the poor, in spite of the growing political salience of inclusive development approaches. Many of these participatory ICTD interventions with the poor remain within the purview of HCI scholars, a research community that tends to focus on user interfaces, computing, and refining methods of participation in design (Maail, 2011). Users, and their interactions with digital artefacts, have been central concerns of HCI research in both industrialised and developing country settings (Shneiderman & Plaisant, 2004; Toyama, 2010).
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Whereas IS scholars have examined the socio-technical entanglements of work and organization during the deployment of existing ICTD artefacts (Avgerou, 2010; Walsham, 2012), HCI researchers have emphasised ethical design techniques, the production of new devices or applications, and most notably, user preferences and experience (Ho et al., 2009; Toyama, 2010).

Toyama suggests that evaluations of HCI projects in ICTD tend to focus on the user interface and generate quantitative metrics such as “task error rates” or “time to task completion”, as well as qualitative assessments such as “user preferences” or “user experiences” (2010). A review paper by Ho et al. (2009) indicates that evaluations of usability in ICTD focused on “first-time” encounters and rarely covered periods longer than six months, with a median follow-up time of two weeks. Even when HCI interventions have aspired to a broader social justice agenda, the changes have been framed resolutely within the scope of the user and the machine:

the scale of changes needed to create social justice is too great a challenge for any single set of tools and techniques. Instead, tools and techniques [of user-centered design] might better be viewed as supporting the more tangible and immediate goals of human rights, dignity and wellbeing. (Light & Luckin, 2008, p. 3)

Methods of evaluating the participatory design of ICT artefacts for the poor have therefore favored conceptualisations of success and failure that remain confined to transactions at the user interface and incorporate theories from cognitive ergonomics, psychology and computer engineering to explain and enhance technology acceptance (Harrison, Tatar, & Sengers, 2007; Ho et al., 2009; Pitula, Dysart-Gale, & Radhakrishnan, 2010; Dell & Kumar, 2016). In these cases, failures of sustainability and scalability in HCI have not been theorised beyond these interactions between users and devices, in spite of increasing acknowledgement that for ICTD to succeed, “technology alone is not enough” (Toyama, 2010, p. 61).

Irrespective of the rather narrow metrics of project success in many HCI projects for ICTD, there is wide recognition that human use of “interactive computing systems” entails “the study of major phenomena surrounding them” (Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong, and Verplank, 1992, p. 5). In this vein, the HCI literature offers numerous descriptive accounts of how ICTDs operate as part of ecosystems of stakeholders and material artefacts extending well beyond the human-machine interface (e.g., Ho, Owusu, & Aoki, 2009; Irani, Vertesi, Dourish, Philip, & Grinter, 2010; Pitula et al., 2010;). While these socio-technical insights have been used to understand user
contexts (e.g., Dell & Kumar, 2016) and to inform design methods in ICTD projects (e.g., Tongia & Subrahmanian, 2006; Luckin, 2008; Dearden & Rizvi, 2009), they have not been incorporated into a theory that can describe systematically the failures of sustainability and scalability that unfold beyond the user interface.

HCI scholars contend that their disciplinary field has instead channeled their work in ICTD towards “usability” in relation to “outputs” – “tangible artifacts created” or “results measured”, rather than the long-term effect that these artefacts or results may exert in relation to broader social aspirations (Dell & Kumar, 2016, p. 2227). Their theoretical explanations of ICTD failure draw traditionally from theories of the user; these evaluation and design methods have not problematised failures of usability, sustainability, and scalability in relation to the broader socio-technical context. The effects of this wider sociomaterial ecosystem are often treated anecdotally, as narratives that remain distinct from theoretical considerations of design and use in HCI (Maail, 2011). These broader socio-technical effects are, for example, explored as issues in discussion sections of scientific papers (e.g., Ho et al., 2009), or as separate reflexive narratives of researchers’ experiences in the field (e.g., Brewer, Demmer, Ho, Honicky, Pal, Plauché & Surana, 2006; Anokwa, Smyth, Ramachandran, Sherwani, Schwartzman, Luk, Ho, Moraveji & Derenzi, 2009).

1.5 Research purpose: tracing sociomaterial relations of “design practice”

This thesis therefore proposes to examine the role of the designer and the user interface in relation to the broader socio-technical ecosystem of a wicked problem in ICTD design. These new empirical perspectives will be integrated into a model that addresses my research question: What are the sociomaterial relations of “design practice” in a globally-distributed, multi-stakeholder, and technologically-mediated ICTD project for poverty alleviation? The data to derive this model come from my two-year ethnographic study of design practice in an academic research intervention for Kenyan health workers. Three inter-related empirical tasks are entailed in formulating this model. First, I demonstrate how design practice in ICTD can be understood as a heterogeneous sociomaterial enactment (Law, 2017), where the roles of “designer” and “user” are not fixed, but instead operate as dynamic assignments that implicate a globally-distributed, diverse array of human stakeholders and material artefacts. Secondly, I draw from Mol (2002) and Barad (2007) to show how these blurred and shifting boundaries between “design” and “use” correspond to power struggles in the ontological politics of
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care (Puig de la Bellacasa, 2011). Finally, in deconstructing the sociomaterial practices of ICTD design as such, I bring the work of the researcher-designer into relief and show how actions to coordinate the contested notions of “design” and “use” not only increase or decrease the likelihood of project failure, but have moral implications as well.

Rather than generating a completely new model to describe these broader sociomaterial relations of design and use in ICTD projects, my empirical work sets out to elaborate Heeks’ well-established model of design-reality gaps (2006). Heeks’ model problematises the socio-technical context of technology deployment and project failure, but the practices of designers in relation to the production of material artefacts remain black-boxed. My aim is to extend the design-reality model so that it attends more closely to the sociomaterial complexity of design work in the field of HCI in general, and ICTD in particular. As Heeks concedes, the design-reality model was formulated when deployments of e-government systems were the prevailing interventions in ICTD (Ibid.). The model of failure was therefore derived from empirical situations involving designers in industrialised settings “who create the dominant IS design” and users in developing countries “who populate the local actuality” (Ibid, p. 104). Such unequivocal distinctions between “design” and “use” are not often found in the growing number of socially-embedded, participatory projects now carried out by both HCI and IS scholars in ICTD. Scholars in the field of IS note the need for an updated theory of design-reality gaps (Masiero, 2016), and comment on the shortage of theoretical approaches that “associate micro-situations of human-technology interaction with socio-economic conditions of the country concerned or beyond it in the global context” (Avgerou, Hayes, & Rovere, 2016, p. 331). What I therefore present is conceptual work that: 1) disentangles the entwined sociomaterial practices around the empirical design, production, and use of technology in a Participatory Action Research project for Kenyan health workers; and 2) integrates those enactments into a more comprehensive conceptualisations of the gaps, success, and failure in ICTD projects.

This extended conceptualisation of the theory of design-reality gaps supports the “material ecosystemic” analysis of design practice advocated recently by sociologist and computer scientist Jenna Burrell (2016). Drawing upon STS and premises from actor-network theory (ANT), she argues for new theoretical work that attends to the “material relationality” of ICTD interventions. Confirming the widely-held view that there has been a “bias to action” rather than to theory in ICTD (Heeks, 2006b; Gomez & Pather, 2011; Walsham, 2013), Burrell calls for additional social theory to redress the problematic
assumptions that are seen to pervade research and practice in the field. She critiques, for example, a tendency to treat ICTs as a homogeneous category of devices and argues for more granular analysis of how diverse material forms and humans interact to shape social progress. Burrell also challenges a widespread “treatment of technology not as a means to particular development goals, but as an end in and of itself”, and further notes the absence of ICTD theory to “problematize the role of the designer in contrast to that of the user” (2016, p. 2). A “material ecosystemic” approach, she asserts, addresses such shortcomings and offers a valuable theoretical framework to study the success and failure of projects without constraining the analysis of social change to the specific normative assumptions inherent within a given ICTD intervention.

Citing Sen (2001) and Habermas (1972), Burrell contends that social theory linking global development objectives to “intentional material practice” (Ibid., p. 8) can also open new possibilities for the ethical practice of technology design:

Richer philosophical thinking has the potential to inspire ways to pursue design that move toward empowering or emancipating the marginalized. To act through technological designs, to lend one’s expertise toward needed social change when in partnership with and respect for the agency of populations who may benefit from these designs, can be soundly ethical and powerfully impactful. (2016, p. 10)

Conceptualising the relationship between ICT and the “D” in development helps to pinpoint what Donner, Grinter, and Marsden describe as the “nexus” of social theory and design practice (2013). In interviews conducted by Dell and Kumar (2016), HCI researchers have expressed frustration that their long-standing work in ICTD “often stirs the imagination but doesn’t go all the way”, and they seek to “engage with theory more deeply” so as to “better articulate the theoretical frameworks [in international development] that shape [their] work and why that matters to HCI” (p. 2226-2228).

However, designers and computer scientists have suggested that their training and scholarship are not geared towards elucidating the theoretical linkages that would connect their work to broader development outcomes. As Pitula et al. assert, while HCI scholars might indeed draw from a range of social theories to study the larger socio-technical context and social impact of designed artefacts, “the considerable skill, time, and effort required to understand and apply such frameworks makes their practice problematic. Additionally, making such analyses relevant to the design is not obvious” (2010, p. 79). Noting the constraints of expertise, academic boundaries, time, and resources, Dell and Kumar report that HCI researchers view multi-sectoral, interdisciplinary collaborations
as promising avenues to extend the theoretical and practical implications of their interactive design work (2016). Responding to this and other calls for inter-disciplinarity within the ICTD community (Best, 2010; Walsham, 2017), I draw upon the field of Science and Technology Studies (STS) and offer new theoretical perspectives on the relationship between HCI and development outcomes. More specifically, I aim to support the work of designers and computer scientists by adopting material-semiotic methods (Law, 2017) to demonstrate the linkages between HCI and IS research, showing how such connections can inform our understanding of project success, failure, and desired social change.

1.6 STS and ANT perspectives on ICTD

Science and Technology Studies (STS) is an inter-disciplinary research tradition that generates empirical accounts of how scientists and engineers construct scientific knowledge and technical artefacts. STS is described as “a heterogeneous body of research, scholars, journals, professional associations, and academic programs that focus on the history, social organization and culture of science and technology” (Roosth & Silbey, 2008, p. 451). These insights are also linked to activism and reform – to holding science and technology accountable to public concerns around issues such as peace, security, democracy, environmental sustainability, and human values (Sismondo, 2008). Within the STS research discipline, actor-network theory (ANT) is part of the family of material-semiotic methods that can be employed to look at “messy methods, scientific and otherwise, at how they get shaped, and also at what they actually do” (Law, 2017, p. 31).

ANT provides conceptual tools to trace how stable – and therefore successful – networks of humans and materials are formed, and how such networks can fail when associations between actors shift or dissolve. These heterogeneous linkages are understood as sociomaterial practices, and the task of the STS researcher is to analyse the processes that associate different people and objects together into more or less robust network configurations. Chapters 2 and 3 will present a history of STS as an academic discipline, discuss the concepts underlying material-semiotic approaches, and describe how I adopted such methods to disentangle the design, production, and use of mobile phones for Kenyan health workers. In this chapter, I limit my discussion to an overview of how ANT methods have been applied in the domain of ICTD.
ANT has been widely-employed in the general IS literature (Walsham, 1997) and has been taken up by increasing numbers of ICTD researchers over the past decade (Gallivan & Tao, 2013). However, given that ICTD scholars have bemoaned their field’s lack of engagement with social science theory in general (e.g., Heeks, 2006b; Duncombe & Boateng, 2009; Walsham, 2013; Thapa & Sæbø, 2014; Burrell, 2016), the overall body of ANT scholarship in ICTD remains limited (Heeks & Stanforth, 2015). For example, a systematic review of 437 empirical studies published in the top three ICTD journals between 2005-2012 yielded only 10 ANT-based papers (Andersson & Hatakka, 2013). As with Heeks’ theory of design-reality gaps (2002), almost all ANT studies of ICTD have been conducted by IS scholars and have examined the take-up of existing artefacts and processes. These studies followed government deployments of computer systems for health (Braa, Monteiro, & Sahay, 2004), financial accounting (Stanforth, 2006), and geolocalisation (Walsham & Sahay, 1999), as well as community-based telecentres (Rhodes, 2009; Díaz Andrade & Urquhart, 2010) and wireless networking technology (Thapa, 2011). These researchers engaged with ANT to analyse these deployments as socio-technical systems comprised of heterogeneous actors and to study the power dynamics of successful actor-networks (Andersson & Hatakka, 2013; Walsham, 2017).

I identified only two papers which applied an ANT approach to study the design and production (rather than deployment) of material artefacts in ICTD. As mentioned earlier, Burrell (2016) drew on ANT concepts to illustrate how low-income Ugandans did not simply take up or reject ICT instruments for financial inclusion. To manage their personal financial liquidity, they instead integrated these new mobile money tools into creative assemblages with long-standing informal financial practices involving livestock, wooden boxes, and other material artefacts. Another paper by de la Harpe (2014) employed ANT to show how levels and modes of participation among South African CHWs, designers, and other stakeholders ebbed and flowed in relation to material artefacts – to the paper-based prototypes, workflows, and computer code – that emerged during the design and production of a mobile application to collect health information.

As Heeks and Stanforth observe (2015), the most frequently-employed ANT concept to describe these ICTD projects has been Callon’s four moments of translation (1984). The next chapters will describe how this early work in ANT articulates a process by which an actor attempts to coordinate the interests of other actors into a robust network of people, objects, and processes. Drawing from an analysis of office information systems
for Sri Lankan public finance bureaus, Stanforth points to the range of ways in which the concept of translation might be applied to ICTD research:

It can be used to research the inter-action of groups and technologies at various stages in the informatics lifecycle, from researching questions about how particular ICTs come to be invented and developed, through questions about the diffusion and adoption of ICTs in developing countries, to questions about how and why ICTs are (or are not) implemented and used [...] (2006, p. 57)

She also demonstrates how other ANT concepts, such as local and global networks (Law & Callon, 1992), are also helpful for understanding ICT innovation and then further suggests that post-structural elaborations of ANT can lead to critiques of “certain views of ICTs and development” (Ibid, p. 54).

Heeks argues that even if ICTD and Development Studies scholars have shown little interest in ANT, these methods are well-suited to address the philosophical, theoretical, and pragmatic concerns of current development research and practice (2013). My next chapter will demonstrate how, from a philosophical standpoint, ANT is neither realist nor constructivist, a stance that Scott-Smith contends is:

particularly welcome in development studies, which tends to be divided between the adherents of an economic approach that reduces the world to rational choice, and a post-development approach that reduces everything to discourse and culture. (personal communication, in Heeks, 2013, p. 14)

In by-passing positivism and relativism, “ANT is neither pro nor anti development” (Ibid., p. 14), and thereby generates other possibilities of investigating and intervening in the world. As Burrell writes:

In defending the possibilities of technology design and, more generally, of intentional material practice toward realizing social goals, we must address such arguments for blanket rejection as well as the promises of technology as a panacea. (2016, p. 8)

In its attention to sociomaterial relations, the methods of ANT are aligned with the theoretical turn from structures to processes in development studies (Heeks, 2013). The approach can therefore be used to analyse work practices that span global/local and macro/micro divides, as well as sectoral silos corresponding to health, education, agriculture, and other concerns.

With respect to development practice, Heeks asserts that ANT is useful because it attends not only to the social, but also the material:

Nothing announces the long-term intentions of a development project more than the mobilisation of cranes and cement mixers; nothing indicates the success of a project more than the ability to point to something material and declare
achievement. Just like the human relationships, the materiality of development is crucial. (Scott-Smith, 2014, p. 788)

ANT offers analytic tools for understanding the role of materials in development, not as deterministic causal agents, but as co-participants in dynamic socio-technical systems that aspire to alleviate poverty and promote human development. This sensitivity to the relationality of heterogeneous actors and its emergent effects is compatible with increasing recognition that development practice is complex, adaptive, and non-linear (Heeks, 2013). It responds to increasing acknowledgement of “wicked problems” in development practice and to growing dissatisfaction with “logical frameworks” and the other prevailing “tools and business processes that deal with static, simple and linear problems” (Ramalingam, Laric, & Primrose, 2014, p. iv). Scott-Smith asserts:

Projects do not succeed because they are structured in a certain way, producing measurable outcomes that can be verified using certain indicators. Rather, projects succeed because they are built on a complex network of alliances. These alliances may be material, social, or conceptual, but they all need to be nurtured and understood. (2014, p. 793-794)

As he demonstrates, ANT can be used to engage analytically with this complex network of alliances, and to describe how the formation and dissolution of relations between objects, humans, and concepts constitute the rise and fall of humanitarian development projects.

1.7 Projects, success and the making of international development

The notion of development has been subject to much theoretical and ethical debate, with its contested interests entwined in the policies and practices of global, national and local politics (Avgerou, 2006). Yet, however contentious these aims and approaches, the construct of the “project” has been almost invariably adopted as the vehicle through which “development goals become development impacts” (Heeks & Stanforth, 2014, p. 14). Understood as an “organised means seeking to achieve specific development outcomes” (Ibid., p. 14), the “project” is viewed as a key mechanism through which funds are delivered from the North to promote change in the Global South (Diallo & Thuillier, 2005). Ika provides the following useful description of development projects:

they are generally limited, temporary, unique, and multi-disciplinary undertakings. They have a life cycle […]; they deliver goods and services […]; they also face time, cost, and quality constraints; finally, like other types of projects, they require some specific tools and techniques for their implementation
Social change is therefore associated with the achievement of specific development project objectives – objectives that are aligned with policies, strategies, and programmes championed by particular funding agencies (Ibid.).

Ika and Hodgson (2014) identify two approaches to development projects: (1) a “traditional, scientific, instrumental and universalist approach” grounded in principles of engineering and the large scale infrastructure investments of the 1950s; and (2) “eclectic, contingent or middle-range approaches”, such as Participatory Rural Appraisal (Chambers 1994), that have drawn upon social constructionism in reaction to rationalist development strategies (p. 1185). Whereas the former approach emphasises “blueprints”, “best practices”, and capital investments, and the latter promotes processes, people, and human development, Ika and Hodgson argue that both types of development projects are limited by an “underlying instrumental rationality” which focusses narrowly on the identification of tools and techniques for “better implementation” (Ibid.). They argue that both forms of intervention are prone to failure because they do not account for how broader power imbalances help or hinder the attainment of development project objectives, be they managerial or participative. The authors therefore call for a critical lens to understand how the design, deployment, and evaluation of these projects are “located within a wider and enduring imbalance of power between developed and developing worlds, and in particular, between the world’s richest institutions and people and its poorest” (Ibid., p. 1194).

Accordingly, Mosse and Lewis (2006) have advanced a critical ethnographic approach to study the “social life” of international development projects. They write:

Anthropology has a significant contribution to the intellectual challenge of better conceptualizing the relationship between international development policy models – an increasing virtual world of sophisticated global ambitions – and the practices, events, and material outcomes they are expected to generate or legitimize. (p.9)

This “ethnography of development practice” traces the multiple rationalities that circulate through increasingly diverse and distributed sets of policymakers, donors, implementing bodies, and local communities (Mosse, 2013). It deploys ANT to study how “people, ideas, interests, events and objects (seeds, engineered structures, pumps, vehicles, computers, fax machines or databases) achieve the “material and conceptual order of a
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successful development project” (Mosse and Lewis 2006, p. 14). This is a notion of “success” that “[…] is not objectively verifiable, but socially produced. It is an institutional process not an objective fact. It is not known in itself, but only by the relationships that emerge around its presence” (Mosse, 2005, p. 172).

In this thesis, I will explore these critical understandings of success and failure by tracing the heterogeneous material-semiotic relationships that formed around an academic research intervention to train local community health workers using mobile phones. This research intervention, known as mCHW, was funded through the ESRC-DFID Joint Scheme for Poverty Alleviation from 2012-2015. Established in 2005, this UK funding scheme had a dual objective: “to provide a more robust conceptual and empirical basis for development and to enhance the quality and impact of social science research which contributes to the achievement of the Millennium Development Goals” (ESRC-DFID, 2011a, p. 2). The mCHW research intervention, referred henceforth as “the mProject”, was implemented by academic researchers at UCL Institute of Education and later University of Oxford, in partnership with AMREF Health Africa, a large international non-governmental organisation (NGO) with headquarters in Nairobi, Kenya. The academics’ Case for Support stated that the “over-arching aim” of the mProject was “to design, develop, implement and evaluate a mobile learning intervention to support the professional education of male and female community health workers (CHWs) working with the poorest and most vulnerable in underserved areas of Kenya” (2001, Introduction, para. 1). According to their proposal, this research intervention would address the Joint-Scheme’s call “to advance a better conceptualisation of ICTs for development” in order to “[…] take full advantage of [ICTs] for poverty reduction” (ESRC-DFID, 2011a, p. 7). More detail about this academic research intervention for international development will be presented as part of my Methodology (see Section 3.2), and in my empirical description of the researchers’ problematisation (see Chapter 4).

Mosse and Lewis assert that “ethnographic research can provide policymakers and aid managers with valuable reflective insights into operations and effectiveness of international development as a complex set of local, national, and cross-cultural social interactions” (2006, p. 1). However, the aim of this form of ethnographic investigation “is not to produce a project overview, a commentary on appropriate approaches or “best practice”, nor make an evaluation, or pass judgement; it does not ask whether, but how development works” (Mosse, 2005, p. 2, authors’ emphasis). As Yarrow writes, the “[…] concern is not to adjudicate the truth or efficacy of what these actors do, but to understand
how they locate truth and efficacy in relation to their own and others’ action” (2011, p.2). Framed in the theoretical tradition of ANT, an ethnography of a “project” such as the one presented here can be understood as “opening up the black box between policy intention and social effects” (Mosse, 2013). My empirical account of the mProject attempts to open up this black box by tracing the contested material-semiotic relations of design and use. It will show how these controversies lead to conflicting notions of success and failure and will demonstrate how alliances, be they conceptual, material, social or textual, “are always important to development success” (Scott-Smith, 2014 p. 789). In locating such alliances in relation to national and global policy-making and funding, I will elaborate the conceptualisations of sustainability, scalability and design-reality gaps that were introduced earlier in Section 1.4.

1.8 Overview of the thesis

What are the sociomaterial relations of “design practice” in a globally-distributed, multi-stakeholder, and technologically-mediated ICTD project for poverty alleviation? By drawing upon ANT to answer this research question, my thesis will offer new theoretical perspectives on how design and use relate to notions of “success” and “failure” in ICTD projects. It will describe the sociomaterial practices that emerged in a globally-distributed and multi-disciplinary “laboratory” as it worked on the design, production, and deployment of a mobile-phone learning intervention for Kenyan Community Health Workers (CHWs). In generating this account, I will, as discussed in Section 1.7, assess the rise and fall of this ICTD project solely in terms of the extent and durability of the alliances that were created: “success” in an ANT analysis is severed from any notions related to the validity, inherent quality, or moral salience of the mobile learning project (Scott-Smith, 2013). At the end of my thesis, the findings of my ANT analysis are used to update the theory of design-reality gaps so that it incorporates the missing sociomaterial practices that implicate HCI scholars and designers in the wicked problem of an ICTD project.

Although Heeks is the architect of design-reality gap model and has championed the use of ANT to trace the formation of successful and failed development projects, there have been no empirical studies that integrate this theory of ICTD project failure with ANT concepts. Adopting ANT and other material-semiotic methods, my thesis is a case study of a mobile learning project that will elaborate theoretical concepts about the user interface, gaps, sustainability, scalability, and project failure in ICTD. Generating
research that is neither inductive or deductive, the next chapter will discuss how the format of my thesis departs from the framework for social science research in the tradition of Crotty (1998) or Creswell (2014). “The STS focus on practice,” Law explains, “means that theory, method, and the empirical get rolled together with social institutions (and sometimes objects)” (2017, p. 32). In the remainder of this chapter, I present an overview of how my thesis will be organised and structured to address this alternative, practice-centered framing of theory, methods, and data in ANT research.

Chapter 2 will discuss STS and material-semiotics in relation to the theoretical foundations of this thesis. I begin by establishing a *relational* and *performative* definition of *practice* as it is operationalised in my analysis of the mProject. My investigation of design in ICTD is then positioned as “theory-making” activity or “theoretical practice” (Rimpiläinen, 2012) in the tradition of the “laboratory studies” of STS research. I then present ANT as a set of material-semiotic methods that have been used to track the sociomaterial practices in the “messy laboratory life” of a range of research domains and settings (Latour, 2005; Law, 2009). I describe the theoretical premises of ANT, focusing particularly on the principle of *the four moments of translation* (Callon, 1984).

Chapter 3 then introduces *praxiography* – the ethnography of practice (Mol, 2002) – as the methodology used to conduct my “laboratory study” of design work in the mProject. I present my data collection methods and discuss my role as a participant observer embedded in this globally-distributed, technically-mediated, and interdisciplinary research intervention. I describe my data analysis methods, which entailed following the trajectory of an *analytical token* (Latour, 1987) called the Malawi Development Assessment Tool, a health assessment survey to detect developmental disabilities in young children. I explain how post-structural and feminist theories were iteratively incorporated into my analysis as I followed this health assessment tool (HAT) through *four moments of translation*. These additional concepts enriched my classic ANT narrative with more contemporary conceptual insights on the formation and dissolution of actor-networks in ICTD. The remainder of Chapter 3 explores my positionality and its implications with respect to power, the ethical considerations in this study, and the politics of my research methods.

The empirical account begins in Chapter 4 with a description of the *first moment of translation*. I describe how academic researchers formulated a *problematisation* that was reified in a grant application to design, deploy, and evaluate a participatory, “pedagogically-rich” mobile learning intervention for Kenyan Community Health
Workers (CHWs). The proposal was a response to the ESRC-DFID joint funding scheme that called for research projects that would bring “high quality social science” to bear on the achievement of the Millennium Development Goals and generate new theoretical insights on how ICT could be used “as a resource in the reduction of poverty” (ESRC-DFIDa, p. 7). I describe the *inter-definition of actors* and the establishment of an academic mobile learning intervention as an *obligatory point of passage* (Callon, 1984) which fixed the initial design parameters for a new training intervention for Kenyan CHWs that I call the mProject.

Up until the 2nd moment of translation, the *problematisation* remained “only a simple conjecture” (Callon, 1984, p. 224), a proposition reified as an initial design solution in a grant application to fund the mProject. Chapter 5 begins with the disbursement of research funding and describes how a variety of material devices of *interessement* were assembled during the second moment of translation. These additional artefacts were gathered to “extend and materialize the hypothesis made by the researchers” (Ibid., p.9). Here, the analytic token of my praxiography, the health assessment tool or *HAT*, is introduced as one such device of *interessement*. I show how the HAT’s sociomaterial heritage as a health assessment tool shaped how other enlisted actors were drawn into the mProject. The chapter also describes how the HAT simultaneously transformed and was transformed by other human and non-human actors to enact design practice during the second moment.

Chapter 6 traces the trajectory of the HAT into the third moment of translation and explores the extent to which this analytic token succeeded in consolidating the alliances that were initially envisioned by the academic researchers. I illustrate how *trials of strength* (Latour, 1988) during this period of *enrolment* could be attributed to the *multiplicity* of the HAT and the ontological politics associated with its fluidity as a health protocol, as educational content, as a job aid, as a consumer choice, and as a patient advocacy tool (Mol, 2002). This shifting and expanding “fluid space” (Mol & Law, 1994) created conflicting accountabilities for CHWs as they negotiated their multiple roles as public health researchers, learners, consumers, health system cadres, and patient advocates. I describe how the researchers attempted to create order from such disorder by *coordinating* the *multiplicity* of the HAT into a “patchwork singularity” through the invocation of *social justice* principles that privileged the HAT’s unanticipated enactment as a patient advocacy tool for disabled children.
Chapter 7 describes how during the *fourth moment of translation*, the researchers worked to enlist additional allies that could endorse and fund the extension of the mProject. With the boundaries of the mobile learning intervention now stabilised through the work of *coordination*, the researchers worked to gain the cooperation of policymakers during a stakeholder’s meeting in Nairobi. I describe how through concerted acts of *displacements* and *representations*, the researchers sought to establish themselves as credible *spokespersons* who could speak effectively on behalf of CHWs and mobile phones and persuade the decision-makers to support additional work. I describe the demise of the mProject as a failure to demonstrate that more CHWs and mobile phones would enroll in this participatory, pedagogically-rich mobile learning project for child disability.

The ontological politics of participation in ICTD design are deconstructed in Chapters 4-7, but this did not capture how poverty, morality and social justice shaped the materialisation of the mProject, how these factors affected the intervention’s ability to mobilise allies, and how they challenged the fixity of my positionality in relation to the objects of my research. To address these remaining empirical and methodological issues, Chapter 8 re-analyses the mProject actor-network as a *matter of care* (Puig de la Bellacasa, 2011). Having described the sociomaterial “bits and pieces” that constituted the mProject in the preceding chapters, I use this concept of *care* to recalibrate my own instrument of observation and study the mProject as an actor in its own right – I analyse this actor-network as a “thing” in relation to broader constellations of humans and non-humans engaged in the aspirations of poverty alleviation in developing nations.

This empirical narrative incorporated social theory to convey the emotional, political, and logistical complexity of design practice in participatory ICT projects for poverty alleviation. Chapter 9 integrates those deployed concepts to elaborate Heeks’ theory of *design-reality gaps*. This conceptual elaboration links the outcomes of the mProject more explicitly to the affective and material dimensions of *care*, and conceptualises *social justice* not only in terms of universal claims or global standards, but as an embodied sociomaterial enactment. Chapter 10 concludes with a discussion of the contributions of my thesis and the challenges and limitations of this work. I propose avenues for further investigation and discuss how my thesis has implications for policy-making, technology design, and research. Finally, I end this thesis by reflecting again on the politics of my own research methods and how they attempt to relate with, and thereby *care* for, the network of actors that enacted design practice in the mProject.
2 Theoretical Foundations

As established in the prior chapter, this thesis will examine the sociomaterial relations of “design practice” and thereby advance new perspectives on the contested notions of success and failure in Information and Communication Technology for Development (ICTD). To do so, it will disentangle the practices related to designers and the human-machine interface, and then integrate those insights into Heeks’ influential theory of design-reality gaps (2002). This chapter discusses the theoretical foundations of my research endeavor, which lie at the intersection of IS, HCI, ICTD, and STS scholarship. It begins by examining the theory of design-reality gaps for ICTD projects, highlighting the model’s grounding in IS projects and theories of context and situated action. I then position my thesis as part of the “Third Paradigm” of HCI, which frames human-machine interaction as “phenomenologically situated”. I continue with an overview of STS research and introduce the “laboratory studies” (Latour & Woolgar, 1979) that will offer analytic resources for understanding the design (and not only the deployment) of artefacts in terms of embodied, socially-situated practice.

Next, the methods of ANT are introduced as a repertoire of concepts and analytic strategies to trace the humans and non-humans that constitute the “laboratory life” of technology production (Latour, 2005; Law, 2009). Critiques of ANT are examined and I describe the post-structural concepts in STS that address some of these issues (Law & Hassard, 1999; Barad, 2007; Puig de la Bellacasa, 2011). I discuss ways in which ANT is useful for analysing my empirical data, and for addressing the “theory-making” aims of this doctoral research. The chapter concludes with a discussion of the ontological orientation of this thesis (Mol, 2002) and will discuss how neither the considerations of inductive nor deductive research apply in this doctoral thesis. I will argue that bypassing such epistemic considerations is not to be construed as what Haraway described as the “god trick of seeing everything from nowhere” (1988, p. 581). That discussion leads into Chapter 3, which presents my methods and methodology and delineates how my own non-innocent ontologies are enacted, attesting to how “nothing comes without its world” (Haraway, 1997, p. 137).
2.1 Theorising failures of IS deployments for ICTD

There are few theoretical models formulated explicitly for ICTD projects (Andersson & Hatakka, 2013). Theories to explain failure in ICTD are even more rare (Masiero, 2016), and Heeks’ model of design-reality gaps is unique in its systemic approach to problematising project outcomes. Drawing from empirical findings in multiple case studies of IS deployments for e-government, Heeks integrated theories of contingency, situated action and local improvisation to conceptualise failure as a parameter in a dynamic and situated socio-technical system (2002). The model in Figure 2-1 illustrates how failure is problematised as a function of the gap that persists between the design as formulated by the designer, and the reality of the user context. Risk of project failure can be mitigated, according to this theory, through local improvisations that a designer undertakes to reduce the gap along seven possible dimensions: information, technology, processes, objectives and values, staffing and skills, management systems and structures, and other resources.

As discussed earlier, the theory of design-reality gaps was derived at a time when e-government initiatives were the major, if not sole form of intervention for ICTD. Projects were “dominated by the transfer of industrialized country designs” and “a flow of resources and artifacts from industrialized to developing countries” (Heeks, 2002, p. 106). In problematising failure in terms of a socio-technical system, the model helped demonstrate how unsuccessful deployments of such projects were related to “country
context gaps”, “public-private gaps”, and “hard-soft gaps” that privileged economic rationality over “people, politics, emotion and culture” (Heeks, 2003, p. 5). Derived from, and applied to, empirical cases where the socio-technical contexts of design and use were considered “distant in physical, cultural, economic, and many other ways”, the theory of design-reality gaps was useful for illuminating failures in the prevailing modes of ICTD intervention (Heeks, 2002, p. 106). The model has become the basis for practical guidelines on assessing and remedying design-reality gaps, so as to improve the likelihood of successful deployments of information systems (Heeks, 2003).

Almost fifteen years after the formulation of the theory of design-reality gaps, Masiero suggests that the model should be updated in light of two major changes in the ICTD landscape (2016). First, she points to the enormous uptake of ICTs in developing countries since the introduction of Heeks’ model. As Avgerou reports, fixed wired broadband Internet subscriptions increased from 71 to 357 million users between 2005 and 2013, while mobile phone subscriptions in developing countries grew from 1213 to 5235 million (2016). Secondly, Masiero highlights a current “push towards localization, intended as the proactive inscription of prospective beneficiaries’ views, ideas, and necessities in the making of ICTD projects” (2016, p. 492). Notwithstanding the historical challenges of conceptualising and operationalising user participation in ICTD (see Section 1.3), the ubiquity of the mobile phone has fueled new interest in “collaborative” and “grassroots” forms of “inclusive” innovation that engage directly with the poor as both designers and users of technology for poverty alleviation (Heeks, 2014).

Masiero responds to the changes in the ICTD space by extending Heeks’ model with new theoretical concepts to “identify the origins” of the design-reality gap. However, this conceptual elaboration is limited in notable ways. Most importantly, it does not engage conceptually with how the uptake of devices in developing countries blurs the spatial and temporal boundaries that formally separated ICTD design and use. This divide between contexts of design and use is a key premise of the original model that requires new theoretical consideration. Furthermore, her updated theorisation of failure was formulated using empirical data from a top-down, e-government intervention for ministry employees and does not attend to the growing number of grassroots ICT interventions that are designed with and by the poor. Finally, Masiero formulates concepts de novo to explain design-reality gaps, rather than drawing explicitly upon the theories of contingency, situated action, and local improvisation that informed the original specification of this model of ICTD failure.
Heeks’ theory is parsimonious and practical for individuals who implement e-government projects in the field. Notwithstanding this accessibility, the model was distilled from a large and established body of theoretical research on organisations, technology, and innovation. The paper introducing the theory (Heeks, 2002) describes the complex conceptual framework that underpins the model. Building explicitly upon the work of Suchman (1987), Bijker and Law (1992), Akrich (1992), and Orlikowski (1996), that paper illustrates how ICTD failure is conceptualised as a parameter within a practice-based socio-technical system. The model is derived from an over-arching axiom related to contingency, where there is “no single blueprint for success and failure” but rather, “situation-specific factors for each information system that will determine success and failure, and hence strategies for success” (2002, p. 103).

Here, design practice is operationalised in terms of dynamic, situated actions aimed at achieving organisational change. These actions correspond to practices that take place within unique socio-material contexts which carry certain assumptions about projected users. Discrepancies between design and reality (i.e., the user context) can be reduced through situated actions referred to as local improvisations. These practices alter the context of design, of use, or of both, in order to reduce the design-reality gap and increase the probability of success. The effectiveness of such local improvisations is related not only to social factors in sociotechnical system, but to the materiality of the artefacts that constitute the design intervention. Drawing from the work of Akrich (1992), Heeks discusses how technologies with deep design inscriptions, such as decision-support systems, often establish large design-reality gaps and do not accommodate local improvisations. Applications containing shallow inscriptions, such as e-mail and word-processing, are seen to be more amenable to local improvisations because they impose fewer assumptions about the user context.

So, while the transformation of the ICTD landscape may indeed warrant a re-examination of the theory of design-reality gaps, I contend that it is not for shortage of rigorous theoretical constructs. Rather than creating new explanatory concepts, I suggest that the challenge is firstly a methodological one, and that the task at hand involves deploying new analytic methods to study design-reality gaps in empirical cases where distinctions between design and use are no longer apparent. If the situated entanglements of design, production, and use can be loosened, it then becomes possible to ascertain what theories, if any, are required to elaborate the socio-technical system that has been articulated by Heeks. This approach would generate a more organic extension of the
original *design-reality gaps* model based on the idea of *situated action*; one that also incorporates the “black box” of HCI practice into a sociomaterial problematisation of IS failure in ICTD.

### 2.2 HCI and design as sociomaterial practice

The analytic methods in my thesis were informed by ethnographies of technologists and designers working in industrialised settings (Wilkie, 2010; Goodman, 2013; Pine & Liboiron, 2014; Seaver, 2014). Inflected with conceptual insights from the field of Computer-Supported Collaborated Work (CSCW) and Participatory Design, this research constitutes part of the Third Paradigm of HCI (Harrison et al., 2007). These studies are “phenomenologically situated” in that they frame design, artefacts, and the user interface as elements in a contingent socio-technical system. Closely affiliated with Suchman’s influential work on *situated action* (1987), this theoretical work draws from many of the same concepts that were used by Heeks to theorise the failures of information systems deployment in ICTD. Table 2-1 shows how *interaction* is defined differently across the three approaches to HCI, leading to different practical and theoretical concerns.

**Table 2-1 The three paradigms of HCI. Adapted from Harrison et al. (2007)**

<table>
<thead>
<tr>
<th>Paradigm 1</th>
<th>Paradigm 2</th>
<th>Paradigm 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Factors</td>
<td>Classical Cognitivism/Information Processing</td>
<td>Phenomenologically Situated</td>
</tr>
<tr>
<td><strong>Metaphor of Interaction</strong></td>
<td>interaction as man-machine coupling</td>
<td>interaction as information communication</td>
</tr>
<tr>
<td><strong>Central Goal of Interaction</strong></td>
<td>optimizing fit between man and machine</td>
<td>optimizing accuracy and efficiency of information transfer</td>
</tr>
<tr>
<td><strong>Typical Questions of Interest</strong></td>
<td>How can we fix specific problems that arise in interaction?</td>
<td>What mismatches come up in communication between computers and people?</td>
</tr>
<tr>
<td></td>
<td>How can we accurately model what people do?</td>
<td>How can we improve the efficiency of computer use?</td>
</tr>
<tr>
<td></td>
<td>How can we support interaction without constraining it too strongly by what a computer can do or understand?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>What are the politics and values at the site of interaction, and how can we support those in design?</td>
<td></td>
</tr>
</tbody>
</table>
Theorising the design-reality gap

Whereas work in the First Paradigm of HCI relates to the ergonomics and human factors, and the Second Paradigm engages with cognitive theories, the Third Paradigm frames human-machine interaction as “a form of meaning making in which the artifact and its context are mutually defining and subject to multiple interpretations” (Harrison et al., 2007, p. 6). Studies within this Third Paradigm of HCI differ from the others in that they ask questions about how interaction relates to situated actions. These actions implicate actors in the wider context of the world, rather than constraining the analysis to the relationship between intended users and designed artefacts. The concept of situated action was introduced by Suchman (1987) in reaction to cognitivist approaches to technology production that defined meaningful action solely in terms of individual mental attributes and formal abstractions, such as goals and “plans”:

The term [situated action] underscores the view that every course of action depends in essential ways upon its material and social circumstances. Rather than attempting to abstract action away from its circumstances and represent it as a rational plan, the approach is to study how people use their circumstances to achieve intelligent action. Rather than build a theory of action out of a theory of plans, the aim is to investigate how people produce and find evidence for plans in the course of situated action. (p. 50)

This socially-situated orientation brought new anthropological and sociological perspectives to HCI (Wilkie, 2010), as researchers attempted to understand users in relation to the broader array of socio-technical resources that constituted what Suchman called “the situation of the user” (1987).

Later studies (such as those that inform this thesis) widened the “ethnographic gaze” of the Third Paradigm to also incorporate the work of professional designers. This was consistent with efforts to understand how a broader array of actors “worked through” and “inhabited the interface” (Suchman, 2006, p. 279). In this framing, interaction was conceptualised not as conversations or other forms of exchange, but as a complex “sociomaterial assemblage” gathered around the human-machine interface. Incorporating the situated actions of professional designers into the analysis of such a gathering makes it apparent that notions of “design” in relation to “use” must be deconstructed to problematise the role of ethics in the production and appropriation of technology:

This means identifying our participation in the various mediations that define the production and use of new technologies, and taking some responsibility for them. It requires analyzing the processes by which boundaries within and between technology production and use are constructed and maintained, and understanding our contributions to their reproduction or transformation. And it means mapping not only our local networks, but locating those as well within
Theoretical Foundations

more extended networks, including an increasingly globalized division of labor. (Suchman, 2002, p. 94)

Within the Third Paradigm of HCI research, design practice is no longer thought of as “the creation of discrete devices, or even networks of devices”, but rather as an “entry into networks of working relations – including contests and alliances – that make technical systems possible” (Suchman, 1994, p. 22). Practices of design (and therefore use) are viewed as emergent and do not fall neatly within the domains of any pre-ordained set of participants or temporal stage in the life cycle of a project. To “locate” design practice involves tracing its emergence as a contingent, sociotechnical system or network of relations, which Suchman suggests is possible by applying ANT and other sociomaterial research methods, in the tradition of STS research (2006).

2.3 STS research and the social construction of science and technology

STS is described as an interdisciplinary field aimed at “creating an integrative understanding of the origins, dynamics, and consequences of science and technology” (Hackett, Amsterdamska, Lynch, & Wajcman, 2008, p. 1). The origins of the field are traced to the publication of Kuhn’s Structure of Scientific Revolutions (1962), which argued that scientific progress does not unfold with the successive discovery of natural facts. According to Kuhn, it proceeds instead through episodic “paradigm shifts” prompted by changing social, cultural, and practical circumstances (Law, 2010; Sismondo, 2008). As Sismondo describes (2008), Kuhn’s historical analysis of scientific progress laid the groundwork for the emergence of numerous overlapping schools of thought that currently inform and constitute the field of STS.

The establishment of the Strong Programme in Social Studies of Knowledge (SSK) (Barnes, 1974; Bloor, 1976) asserted, for instance, that the “content” of scientific knowledge (i.e. the work of scientists), and not just its “social structures” (e.g. funding regimes, professional societies, tenure systems) could be treated as empirical objects of systematic inquiry. In their historical account of the ascendance of Boyles’ experimentalism over Hobbes’ natural philosophy, Shapin and Schaffer described the methods and aims of SSK:

We intend to address the problem […] by dissecting and displaying the mechanisms by which Boyle’s experimental procedures produced knowledge, and in particular, the variety of knowledge called “matters of fact”. We will show that experimental production of matters of fact involved an immense amount of labour, that it rested upon the assumption of certain social and discursive conventions, and that it depended on production and protection of a
special form of organization. The programme was, in Wittgenstein’s phrases, “a language game” and a “form of life”. (1985, p. 22)

SSK scholars also advanced the tenet of methodological symmetry, whereby any phenomena deemed true or false, rational or irrational, could be studied using a common set of analytic principles. Influenced by Marxist theory, SSK studies often cited interests related to social class and the economic modes of production as important explanatory factors in construction of scientific facts (Collin, 2011).

A novel series of ethnographic “laboratory studies” were also initiated following the publication of Kuhns’ work, bringing the methods of anthropology out of exotic locales and into the scientific laboratories of research institutions (Knorr-Cetina, 1981; Collins, 1985). In this “anthropology of science”, STS scholars became participant observers of the routine work taking place in laboratories. These undertakings, writes Sismondo, made “epistemology a topic of detailed empirical study” (2008, p. 15), and chronicled in meticulous detail how scientific facts were constructed through the manipulation of equipment, data transformations, and rhetorical negotiations of truth claims. This culture of laboratory life involved tinkering or bricolage (Latour & Woolgar, 1979, p. 250) to tame the “messiness” associated with experimental intervention, observation, and reporting. Collins showed how controversies in the production of scientific knowledge exposed the interpretive flexibility of given sets of materials, methods, data, and ideas. He argued that these debates brought to light “much of what remains hidden in ordinary science” (1985, p. 169) and could be therefore used as a conceptual tool to compare and contrast conflicting regimes of knowledge production.

SSK approaches to studying scientific facts were then eventually adopted to analyse innovations in technological artefacts, launching the strand of STS research known as SCOT, or the “social construction of technology”. In arguments parallel to those of the Strong Programme, Pinch and Bijker (1984) observed that research accounts to explain the take-up of technological artefacts had privileged the analysis of social organisations (e.g. the innovating firm, marketing, economics) as objects of inquiry while neglecting to examine the actual practices of technology production. Their research attended to these processes of technology production, and cultivated the methodological symmetry needed to analyse all technical artefacts in common conceptual terms, irrespective of their success or failure. Analogous to Collins’ deployment of controversies to track the construction of scientific facts, Pinch and Bijker’s case study (1984) examined the alternation of variation and selection to understand how one variant of the bicycle
came to prevail over other existing models. Whereas *interests* were often cited to explain the construction of science in SSK, *relevant social groups* frequently figured as important drivers of technological innovation in SCOT research (Ibid., p. 414).

With its emphasis on *materiality*, actor-network theory (ANT) marked a dramatic departure from contemporaneous approaches to studying the social construction of science and technology. Whereas other schools of STS focused only on human-centered social forces and structures as explanatory factors, ANT scholars also included non-humans (e.g., scallops) and non-living material (e.g., documents and navigational instruments) in granular, descriptive accounts of knowledge production and technical innovation (Callon, 1984; Law, 1986). The *methodological symmetry* of SSK studies was redoubled with an additional *principle of generalised symmetry*, which imposed an added requirement – the participation of both humans and non-humans would be studied with the same set of analytic concepts. The construction of scientific facts and technology was therefore conceptualised as a process by which human and non-human actors assembled into *actor-networks*. Law asserts:

> The metaphor of the heterogeneous network lies at the heart of actor-network theory and is a way of suggesting that society, organisations, agents and machines are all effects generated in patterned networks of diverse (not simply human) materials. (1992, p. 380)

*Actor-networks* therefore generate *effects* – such as turning beliefs into *matters of fact*, or assuring the uptake or demise of new technologies.

### 2.4 Key concepts of locating design with ANT

Law describes ANT as a “toolkit” for “telling interesting stories” about how relations between humans and non-humans assemble (or not) (2009, p. 142). Rather than proposing “grand theory” or explanatory factors, ANT offers concepts, approaches, and methods to follow the formation of *heterogeneous networks* and to analyse *controversies* in the production of science and technology (Latour, 2005). Sørensen describes ANT concepts as *theoretical technologies* that “make certain empirical studies possible” through their connections to practice and to other concepts (2010, p. 12). In this thesis, I deploy the *theoretical technologies* of ANT to trace empirically the “working relations” of *design* and *use* in ICTD, as part of updating Heeks’ theory of *design-reality gaps*. I extend the work that Wilkie (2010) and Goodman (2013) carried out in industrialised settings by using similar methods to “locate design” in participatory grassroots projects for poverty alleviation. This theoretical stance is premised on key inter-related principles
that underpin all ANT research: *materiality, relationality, performativity, and sociomaterial practice.*

**2.4.1 Materiality**

My thesis aligns with the claim that “the social” is constituted as “patterned networks” of heterogeneous materials which include not only humans, but also “machines, animals, texts, money, architectures – any material that you care to mention” (Law, 1992, p. 381). Non-human materials are not merely tools to be used by humans in the production of technoscience, nor do they simply constitute an environment or context for the work of professional designers and engineers. Rather, non-human materials participate *with* humans in assembling *matters of fact* and technological artefacts. Callon (2004) argues:

> to understand the functioning of the communities involved both in designing goods and in defining the needs to be satisfied, we need to give up the traditional opposition between (wo)men and machines, between ends and means, or in other words between human beings and non human beings. (p. 4)

Callon describes several ways in which non-humans and especially ICTs might “participate in their own right in the definition and course of action, and in the production of knowledge on which design is based” (Ibid): (1) these objects can link and coordinate the activities of new combinations of actors; 2) they can contribute to the emergence of new social identities or groups; 3) they can connect actors across new temporal and spatial settings; and 4) they can delegate action and cognition across collectives of actors in new ways.

**2.4.2 Relationality**

The ANT approach asserts that “entities take their form and acquire their attributes as a result of their relations with other entities” (Law, 1999; p. 3). Meanings of objects and identities of persons are shaped and defined according to their positions within *actor-networks*. Humans and non-humans are not endowed with fixed roles or essential properties, but acquire or lose these attributes through the formation or cessation of relations with other actors. Latour writes, “We have to pass from relativism to *relationism*. […] To study a technological project, one constantly has to move from signs to things, and vice versa” (1996, pp. 79–80, author's emphasis). Akrich (1992) describes how both the material form and meaning of design and use are constituted through relationships between humans and objects:
We have to go back and forth continually between the designer and the user, between the designer’s projected user and the real user, between the world inscribed in the object and the world described by its displacement. For it is in this incessant variation that we obtain access to the inventory and analysis of the mechanisms that allow the relation between a form and a meaning constituted by and constitutive of the technical object to come into being. (pp. 208-209, author’s emphasis)

Reviewing exemplar case studies in ANT, Law demonstrates how this “semiotic relational logic” brings to the foreground intricate and far-flung webs of “strange” associations that often elide conventional ontological dualities—“Human and non-human, meaning and materiality, big and small, macro and micro, social and technical, nature and culture—these are just some of the dualisms undone by this relationality” (2009, pp. 146-147). In likewise fashion, this thesis will trace the shifting socio-technical arrangements that transcend the conventional design/use binary, demonstrating how such activities are relational effects that do not necessarily conform to organisational charts, formal job descriptions, or pre-defined communities of users and designers (Callon, 2004).

2.4.3 Performativity

ANT’s claim of relational materiality suggests in turn that no causal arrows can be drawn between actors and effects; the production of science and technology is performative, rather than deterministic. If technoscience does not exist outside of the relations that produce it, then such realities are performed or enacted, instead of constructed or built:

Natural, social, and human materials and realities, all of these are understood as effects rather than causes. This means that there are no essential or foundational differences between such realities. The differences that there are (and these are often deep) are taken to be consequences, not causes. It also means that they cannot be treated as explanatory resources. […] Rather, it is that they are in need of explanation. (Law, 2010, p. 8)

Closures of controversy are not construed as endpoints, finite achievements, or outcomes of complex causal factors, but are instead treated as continuous performances enacted by a dynamic and shifting actor-network. The concept of performativity leads to a way of describing the participation of humans and non-humans that is distinct from SSK and SCOT approaches. Given that technological artefacts simultaneously embody and perform a set of relations with other heterogeneous entities, neither technological determinism nor social constructivism suffice to study the emergence of material forms and their meaning (Akrich, 1992). Deterministic explanatory factors, be they technical or
social, cannot account for the reciprocal and adaptive relations connecting design, use, and technological artefacts. To understand technological innovation, Law asserts that “we need to study relations, networks, and webs of practice” (2017, p. 42) and identify the methods of ordering that gather humans and non-humans into stable configurations of practice.

2.4.4 Sociomaterial practice

ANT asserts that the relationships which enact an actor-network are constituted through sociomaterial practices (Law, 2017). While distinctive in the extent of agency it attributes to non-humans, ANT aligns with the growth of “practice-based” social theories, where practices are defined as “embodied, materially mediated arrays of human activity centrally organized around shared practical understanding” (Schatzki, 2001, p. 11). Goodman (2013) identifies two distinct strands of practice theory in social sciences and philosophy: (1) a “practice-as-enactment” approach; and (2) a “practices-as-stability” approach. “Practice-as-enactment” considers practice in its singular form – as a contingent and precarious site of cultural negotiation and improvisation, consistent with the research of Suchman (2000) and Pickering (1995). The “practices-as-stability” orientation follows the tradition of Bourdieu (1977) and Giddens (1979) and examines practice in its plural form, – as repetitions, routines, or patterns that “reproduce social order as they go unconsidered” (Goodman, 2013, p. 33). In tracing the “methods for assembling, stabilizing, or undoing realities” (Law, 2017, p. 42), ANT explores both these understandings of sociomaterial practice. It attends to how such ordering methods generate practice-as-enactments, and how these tenuous, relational effects are stabilised (provisionally) into routine, black-boxed practices-as-stability known as punctualisations (Law, 2003, p. 5).

2.5 Translation and other ordering methods in ANT

ANT has been described as the “sociology of translation”, as a “process of ‘heterogeneous engineering’ in which bits and pieces from the social, the technical, the conceptual and the textual are fitted together, and so converted (or translated) into a set of equally heterogeneous scientific products” (Law, 1992, p. 381). Informed by Serres’ studies of “order and disorder” in the philosophy of science (1974), Callon articulated the four moments of translation as a core set of concepts to study the emergence of sociomaterial practice. Through his classic empirical case study of scientists, scallops,
and fishermen (1984), Callon describes a mechanism by “which the identity of actors, the possibility of interaction and the margins of manoeuvre are negotiated and delimited” (1984, p. 203). Translation is in this sense a “conceptual tool kit for talking about heterogeneous relationality, a method for mapping how every object or actor is shaped in its relations” (Law, 2017, p. 41). It is a theoretical technology to describe a mechanism that “relates, defines, and orders objects, human and otherwise” (Law, 2009, p. 145). Translation is further described in Chapter 3, when I present the methodology of my doctoral research.

As alluded to in the prior chapter, ANT offers a multitude of other concepts that, along with translation, can be used to analyse how order is created from disorder – that is, to describe how “practice-as-enactment” emerges and is embedded into patterns of recurrent “practices-as-stability”. Such ordering methods enhance the material durability, strategic durability, and discursive stability of an actor-network (Law, 2009, p. 148). For example, objects such as inscription devices (Latour & Woolgar, 1979) and immutable mobiles (Latour, 1998) enhance the material durability of an actor-network, consistent with Law’s observation “that social arrangements delegated into non-bodily physical form tend to hold their shape better those that simply depend on face-to-face interaction” (2009, p. 148). The strategic durability of a network is advanced when actors devise deliberate tactics to incorporate other stabilised, “black-boxed” networks, as described in Law’s account of long-distance control in the 16th century Portuguese navy (1986). Finally, Law draws from Foucault to describes how the discursive stability of a network is achieved through ordering methods enacted not via individual objects or actors, but through regimes of mini-discourse that define the conditions of possibility for enrolling entities into an actor-network.

2.6 Critiques of ANT

As Walsham observes, ANT differs from many social theories in that it is both theory and methodology combined:

It not only provides theoretical concepts as ways of viewing elements in the real world, it also suggests that it is exactly these elements which need to be traced in empirical work. (1997, p. 469)

Consequently, critiques have challenged ANT’s metaphysical premises and its ability to address the issues considered most germane to the study of science and technology. Objections come from outside of STS in substantive domains where ANT has been
applied, such as Organisational Studies, Information Systems and ICTD. They also come from inside the field of STS, with the ANT pioneers acting often as their own most vocal critics (Stanforth, 2006).

“Only dead theories and dead practices celebrate their self-identity,” writes Law, “Only dead theories and dead practices hang on to their names, insist upon perfect reproduction” (1999, p. 10). Indeed, if the first ten years of ANT scholarship was spent establishing the material relationality of scientific facts and technology production, the latter two decades have consisted of adaptations and extensions in response to its critics (Gad & Bruun Jensen, 2010). Scholars have addressed the limitations of classic ANT through further explication of ANT's core premises – materiality, relationality, performativity, and sociomaterial practice – and by conducting a host of new empirical cases studies. The notion of performativity in particular has been crucial in the elaboration of post-ANT methods, and there has been a commitment to understanding “how the material-semiotic traditions have interfered with one another to articulate new intellectual tools, sensibilities, questions, and versions of politics” (Law, 2009, p. 150). These post-ANT responses enrich classic ANT concepts with ideas related to performativity, multiplicity, fluidity, bodies, spatialities, and reflexivity, integrating material-semiotic perspectives from fields such as Feminist Theory, Post-Colonial Studies, and Geography.

The remainder of this section reviews some of the criticisms that have been levelled at ANT and describes the responses from the ANT research community.

2.6.1 The problem with generalised symmetry

Some of the most strident opposition to ANT relates to its treatment of non-humans in descriptions of technology production (Sayes, 2014). As described earlier, through the principle of generalised symmetry, ANT departs from other approaches to STS research by insisting that the participation of both humans and non-humans be studied with a common set of analytic concepts. Law writes:

Actor-network theory is analytically radical in part because it treads on a set of ethical, epistemological, and ontological toes. In particular, it does not celebrate the idea that there is a difference between people on the one hand, and objects on the other. It denies that people are necessarily special […] Necessarily then, it sets the alarm bells of ethical and epistemological humanism ringing. (1992, p. 383)

Early opposition from SSK scholars (Collins & Yearley, 1992) viewed ANT’s stance on non-human participation as a setback for the field of STS, which had finally succeeded
in shifting away from technological determinism and challenging the privileged status of scientific knowledge. In a review of *The Pasteurization of France* (Latour, 1988), Schaffer further accuses Latour of committing “the heresy of hylozoism, an attribution of purpose, will and life to inanimate matter, and of human interests to the nonhuman” (1991, p. 182). Only humans act with intentionality, argued Vandenberghe (2002), who claimed that *principle of generalized symmetry* results in:

\[
\text{[...] a formal, atomistic, intellectualistic and pseudo-economic analysis of the vulgar interests of humans who link up with other humans and non-humans, translating their interests in a reciprocal exploitation of each other’s activity for the satisfaction of the personal interests of each of the parties involved [...] meaningful action disappears and all we are left with is a pasteurized and desymbolized world of strategically acting dehumanized humans, or humants. (2002, p. 55)}
\]

Debates remain over how entities such as objects, animals, and things contribute to social life, and the controversy continues over what the agency of non-humans means for human action (Sayes, 2014).

ANT proponents have responded to these critiques by generating more empirical examples involving objects such as hotel keys (Latour, 1991), photo-electric lighting kits (Akrich, 1992), and hydrogen fuel cells (Callon, 1980) to further illustrate how non-humans participated in the social life of technoscience. Given that all actors possessed the potential to act in the production of technology, they argued, the roles of both humans and non-humans had to be analysed with same sets of social science methods. As Latour clarified, “To be symmetric, for us, simply means not to impose a priori some spurious asymmetry among intentional human action and a material world of causal relations” (2005, p. 76, author's emphasis). Law further explained:

\[
\text{We need, I think, to distinguish between ethics and sociology. The one may – indeed should – inform the other, but they are not identical. To say that there is no fundamental difference between people and objects is an analytical stance, not an ethical position. (1992, p. 383)}
\]

Constraining understandings of non-humans to that of tools or context was seen to foreclose the possibilities of identifying new forms of meaningful action that might emerge in the production of increasingly sophisticated forms of technology (Sayes, 2014).

Proponents of ANT further pointed out that the conflations of human beings with attributes of agency would preclude the analysis of ethics and morality in hybrid situations where human-machine boundaries are blurred, such as those involving assistive and end-of-life technologies (Law, 1992; Walsham, 1997). They would later turn to
tential realism extended a performative, post-human specification of humans and non-humans. In this light, agency becomes a sociomaterial “enactment, not something that someone or something had”; agency is instead an effect that “[…] cannot be designated as an attribute of ‘subjects’ or ‘objects’ (as they do not preexist as such)” (1998, p. 112)

Barad continues:

Post-humanism marks the practice of accounting for the boundary-making practices by which the “human” and its others are differentially delineated and defined. In invoking this contested term, […] I am not interested in postmodernist celebrations (or demonizations) of the posthuman as living testimonies to the death of the human […] No uncritical embrace of the cyborg as the ironic liberatory savior is at issue here. (2007, p. 136)

Recognising the entangled relations between agency, people, and objects “does not mean there are no differences. The problem rather is how to understand the nature of difference differently” (Suchman, 2006, p. 260).

2.6.2 Limited social structures

ANT is also often critiqued for its limited attention to broader social structures and how they relate to the local (McLean & Hassard, 2004). In ANT, there is “no group, only group formation” (Latour, 2005, p. 27); scholars do not presume a priori the existence of macro-level “social categories” or “social forces”. Collective action is constituted through the formation of the actor-network – “society is not what holds us together: it is what is held together” (Stanforth, 2006, p. 55). Detractors in the field of IS argue that this stance focuses unduly on the emergence of micro-relations in the present, and underestimates how broader entrenched social structures influence the formation of such local sociomaterial relations (Harbers, 1995; Reed, 1995; Walsham, 1997). In their study on telecentres in Peru, Diaz Andrade and Urquhart contend that ANT risks falling into a “presentism trap” by ignoring how “contextual background”, “social capital”, and “institutional allegiances” shape the formation of heterogeneous relations (2010, p. 359). As Donovan observes (2014), this macro/micro distinction in ANT is a source of contention in the field of Development Studies, and scholars have argued that the performative sociomaterial approach must be complemented by “historical structures, and political-economic determinations” (Ferguson, 1999, p. 98).
If the role of broader social structures in classic ANT had been neglected, this was viewed by ANT scholars as an empirical shortcoming rather than a methodological or theoretical one. Law explained:

class, nation-state, patriarchy become effects rather than explanatory foundations. [...] many sociologies have little sense of how the social is done or holds together. They ignore the material practices that generate the social: ships, sailors, currents. They simply move too quickly to a non-material version of the social. (2009, pp. 147-148)

In ANT, macro-level factors were considered effects rather than causes. What was needed, argued its scholars, were additional case studies to trace the micro-associations that constituted these “social structures” and contributed to their durability and mechanisms of domination. Post-ANT scholarship drew upon material-semiotic methods in geography (Massey, 1991; Thrift, 1996) and mobilities (Urry, 2000) to illustrate further the performativity of seemingly stable actor-networks. These empirical studies challenged the notion of pre-ordained, fixed “social structures”, refuting the essentialism of global/local binaries, territorial boundaries, nation-states, and other a priori groupings embraced by alternative schools of STS thought (Law & Mol, 2001; Law & Urry, 2004).

2.6.3 Amorality

Another frequent objection to ANT relates to its amoral stance. As Latour observes, ANT is often accused of “immorality, apoliticism, or moral relativism” (1991, p. 130). For example, Walsham questioned whether ANT’s material-semiotic approach is equipped to render critical analyses of power and exclusions:

There is no problem here with ‘first describing the network’ but what comes after this? Where do the moral judgements come from if not from ideas that transcend the situation? [...] If the Internet is examined, we do not need actor-network theory to tell us that the African continent is almost totally excluded. We cannot make a moral judgement on this on the basis of the network alone, but need political and ethical theories concerning socio-economic development. (1997, p. 475)

Whittle and Spicer argued that ANT’s insistence on generalised symmetry and situated practice is contrary to the notion of meaningful, purposeful political action:

By claiming that the repetitive action of an automated system [i.e. the actor-network] is of the same status as political action, ANT degrades our understanding of action by obscuring the fact that it is only through the intervention of humans that agency – and thus political transformation of social arrangements – can occur. (2008, p. 6)
Other scholars have raised concerns that ANT’s agnostic stance is blind to the “elitism” of stabilised actor-networks (Winner, 1993, p. 370) and that the approach to studying technology reinforces patterns of domination by lending itself too readily to Machiavellian or managerial perspectives (Star, 1991).

ANT scholars denied accusations of assuming an amoral or apolitical stance in their research. Latour writes:

Refusing to explain the closure of controversy does not mean that we are indifferent to the possibility of judgement, but only that we refuse to accept judgements that transcend the situation [...] Domination is an effect not a cause. In order to make a diagnosis or a decision about the absurdity, the danger, the amorality, or the unrealism of an innovation, one must first describe the network. (1991, p. 130)

Law argued that studying actor-networks need not always be a Machiavellian undertaking, contending that “it is not necessarily cynical to explore how power is done. On the contrary, if we want to undo power, it may help if we understand its methods” (2017, p. 42). Mol’s ethnographic rendering of ontological politics in health care (2002) and Verran’s postcolonial theorisation of Aboriginal imaginaries (1998) offers mechanisms for understanding how values and norms are entwined with the material to generate controversies in technoscience, and how those differences might be accommodated.

Feminist research has addressed critiques by supplementing the heroic accounts of classic ANT with more detailed narratives of excluded actors (Star, 1991). It has also explored relationships between activism and hybrid knowledge (Haraway, 1997) and examined the role of affect and care in technoscience (Puig de la Bellacasa, 2011). I will argue that this feminist notion of care played a crucial role in design practice for ICTD, and towards the end of this thesis, I will deploy this concept as a conceptual tool for analysing how politics, poverty, and morality shaped the formation and dissolution of a mobile learning intervention for Kenyan health workers. This notion of care – with its host of scholarly and colloquial usages and ambiguities – is viewed as “necessary to the fabric of biological and social existence and notorious for the problems that it raises when it is defined, legislated, measured, and evaluated” (Martin, Meyers & Viseu, 2015, p. 625). “Thinking with care in Science and Technology Studies [...] privileges themes of power in specific on-the-ground sites of care that entangle both humans and more-than-human others” (Ibid., p. 626). Care operates at two levels in feminist STS: it is both an
object of study and an ethos that shapes the ways STS researchers interact with the worlds that they investigate.

2.6.4 **Rigidity of networks**

Whittle and Spicer have critiqued the accounts of network formation in Organisation Studies as mechanistic, deterministic, and limited to descriptions of successful projects, raising questions about whether ANT could bring to the foreground the performative, material, and relational dimensions of sociomaterial practice (2008). This rigidity has been source of consternation among the proponents of ANT themselves (Stanforthish, 2006). Latour claimed that the emergent, relational materiality of ANT was muddled with a common parlance understanding of “network”, one that emphasised final states and “the circulation between nodes being made compulsory through a set of rigorous paths” (1996b, p. 2). Law explained that the term actor-network was meant to convey an ever-present tension that exists between agency and structure, but this tension was lost with the widespread use of the approach:

> Easy use of the term ‘actor-network’ has tended to defuse the power and the tension originally and oxymoronically built into the expression […] The blackboxing and punctualizing that we have witnessed as we have named it have made it easily transportable. They have made a simple space through which it may be transported. But the cost has been heavy. *We have lost the capacity to apprehend complexity […]* (1999, p. 8, author's emphasis)

Lee and Brown argued that in its quest to eliminate essentialised binaries, ANT risked becoming its own essentialised system, foreclosing the possibility of studying *actor-networks* as dynamic heterogeneous formations and discounting the micro-relations that may exist among excluded actors (1994).

Insights from Geography and the mobilities research paradigm have been applied to offset the rigidity of the actor-network concept. For example, post-ANT theoretical work on *fluidity* (Mol & Law, 1994; de Laet & Mol, 2000; Law & Singleton, 2005) countered the linear, deterministic tendencies of classic ANT accounts of technology production. Through their case study of UK cervical cancer screening, Singleton and Michael demonstrated that:

> […] actor-networks are not simply sustained through black-boxing, simplification and the generation of unitary identities and discrete associations. Rather, ambivalence, ambiguity, problematization, marginality and multiple identities can also play a part in the reproduction of a network. (1993, p. 257)
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Whereas the classic ANT account demonstrated the generation of a single actor-network enacting a singular reality, Mol’s empirical work on atherosclerosis illustrated how reality is *multiple* – at any given point, it is enacted by many different, but overlapping sets of sociomaterial practices (2002). This post-ANT concept of *multiplicity* expanded the understanding of the performativity of actor-networks, providing scholars with theoretical tools to study actor-networks not as centralised consolidations of interests, but as distributed, dynamic ecosystems constituted through partial and intermittent connections.

2.7 ANT, epistemologies, and ontologies

When STS is predicated on “a cosmos [that] is endowed with a singular order”, empirical data, research methods, epistemology, and ontology take on specific functions and meanings (Law & Lien, 2013, p. 364). These versions of constructivist scholarship presume that there is one reality waiting to be unveiled or discovered, and that the task of the researcher is to ascertain and implement the appropriate epistemology and concomitant theoretical perspective, methodologies, and methods (Crotty, 1998). Empirical data, then, are considered messy and disordered. This data must be purified, refined, arranged to discover or reveal a singular, pre-existing ontology. Within such research, *theories* serve to distill empirical data to deliver this one true reality. Each successive empirical case provides a new occasion to confirm, refute, and/or propose new theories, as well as to refine methods, but always with the aim of arriving closer and closer towards this single reality.

The ideas of materiality, relationality, performativity, and sociomaterial practice that underpin ANT lead to a markedly different kind of STS research. Aligned with post-humanist elaborations of social theory (Barad, 1998), my thesis makes an alternative claim that reality is multiple rather than singular. Drawing parallels with long-standing traditions in classical Chinese philosophy (Hall & Ames, 1995) and Amerindian cosmologies (De Castro, 1998), Law and Lien explain that in ANT, the dominant assumption of a single ontology is decoupled from understandings of the cosmos:

> [Q]uestions of ontology (the kinds of objects or entities that exist) are detached from general assumptions about the character of the cosmos and become a matter for empirical investigation. At the same time, the cosmos turns from a general framing order into contingent sets of orders, ordering processes, disorders and unknowable fluidities. (2013, p. 364)
With this stance, both classic ANT and post-ANT support the study of *empirical philosophy* (Mol, 2002) or *empirical ontology* (Law & Lien, 2013), which is premised on an assumption that reality is multiple and messy, rather than singular and ordered.

With this shift, the research enterprise changes in fundamental ways. Instead of creating *order out of disorder*, ANT and other material-semiotic methods are deployed to generate *disorder out of order*. They serve as tools to bring to the foreground the messy realities that belie the universalisms, institutions, standards, social categories and other essentialist framings of the world. Applied in empirical cases, material-semiotic tools help demonstrate how the entangled identities, meanings, objects, and bodies that constitute a disorderly cosmos are organised, ordered, *brought into being*, through different arrays of sociomaterial practice. When reality is severed from the foundational assumptions related to one true order of the universe, *ontology* becomes an object of empirical analysis, directly observable through the methodology that Mol calls *praxiography* – the ethnographic study of sociomaterial practices (2002).

An ANT-oriented praxiography cannot claim to generate explanatory factors if it is premised on a cosmos that is multiple and disorderly (Law & Lien, 2013; Mol, 2002). Given the assumption that reality itself is multiple, entangled and messy, the aim of studying sociomaterial practices is to describe the enactment of multiple ontologies, rather than revealing a singular one that lies hidden. Because it never aims to explain one true reality, praxiography in STS is neither inductive nor deductive. Its empirical investigations neither create nor confirm theories about a singular cosmos. Referencing Dewey’s notion of *theoretical technologies* (1929), Sørensen describes how theories are used by STS researchers to build instruments of observation that make the sociomaterial practices of science and technology perceptible, traceable, amenable to analysis and critique (2010).

Law describes how ANT and other material-semiotic tools are deployed by STS researchers to map the dynamics of multiple ontologies. Enacted through arrays of sociomaterial practice, these *knowing spaces*:

> set more or less permeable boundaries to the possible and the accessible; they are defined by patterns of relations which enact those gradients of possibility and accessibility; and they intersect with and are implicated in the generation of alternative knowing spaces that cannot be included. (2017, p. 47)

Such ontological maps may be not be helpful to the epistemological pursuits of scientific certainty and explanatory power, but they are valuable for imagining how actor-networks
might be configured in novel ways (Haraway, 1997; Law, 2015; Verran, 1998). Drawing from both Rittel and Webber (1973) and Aristotle, Jenkins notes that deterministic, generalisable analytics might suffice for the “tame problems” in international development but will not support the analysis of wicked problems where “things can be other than they are” (2010, p. 16). “Reality is not destiny” and the mapping of knowing spaces can reveal the ways in which ontological politics might emerge out of an empirical landscape of alternative sociomaterial configurations (Law, 2009, p. 15). As Law writes, “knowing and its methods […] imply particular arrays of subjects, objects, expressions or representations, imaginaries, metaphysical assumptions, normativities, and institutions” (2017, p. 47).

Jenkins has described the field of international development as “a knowledge-intensive sector with many stakeholders with diverse backgrounds and insights” and has called for a practiced-based approach to understanding “whose knowledge matters?” (2010, p. 8). As Powell writes:

The issue for anyone working on development issues cannot be simply how to deal with “knowledge”, but how to act effectively in an environment of multiple “knowledges”. How can this be done? What relationships are possible between different “knowledges”? (2006, p. 521)

These questions about “what to do” cannot rest on answers about “what is real” if the cosmos is presumed to be multiple. Mol argues further:

[I]f we can no longer find assurance by asking “is this knowledge true to its object?” it becomes all the more worthwhile to ask “is this practice good for the subjects (human or otherwise) involved it?” (2002, p. 165)

As she contends, positive interventions in an uncertain world do not hinge on deliberations over representations of truth. Acting on the world instead requires attending to the question of goodness – to discerning the goodesses that are enacted through the different sociomaterial arrangements that constitute the empirical terrain.

2.8 The politics of ANT research

In mapping the situated knowledges that order the cosmos in varied ways, ANT refrains from asserting the ontological primacy of its approach. ANT is its own, situated and embodied world-making practice that claims “no grand overview, no neutral place” (Law & Singleton, 2013, p. 486). Instead, ANT intervenes on the world with its distinct set of knowledge-making practices; its empirical settings, methods and materials enact their proper ontologies. Informed by feminist understandings of objectivity (Haraway,
1988), ANT renounces “the god trick of seeing everything from nowhere” (Ibid., p. 581) and aspires to a “self-critical partiality” and a “practice of objectivity that privileges contestation, deconstruction, passionate construction, webbed connections, and hope for transformation of systems of knowledge and ways of seeing” (Ibid., p. 585). This feminist-informed ANT is aligned with the “engaged program in STS research” that integrates the study of science and technology with activism, reform, and “the project of promoting a socially responsible science” (Sismondo, 2008, p. 18).

ANT also assumes an activist stance through its reflexivity about the politics of methods. As Law and Singleton observe:

> When we describe a scene we make choices – mostly implicit – about what we’re going to describe and what we’re going to leave out. About which actors to follow and which to leave be. About what to treat as powerful […] and what to ignore. And those choices partly depend on our own agendas, political, theoretical, personal […] It’s that a choice like this – any kind of choice – means that you’re not attending to the full specificity of a field. So to translate into an ethnographic story is also to betray. (2013, pp. 495-496)

ANT narratives are therefore inherently normative, ethical, political; they are a “form of policy” (Law, 2011, p.6). Haraway has called for a critical practice for recognizing how these “semiotic technologies” of STS intervene on the world with its non-innocent meaning-making knowledge practices (1988, p. 579). As described in the next chapter on Methodology, the methods and materials of ANT “cut the network” (Strathern, 1996) to establish the boundaries of my thesis and thereby enact exclusions that have political and ethical implications.

### 2.9 Summary

Positioning my thesis at the intersection of IS, HCI, ICTD, and STS research, this chapter has established the conceptual basis for adopting ANT to trace the sociomaterial relations of design and use in the mProject. I assert that deterministic models of sociotechnical systems are ill-suited to address the contingent and adaptive nature of wicked problems in ICTD design. Instead, ANT methods that stress the materiality, relationality, performativity, and sociomaterial practice in science and technology are more appropriate for disentangling complex relationships between the design, production, use, sustainability and scalability of projects. ANT is also conceptually compatible with Heeks’ theory of design-reality gaps. This well-accepted model incorporates ICTD failure as a parameter in a dynamic sociomaterial system, but is derived from and applied
to empirical cases where contexts of design and use were separated in terms of geography, culture, and economics.

Such divides are less pronounced now, given the dramatic uptake of ICTs in developing countries and the increasing importance of local participatory development projects. I have argued that to update the theory of design-reality gaps, it is first necessary to adopt ANT to describe how, along with the putative users, a broader array of humans and non-humans work through and inhabit the human-machine interface to enact the sociomaterial contexts of design and use. That is, theorising success and failure in the current ICTD landscape first requires “locating” the working relations of technology design and use, in the manner articulated by Suchman (1994). Therefore, the overarching research question of this thesis is:

*What are the sociomaterial relations of “design practice” in a globally-distributed, multi-stakeholder, and technologically-mediated ICTD project for poverty alleviation?*

In the next chapter, I present the methodology I developed to answer this research question.

As Law and Singleton have written, “ANT does its theoretical work in its case studies” (2013, p. 500) and Chapter 3 will describe how I conducted my own case study of an academic research project that sought to design, build, and evaluate a mobile phone learning intervention for Kenyan CHWs. I will present how I used praxiography as a methodology to link the methods of ANT with this empirical data and iteratively assemble additional theoretical concepts to describe the emergent practices of design and use in ICTD. These are the methods and materials of my knowledge-making practices, which I deployed in turn to study other knowledge-making practices involving academic researchers, CHWs, a Kenyan non-governmental organisation (NGO), and mobile phones. In the tradition of feminist ANT, mapping the multiple ontologies that implicate these different actors is meant to be an intervention on reality that explores how “trajectories and positions can connect and transform each other without needing to erase their divergences” (Puig de la Bellacasa, 2012, p. 205).
3 Methodology

I described in Chapter 2 how the conventional designer/user dualism is challenged when the design, production, and deployment of technology are understood as situated action (Suchman, 1994). Within the Third Paradigm of HCI research (Harrison et al., 2007), interaction is understood as a situated phenomenon and design and use are conceptualised as entangled and contingent practices “working through” and “inhabiting” the interface (Suchman, 2006). ANT offers a useful repertoire of analytic tools to trace these emerging practices as they constitute a socio-technical system. Deconstructing design and use in this way can help update the theory of design-reality gaps, a theory of project success and failure which also draws from concepts of contingency and situated action, but is premised on geographic, cultural, and economic divides between design and use that are less apparent in the contemporary ICTD moment. In the last chapter, I argued that generating more nuanced conceptualisations of success and failure requires the deployment of ANT to answer my research question: What are the sociomaterial relations of design practice in a globally-distributed, multi-stakeholder, and technologically-mediated ICTD project for poverty alleviation?

Having established those theoretical foundations and my research question, I now present the methods and materials that I adopted in my thesis. In this Methodology chapter, I will describe how I engaged with ANT and this practice of “theory-making” by conducting an empirical case study of an academic mobile learning intervention. I begin with an overview of praxiography, the ethnographic study of practices, as the methodology I use to document the emergence of the object of my study – design practice in an ICTD project. Next, I describe the empirical setting, the inquiry strategies, and the narrative conventions that I used to attend to the complex and contingent associations that would constitute a yet-to-be assembled heterogeneous group of design actors. I continue the chapter with an exploration of my positionality with respect to my research, which then leads into the final section on research ethics.

3.1 Praxiography as a methodology for ANT research

In The Body Multiple, Mol suggests that complex day-to-day practices can be investigated using praxiography as a research methodology (2002). Praxiography
Theorising the design-reality gap

employs the methods of ethnography to study sociomaterial practices. Ethnography is a methodology established during the early 20th century by anthropologists such as Malinowski (1922) and Mead (1928) to study exotic and distant cultures. It has been eventually adapted for use by sociologists in STS studies, medical work, educational research, Computer Supported Collaborative Work in industrialised settings and more recently, development studies (Jordan, 1996; Mosse, 2013). Researchers have also conducted ethnographies to solicit user input in the Participatory Design and HCI communities (Blomberg & Karasti, 2012), as well as to study the use of ICTs for poverty reduction (Tacchi, 2004) and to develop interventions for community health workers or CHWs (Maes, Closser, & Kalofonos, 2014). Classic ethnographic methods include participant observation (Spradley, 1980) and interviews (Spradley, 1979) that immerse the researcher in a field site for extended periods of time.

Altheide (1987) suggests that the method of document analysis should also be conceptualised as ethnographic fieldwork, and researchers have demonstrated how the ethnographic gaze can be directed at media such as texts and film footage (Bowen, 2009; Miller & Alvarado, 2005; Prior, 2003; Woodhouse, 2006). Beaulieu (2010) observes that the ethnographic accounts in the classic laboratory studies of STS highlight an abundance and variety of inscriptions that precede the publication of a scientific paper. She asserts that studying such “texts” and “traces” becomes increasingly important with the growth of the Internet, globalisation, and the proliferation of ICTs. When the organisational activities of co-operating actors are distributed across far-flung networks, it is difficult to aspire “to the ethnographic ideal of ‘being there’ with informants in order to observe their activities and understand their lives” (Jensen, 2010, p. 72). Beaulieu (2010) argues that the concept of co-presence, rather than co-location, is a useful epistemic strategy for widening the parameters of ethnographic field work to include “streams of practice” that exceed what is observable through face-to-face interaction and within the more restricted physical confines of a laboratory or work locale.

In spite of the diversity in the motivations and application of these ethnographic methods, Flewitt contends that they all share certain commonalities in their approach to describing culture, noting that while:

Ethnographic approaches vary and have been used in the pursuit of a range of theoretical ideas […] over-arching characteristics of ethnographic research include recognition that: 1) data should be drawn from ‘real world’ contexts; 2) both participant (emic) and researcher (etic) perspectives should be valued; and
3) meanings emerge in social and cultural contexts from the interwovenness of language, bodily movements, artefacts, images and technologies. (2011, p. 296)

Walford similarly suggests that a research project may be identified as “ethnographic, as opposed to, say, just qualitative or naturalistic” (2008, p. 7), when it involves substantial immersion and engagement in the study field, in addition to the reflexive, iterative application of multiple methods with the aim of generating a description of a culture.

Having defined praxiography as an ethnographic methodology, it is now useful to discuss what distinguishes praxiography from other ethnographic approaches, for these distinctions are what make it particularly suitable for my ANT-inspired account of design practice in an ICTD intervention such as the mProject. The first distinction has to do with the idea of practice as the object of research in a praxiological investigation. Whereas in ethnography, the unit of analysis is the culture – broadly defined according to various configurations of space, time, humans, activities, objects, acts, events, goals, and feelings (Spradley, 1980) – in praxiography, the ethnographer’s lens is focused and fixed at the level of practice. Here, practice has the specific conceptualisations described in the last chapter – as both the precarious “practice-as-enactment” and the more routine-like “practices-as-stability” (Goodman, 2013). Both forms of practice are operationalised in terms of relations among human and non-human actors, and what these actors do in relation to one another. Praxiography is concerned “[...] with something happening, contrary to elements or to something being” (Sørensen, 2010, p. 22). This is in contrast to other methodologies such as grounded theory which focus on “the question of who and what were present in the empirical setting“ and then creates a ‘messy map’ to position actors in relation to one another (Ibid.). The aim in praxiography is to always describe relations that are happening – something happening can be anything that can be described with verbs (Law, 2010; Mol, 2010). As Oliver notes, “It is the networked enactment of things that is studied, rather than the mapping of networks per se or the analysis of historical snapshots” (2012, p. 442).

Besides foregrounding practice as the unit of analysis, there is a second related feature of praxiography that distinguishes it from its larger family of ethnographic approaches. This relates to the way the methodology addresses the materiality of practice. In studies of educational technology, Sørensen asserts that while the sociomaterial nature of practice has been addressed theoretically by situated learning and activity theory scholars, their empirical accounts of practice still tend to privilege the human aspects of those practices (2010). When “human aims, interests, or consciousness” drive this
research, the only role that objects, such as technology, can serve “is that of a means to social, psychology, or pedagogic ends”, meaning that “the diverse other ways in which materials take part in social interaction remain under-theorized and little examined” (Ibid., p. 6). Praxiography employs ethnographic methods to understand not only the human dimensions of sociomaterial relations, but also the materiality of those relations in the constitution of practice. Attending to the symmetry of non-human and human actors in heterogeneous networks requires researchers to engage more deliberately with objects, to “speak with things”, to “interview artifacts”, in order to “catch insightful glimpses of the artifact in action” (Adams & Thompson, 2011, p. 734).

Mol’s *The Body Multiple* illustrates how praxiography provides a vehicle for engaging empirically with the conceptual underpinnings of ANT. However, a reading of Mol’s pioneering account provides few details about the specific methods to employ when adopting such a methodology (Oliver, 2012). Heeks observes that “ANT’s complexity, diversity, volatility and oftentimes failure to offer practical guidance” has led to its limited adoption by scholars in Development Studies and ICTD (2013, p. 7-8). Thompson and Rimpiläinen observe that “not only are approaches to studying these gatherings and heterogeneous processes not well developed, the researcher’s toils in this respect are not often evident in ANT accounts” (2012, Introduction section, para. 2). There are nevertheless a handful of useful methodological accounts of praxiography for ANT research, mostly in the literature related to educational technology (Leander & Lovvorn, 2006; Sørensen, 2010; Adams & Thompson, 2011; Oliver, 2012; Rimpiläinen, 2012, Thompson & Rimpiläinen, 2012; Thompson & Adams, 2013), in addition to work by Law & Singleton (2013). In the next sections, I will discuss how I drew from those accounts to conduct my praxiography of design, production, and use in a mobile learning intervention for Kenyan health workers.

### 3.2 Data collection methods

#### 3.2.1 Study field - the mProject as a globally-distributed “laboratory”

In the tradition of STS scholarship, my thesis is a praxiography of the “laboratory life” of a globally-distributed, multi-disciplinary and digitally-mediated ICTD research intervention that I call “the mProject”. This was an academic research intervention funded for three years by the ESRC-DFID Joint Scheme for Research for Poverty Alleviation. The co-recipients of the grant were from the London Knowledge Lab at the UCL Institute
of Education, where I am pursuing my doctoral degree, and AMREF Health Africa (AMREF), an international non-governmental organisation (NGO) headquartered in Nairobi, Kenya. Two years into the project, the principal investigator and research officer re-located to the University of Oxford, and I remained at UCL with a co-principal investigator. As stated in the original bid, the purpose of the mProject, was to design, develop, implement and evaluate a mobile phone based learning intervention to help train and supervise Community Health Workers (CHWs) in Kenya. As will be described in later chapters, CHWs are non-professional members of the health care system who have been chosen by their community to deliver basic health and medical services to the community (Haines, Sanders, Lehmann, Rowe, Lawn, Jan, Walker, & Bhutta, 2007). They were viewed by policymakers as a key way of addressing the global shortage of health professionals to meet the Millennium Development Goals, particularly in sub-Saharan Africa (Redick, Dini, & Long, 2014) and they continue to be regarded as important resources in achieving the post-2015 Sustainable Development Goals (Hyde & Hawkins, 2015).

There was concern that most international development research funded by DFID and other institutions had been of an applied nature, and the Joint Scheme with ESRC was viewed as a unique way of advancing more fundamental social science research in the sector. ESRC would take the lead in addressing the “world-class” and “quality” aspects of social science research by promoting theoretical and methodological rigour, while DFID attended to the applied aspects of “impact” and quantifiable “progress” toward the Millennium Development Goals (Scholz, 2012). The Call for Proposals stipulated that at least “50 percent of the research focus and effort” in each proposal should draw from “social science theory, concepts and methodologies” (ESRC-DFIDa, 2011, p. 3). This measure was to ensure that grantees would “contribute to a more robust conceptual and empirical basis for development” and “enhance the quality and impact of social science research which contributes to the achievement of the Millennium Development Goals (MDGs)” (Ibid, p.2). It is through such provisions that I eventually came to embed my theoretical ANT-oriented doctoral research into this mobile learning intervention for poverty alleviation in Kenya.

In this effort to link rigour with relevance, the Joint Scheme funding mechanism was organised along several “thematic highlights” corresponding to the strategic priorities of DFID’s operations in developing countries. One such thematic highlight focused on ICTs as both resources “in the reduction of poverty [and] improved
governance, human rights, accountability and mobilisation”, and as factors in “patterns of exclusion and inclusion” (Ibid, p. 8). The proposed mProject aimed to build on prior educational research in “mobile learning” and “collaborative knowledge-building”, as well as utilise the “Conversational Framework” to design, build, and evaluate a mobile phone learning intervention for CHWs in Kenya. The project bid further specified that the design parameters and requirements would be determined through a “Participatory Action Research” methodology, in order to “ensure that all stakeholders have a voice in the decision-making process” (See Table 3-1, mProject document #5, Theoretical framework, para. 1). More details about the theoretical orientation of the mProject project, the intervention, and its research questions will be presented in the next chapters, as part of my empirical account of design practice. There I will recount how the research investigators formulated the design problem, identified the actors necessary to arrive at a solution, and then devised and implemented their plan for persuading the others to participate in their efforts.

At the suggestion of leaders at AMREF Health Africa, the mProject was rolled out to 90 CHWs and their supervisors, mostly female, in two different settings: Kibera, a large informal urban settlement in Nairobi; and Makueni, a drought-ridden rural district in the Eastern Province. It was estimated that more than 50% of Kenyans resided in the small mud and corrugated tin structures that made up informal settlements like Kibera (Benoit et al., 2013). Lacking public sanitation systems and paved roads, Kibera experienced high rates of communicable and non-communicable diseases and injury, leading to alarming levels of mortality among young children (Olack et al., 2014). In the rural area of Makueni, government surveys estimated that there were 884,527 inhabitants spread out over an area of 7965.8 km², with three quarters of this population living below the poverty line (Masua, 2011). Food insecurity, poor sanitation, and limited access to infant and child health services led to high rates of chronic malnutrition and stunting (ACF International, 2012). District surveillance reported high case rates for malaria in Makueni (Government of Kenya Ministry of Health, 2013), leading to numerous prevention and treatment interventions for residents (Amin, et al, 2003; Chuma et al, 2010).

3.2.2 Participant observation and document review

As articulated by Spradley (1980), my participant observation of the mProject served the two purposes: (1) “to engage in the activities appropriate to the social
situation”; and (2) “to observe the activities, people, and physical aspects of the situation” (p.54). My research took place with the permission of the lead investigators, who were also my doctoral supervisors. As stipulated in the Institutional Review Board (IRB) documentation for my doctoral study (refer to Appendix C), my ethnographic engagement with the mProject was adjunct to the design, implementation, and evaluation of their mobile learning intervention for CHWs. This involvement as a doctoral researcher was expected to result in an independent piece of research that would fulfill the requirements of a thesis, bring an additional layer of reflexivity to the work of the mProject researchers, and thereby add to the overall theoretical contributions that had been stipulated by the ESRC-DFID Joint Scheme. This arrangement, as well as its ethical implications, will be examined further in Sections 3.6 and 3.7.

This engagement with the mProject began roughly one year into the project cycle and lasted until the end of the funding period two years later. During this time, I was given access to an extensive and constantly evolving online repository containing the academic researchers’ project field reports, photos, videos, notes, draft publications, audio recordings, phone logs, and interview transcripts. From my home in Paris, France, I developed a baseline familiarity with the mProject by reviewing all project documents and interview transcripts stored in the online repository as of November 2013 (See Tables 3-1 and 3-2 for complete lists of secondary data sources). I kept abreast of project developments as additional files were added to the repository, and also tracked the progress through the mProject blog, the mProject Twitter account, the WhatsApp postings by a group of Kenyan CHWs and their supervisors, and through my monthly face-to-face and Skype interactions with the UK-based principal and co-investigators who, as will be discussed in more detail below, also served as my doctoral supervisors.

I shadowed the mProject researchers at the UNESCO Mobile Learning Conference in Paris from October 28 to October 30, 2014. Between January 22 to February 4, 2016, I joined UK and Kenyan team members for parts of a ten-day meeting in London and Oxford, taking part in social events and technical discussions about evaluation and capacity building. From March 13 to March 21, 2016, I carried out fieldwork in Kenya to shadow the researchers as a participant observer. There, I engaged in some of their data collection activities in Kenya, including their photo-elicitation research practices (see Clark-Ibáñez, 2004; Harper, 2002) with CHWs, supervisors, and their patients (refer to Table 3-3). I also attended community forums in Kibera and Makueni, working sessions with researchers and AMREF representatives, as well as a
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stakeholders’ meeting in Nairobi with members of the mProject, the Ministry of Health, non-government organisations, and multi-lateral aid agencies (refer to Appendix A). Back in Paris, I transcribed audio recordings from the photo-elicitation sessions as well as from the community and stakeholders’ meetings, and I contributed to presentations and an academic paper (Table 3-1, mProject document #52). I generated 42 pages of typed fieldnotes and 10.5 hours of audio recordings from my face-to-face encounters, adding this primary source of data to the secondary data that I collected as part of my engagement as a participant observer with the mProject.

Table 3-1 Secondary data sources: Documents from mProject online repository

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<td>mCHW – Second Field Trip – Action Plan</td>
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<td>mCHW blog entry – Simon Mbae joins us AMREF’s new research assistant</td>
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The design and evaluation of a mobile learning intervention for the training and supervision of community health workers (mCHW). Research Proposal to AMREF Ethics and Scientific Review Committee.

Decision Letter from AMREF Ethics and Scientific Review Committee for Project AMREF-ESRC P83/2013

mCHW advisory panel meeting AMREF HQ 29th October 2013. Presentation

mCHW REFER App Training Session AMREF HQ, Nairobi 30th October 2013. Presentation

mCHW stakeholder panel meeting AMREF HQ, Nairobi 1 Nov 2013. Presentation

Brief on User Experience. The uptake of the Referral Application by the CHVs

REFER Project Joint Feedback Meeting Held in Makueni - Kasikeu Dispensary. April 29-30, 2014

REFER App Refresher Workshop for the CHVs and CHEWs of Makueni and Kibera. 11 September 2011. AMREF HQ. Presentation

Takeaway points from 13 Sept REFER App Refresher Workshop (and beyond)


Amref Health Africa International Training Centre - Programme for the Childdevelopmental milestones ToT refresher training November 26, 2014. Presentation

Amref Health Africa International Training Centre Programme for the Peer to Peer Training on the Referral App November 27, 2014. Presentation

Blog entry – The Hidden Children of Kibera and How They Rally for Support


Plan for Capacity Building Trip 21 Jan – 4 Feb 2015

Experiences of Evaluation (Morning, 22 January)

Evaluation notes – week 2. (Notes from Capacity Building Meeting)

Evaluation notes – week 3. (Notes from Capacity Building Meeting)

Blog entry – First Love Mother’s Group

FLM focus group meeting 8 March 2015 (summary notes)

Minutes of  the 2nd Stakeholders Meeting for Mobile Community Health Worker (mCHW) Project, held on March 18, 2015 at Amref Health Africa-Headquarters Auditorium

Mobile Community Health Worker Stakeholders Close Out Meeting. 16 June 2015. Agenda

Summary of REFERApp Utilization 10/28/2013-10/2/2015

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Through the participant observation described above, I immersed myself in the practices of the mProject. Much of this immersion was mediated through digital technology. While the face-to-face contact in the UK and Kenya was essential for sustaining my commitment and enthusiasm for my doctoral research, much of my analysis involved academic publications, policy reports, as well as secondary data sources that had accumulated from the actual work of the mProject and made available to me through digital communication. This approach to immersion resembles the ANT research on learning technology by Rimpiläinen, who found that:

[…] studying the work practices in a geographically distributed project, where multiple settings are being engaged at the same time, and work progresses at different paces, arranging a constant physical researcher presence in the field was not possible […] Despite being physically distant from the ‘field’, being involved in studying the project created a kind of constant ‘absent presence’ (c.f. Law 2004). (2012, p.56).

This remoteness is not necessarily a methodological weakness. Drawing from work on virtual ethnography by Beaulieu (2004), I contend that this distance from the field can be viewed as part of immersing myself into the practices of the project, given the fact the mProject team members were also geographically separated, but digitally connected, from numerous different work settings in Makueni, Nairobi, Oxford, and London.

Like many ICTD projects, the laboratory life of the mProject was globally distributed and spanned across diverse institutions and areas of expertise. The research team that I studied was comprised of three Kenyan nationals employed at the Nairobi
Theorising the design-reality gap

headquarters of AMREF, along with one freelance Nigerian technologist residing in London, one UK co-principal investigator based at UCL, and an Irish principal investigator and Swiss post-doctoral researcher working at the University of Oxford. Their working relations over the three-year study period were created through continuous, digitally-mediated interactions via e-mail, WhatsApp, and Skype, interspersed with different kinds of face-to-face encounters. The post-doctoral researcher conducted several field visits to Kenya lasting 4-8 weeks, the principal investigator made multiple 1-2 week trips, while the co-principal investigator remained based in London. The Kenyan team members travelled once to the UK for 10 days of meetings and workshops. And the CHWs, who were the envisioned learners in the mProject, worked independently or in pairs in households across Kibera and Makueni.

As Jensen notes, what would appear as methodological barriers to the study of ICTD “can itself be seen as symptomatic and illustrative of some particular characteristics of technologically mediated objects of inquiry […] as replications of the field” (2010, p. 73). Like the “absent present” ethnographer described by Rimpiläinen (2012), the geographically-distributed actors in any ICTD intervention interact through ICTs and experience asymmetries of knowledge due to their emergent and distinct positionalities. Jensen asserts that the limited presence, partial information, and uncertain associations that characterise globally-distributed ICTD work should not be viewed as epistemological constraints or methodological inadequacies, but rather as generative of a particular kind of ethnographic knowledge:

All [ICTD actors] live with limited presence, have to handle problems relating to partial information and other parts of the network and need to sort their uncertain connections on that basis […] a mediated ethnography attentive to the pervasive ontological opacity of ICT4Dev has unique opportunities for understanding how and why this phenomenon come[s] into being as a perpetually unstable, fragile, indeed, only partially existing object. (Ibid., p. 82)

Beaulieu further argues that if STS research is “to counter new universalizing claims around ICT from policy-makers and funding agencies […] ethnographic approaches must loosen their grip on co-location as a necessary requirement for “being in the field”” and explore alternative, inscription-based approaches to establishing “co-presence” (2010, p. 455-456). Figure 3-1 summarises the array of digitally-mediated and face-to-face approaches to participant observation that I adopted to establish a co-presence with the mProject. This figure also illustrates how “being there” maps roughly to the funding period as well as to the narrative that I will present in Chapters 4 through 9.
Figure 3-1 Establishing "co-presence" with the mProject for my doctoral research

<table>
<thead>
<tr>
<th>Date</th>
<th>Funding Period</th>
<th>mProject Digital Repository</th>
<th>Face to Face Interaction</th>
<th>Digitally-Mediated Interaction</th>
<th>Timeline of Praxiography</th>
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Note: this figure illustrates how and when I adopted various digitally-mediated and face to face approaches to establish co-presence with the mProject. This co-presence is displayed in relation to the project funding dates, and to the timeframes of my ethnographic narrative.
While this inability to establish a sustained “co-location” need not be a methodological weakness, it does nevertheless prevent me from identifying many of the discrete acts that individual actors perform in the course of carrying out their routine work. My practice-oriented analysis does not seek to provide the highly granular descriptions associated with ethnomethodological treatments of local, situated workplaces which “endeavor to illuminate the organization of the social world, not by positing theoretical systems but instead by carefully attending to the details of just how the social world is brought into being” (Koschmann, 2008, p. 363). This thesis does not, for instance, attempt to generate a high-resolution account of practices within a physical work site, as is offered in the refined, ethnographic renderings of studio work by Goodman (2013) and Yaneva, (2009). Nor will it produce the kind of engaging accounts of local user practices that Burrell (2016), Wyche (2015), and Maes and Kalafonos (2013) provide in their studies of African communities. Instead, my praxiography will “zoom out” (Suchman, 2006, p. 283) and attempt to provide a fine-grained narrative of the routine and technologically-mediated practices that constitute and connect such transnational, geographically-distributed sets of ICTD practices as they work through and inhabit the human-machine interface (Ibid.).

3.3 Data analysis methods – locating ICTD design as a research object

As discussed in the prior chapter, ANT does not propose natural laws or causal factors to be tested empirically, nor does it offer a grid or perspective to produce cross-sectional descriptive accounts. Rather, the ANT tradition offers a large repertoire of methods for analysing the distributed, heterogeneous, and emergent features of social phenomena such as ICTD design practice, the object of study in this ethnographic investigation. Mol writes:

If you link up with it [the ANT repertoire] you learn sensitising terms, ways of asking questions and techniques for turning issues inside out or upside down. With these you may go out and walk new roads. But beware: as you walk nobody will hold your hand, there are no assurances. (2010, p. 261)

What Mol is suggesting is that ANT may offer a vast range of promising methods to engage with empirical data, but it does not furnish easy guidance on which of those methods to adopt. Selecting these conceptual tools is to be done iteratively, according to the various events that comprise the object of study and to the sensibilities of the researcher.
Methodology

Thompson & Adams formulated two types of heuristics to “interview objects” (2013), responding to Latour’s call for “specific tricks […] to make them [objects] talk, that is, to offer descriptions of themselves, to produce scripts of what they are making others, humans and non-humans, do” (2005, p.79). Their first cluster of heuristics involves “attending to objects, attuning to things” to identify possible entry-points into an exploration of a heterogeneous actor-network. The second type of heuristic allows the researcher to “loosen the network” and further analyse the materialities of the gathering. These heuristics are presented as part of a menu of possible analytic strategies from which to choose: “Each heuristic provides a different sensitivity for recovering non-human contributions at the research site. Not all need to be applied, not all questions asked” (Thompson & Adams, 2013, p. 353).

In the following subsections, I will describe my analysis plan to “locate” design practice in a globally-distributed, multi-stakeholder, and technically-mediated mobile learning project. I will present in more detail the methods I adopted first to “attend to the object” of my study and then discuss how I “loosened the network” to further explore the politics of designing a mobile learning intervention for Kenyan CHWs.

3.3.1 Attending and attuning to ICTD design as an object of study

To attend to design practice as the object of this study, my first analytic decision was to “follow the actors” as they formed relations with one another, rather than to “limit in advance the shape, size, heterogeneity, and combination of associations” (Latour, 2005, p. 11). Consistent with the methodological approach used in Rimpiläinen’s study of educational technology (2012), I set out to present the findings as an unfolding empirical narrative of design practice in the mProject, one that would also reflect my emergent understanding of ANT. To do so, I conducted a retrospective follow-up analysis of my empirical data, tracing the formation of the mobile learning intervention from the point in time when the grant was submitted to the end of the project funding period. As Latour warns, following the actors in this manner presents certain difficulties:

How ridiculous is it to claim that inquirers should “follow the actors themselves” when the actors swarm in all directions like a bee’s nest disturbed by a wayward child? Which actor should be chosen? Which one should be followed and for how long? (2005, p. 121)

The analytic task here was to determine an entry point into the vast and complex web that was formed through the mProject, and to then carve out and characterise an initial set of actors most germane to the object of my research: design practice in the mProject.
Strathern describes this as a question of “cutting the network” (1996), of defining a scope of analysis that can accommodate the contingency and heterogeneity of the research object.

To “follow the actors”, I also drew on the concept of a “token”, a term coined by Latour (1987) and further operationalised in empirical work by Gaskell & Hepburn (1998) and Rimpiläinen (2012) from the field of education. A token, according to Latour, is a claim or artefact that does not simply “diffuse through society”, riding the inertia of the power of its originators until it meets with the frictions and resistances of vested interests. Rather,

the token is either ignored or taken up by people who see their interests translated within it. In the process of shaping it to their interests, these people usually modify the token. The path of the token is a product of the number and strength of the links that are established between it and a diverse group of other actors [...] The network is defined by the token, but the token is also simultaneously defined by the network. The network and token co-evolve. (Gaskell & Hepburn, 1998, p. 66)

Thompson and Rimpiläinen found that “following the token” provided a way into their complex and emergent data sets. They illustrated how this method allowed for the foregrounding of diverse, intertwined practices along a non-linear path and served as a means “for following a moving, changing target through, and as part of, the practices without fixing it in place in advance” (2012, The Token section, para. 7). To study the emergence of sociomaterial practices that constitute actor-networks, educational researchers have deployed analytic tokens such as a “prescribed curriculum” in higher education and vocational training (Edwards, 2011), a new applied physics course (Gaskell and Hepburn, 1998), and the research question in a funded academic collaborative for educational technology (Rimpiläinen, 2012).

To study the emergence of design practices in the mProject, I determined what token to follow by constructing an initial visual inventory of practices in the mProject and then selected the artefact that I thought would encounter the greatest number of human and non-human actors. Building on Spradley’s nine dimensions in ethnographic research (1980), I analysed the 31 interviews conducted by the mProject researchers (refer to Table 3-2) using NVivo to generate the coding system shown in Table 3-4. Codes related to Actors, Space, Activity, Event, and Object were then mapped in relation to one another to produce the baseline inventory of sociomaterial practices in Figure 3-2. This was an attempt to ensure that I would have enough data to generate an engaging ethnographic
account. Based on that review, I adopted the Malawi Development Assessment Tool, a health assessment tool (HAT), as the token of my ANT-inspired praxiography. The HAT was a clinical protocol constructed by pediatricians and statisticians from the UK and Malawi in order to track the developmental milestones of young children in low resource, rural African settings (Gladstone, Lancaster, Umar, Nyirenda, Kayira, van den Broek, & Smyth, 2010). Chapter 5 will describe how the HAT was adopted early on by mProject researchers as an object to provide culturally appropriate, practice-oriented “content” in the mobile learning intervention to train CHWs. In following the HAT as an analytic token, both the researcher-designer and the mobile phone were de-centered from my sociomaterial analysis of the mProject, thereby addressing critiques that ANT portrays humans as heroic actors (see Fujimura, 1991; Star, 1991), as well as the charges of technodeterminism in ICTD (see Granqvist, 2005; Gurumurthy, 2009). More description about the HAT will be presented later in the Chapter 5 on interessement, as part of my empirical narrative.

3.3.2 Loosening the network to enrich the narrative

Having decided to “follow the HAT” to investigate the sociomaterial enactment of design practice, I then drew on Callon’s four moments of translation (1984) as a conceptual tool to “loosen the network”. In the first moment, referred to as problematisation, an actor, which Star and Griesemer call the “entrepreneur” (1989, p. 389), undertakes (“entreprendre” in French) an initiative by formulating a problem to be solved. The set of other actors that must be recruited is identified and the problem is defined in such a way that the entrepreneur is the obligatory passage point where all others must pass. At this point, these are only potential recruits, and what follows during interessement, the second moment, are a series of attempts to “stabilise their identities”, so that they pull away from alternative engagements and approach the entrepreneur’s plan. The third moment of translation, enrolment, consists of actions that prompt recruits to become allies who perform a defined set of interrelated roles in the ways required to solve the entrepreneur’s problem. Finally, during mobilisation, the fourth moment, the entrepreneur becomes the spokesperson for the broader collectivities that they represent, without betraying their immediate allies.
Table 3-4 Codebook for baseline inventory of sociomaterial practices of the mProject

<table>
<thead>
<tr>
<th>Codes based on Spradley's dimensions (1980)</th>
<th>Child Codes developed iteratively during initial review of interview transcripts in Table 3-2</th>
<th>Sub Codes developed iteratively during initial review of interview transcripts in Table 3-2</th>
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<tr>
<td>ACTORS</td>
<td>PEOPLE, YCHW1, NGO1, YCHEW1, YCHW2, YCHW3, YCHW4, XCHEW1, MOH1, MOH2, XCHW1, XCHW2, XCHW3, COM1, XCHW4, XCHEW2, NGO2, NGO3, NGO4, COM2, MOH1</td>
<td>AMREF ADMINISTRATOR, AMREF RESEARCHER, CHEW, CHV, IOE RESEARCHER, MOH ADMINISTRATOR, OTHER NGO ADMINISTRATOR, HEALTH CARE PROVIDER</td>
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<td>QUALIFICATIONS</td>
<td>EDUCATIONAL BACKGROUND, EXPERIENCE</td>
<td>CHC, FACILITY, OTHER COMMITTEES</td>
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<td>SPACES</td>
<td>KIBERA, MAKUENI, NAIROBI, LONDON</td>
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<td>ACTIVITY</td>
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<td>ACTION DAY, DIALOGUE DAY, EMERGENCY MEETINGS, FORMAL TRAINING, HOUSEHOLD VISITS, MONTHLY MEETINGS, OTHER EVENTS, QUARTERLY MEETINGS</td>
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<td>TRAINING NEEDS, LEGITIMACY, VOLUNTEERISM, GENDER ISSUES, POVERTY ISSUES</td>
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Methodology

Figure 3-2: Baseline Inventory of Sociomaterial Practices in MProject
Theorising the design-reality gap

The concepts of translation provided ways for me to “interview” the HAT as it travelled along its sociomaterial trajectory. I adopted the four moments of translation early on because these concepts were derived from a case study of scientists engaged in a field-based research project (Callon, 1984), and therefore seemed well-suited for delving into the research practices of a community-oriented, academic intervention such as the mProject. The conceptual insights from the four moments of translation provided a framing for both the analysis and the writing of the thesis. Actually, most of the empirical analysis in my research was performed through the practices of writing, much in the manner described by Bardzell and Bardzell in their discussion of the essay as a literary form for HCI scholarship:

> The act of writing itself often serves as the medium of a writer’s thinking; the essayist is not reporting knowledge gained through prior acts, but in some senses is constructing the knowledge in the act of writing. The essay has two key features: It reveals a process of thinking and it is shaped and crafted as a work of writing. The two go hand in hand [...] Thus, rather than reporting a truth already discovered, as presented in the standard scientific report, the essay can instead be seen as ‘enacting the struggle for truth in full view’ [...] (2016, p. 22, authors’ emphasis)

In this sense, I deployed Latour’s notion of the “token” and Callon’s paper on the domestication of scallops to craft an overarching structure for both my analysis and the writing in this ethnography of design practice in ICTD.

I embarked on the analysis of the mProject with only this slight “theoretical rigging” (Kenney, 2015, p. 18): Follow the HAT as an analytic token through Callon’s four moments of translation. This minimal methodological approach “cut the network” that would constitute the object of my investigation and shaped the narrative arc of my praxiography of ICTD design. It is important to note that in adopting these methods, I was trying to demonstrate the sociality of the token, but the token was not the object of my research. I used the token of the HAT as a device, a theoretical tool, to bring into foreground the sociomaterial practices that in turn enacted design practice in ICTD. As discussed earlier, the “object” of investigation in my research was the “practice” of design performed by a yet-to-be determined, heterogeneous group of actors. Rather than providing an account of the HAT artefact per se, my research goal was to describe or “locate” design practice (Suchman, 2002) that was constituted as this analytic token travelled through a larger and more extensive constellation of mProject actors.

As discussed in Chapter 2, classic ANT concepts, such as Latour’s token and Callon’s translation, have been critiqued for being too deterministic, for rendering
accounts of sociomaterial practice that are excessively smooth and devoid of controversy and tension. Admittedly, these early ANT concepts provided useful parameters to constrain the scope of my analysis into a feasible doctoral project and to organise my writing into a coherent, temporally linear narrative. However, these methods did not necessarily preclude the possibility of incorporating more contemporary post-structural approaches from the ANT repertoire. Within each successive moment of translation, the empirical data from the mProject retained its complexity, offering occasions to return to the literature and bring in additional methods related to multiplicity (Mol, 2002), fluidity and mobilities (de Laet & Mol, 2000; Hannam, Sheller, & Urry, 2006; Massey, 1992), as well as recent scholarship in feminist STS (Barad, 2007; Puig de la Bellacasa, 2011; Murphy, 2015).

These post-ANT conceptual tools were added on to my “minimal theoretical rigging” according to unfolding demands of the empirical data, the page constraints of a doctoral thesis, as well as my technical skills and aesthetic sensibilities, which will be further discussed in a later subsection. Here, I emphasise that in keeping with ANT’s origins as a “wild and creative theoretical tradition” (Mol, 2010, p. 254), my methodology for “theory-making” was deliberate and systematic in its iterative and highly discretionary approach. As Law and Singleton assert, “[…] ANT theory is not reified, separate or abstract. It does not pre-exist, waiting to be applied. Instead it is created, recreated, explored and tinkered with in particular research practices” (2013, p. 486). “ANT is best treated as sensibility” they continue, “as a craft or a set of practices that works slowly both on and in the world, as uncertain, as empirically sensitive, as situated, and as passionate because it stays with the trouble” (Ibid., p. 489).

3.4 Praxiography as a multi-sited, connective ethnography of practice

The praxiography of design practice that unfolds in the next five chapters can be viewed as a form of “multi-sited” (Marcus 1995) or “connective” (Hine, 2000) ethnography which departs from traditional approaches to data collection, analysis, and representation. Rather than treating the ethnographic “field” as a bounded physical place, I assert that the “laboratory” of the mProject is better-understood as a contingent, shifting “field of relations” (Olwig & Halstrup, 1997) that extended across multiple sites of knowledge production – from the desk of a London academic in a brick and glass building, to the hands of a Kenyan CHW as she interviewed her patient. In “cutting the network”, the methods of data collection and data analysis described in Sections 3.2 and
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3.3 delineate the “field of relations” that enacted design practice as the object of my research. As such, this praxiography is not about prolonged, sustained physical engagement in a pre-existing local site, containing local people, with local objects. Instead, my research attempts to trace the extended flows and connections between more diverse arrays of people, texts, and objects as they perform culturally meaningful spaces (Leander & McKim, 2003). Such spaces will not necessarily conform to a priori understandings of “study sites” and “study populations”, nor will they necessarily correspond with the typical boundaries that separate sectors, disciplines, the “real” from the “virtual”, the “human” from the “non-human”, the “local” from the “global”, or the “self” from the other.

Classic ethnographic methods that remain contained within given physical spaces – or fixed on certain groups of people – are ill-suited for disentangling the emergent design practices in a multi-disciplinary, globally-distributed, and technologically-mediated ICTD project. As Dirksen, Huizing and Smit assert:

“This traditional ‘focus-on-the-locus’ and ‘synchronized-time’ take on ethnography is in need of revision to better capture the complexities of modern work practices in organizations that are increasingly marked by highly interconnected information resources in the form of technical systems, texts and geographically dispersed people. (2010, p. 1046)

The emergent, hybrid, and far-reaching spaces of ICTD design work test the well-established ethnographic conventions related to the study object, the physical field site, the concept of community, the primacy of face-to-face interaction, the role of artefacts and documents, and the positionality of the ethnographer (Leander & McKim, 2003; Jordan, 2009). Methodological innovations in socio-cultural anthropology (Marcus, 1995; Hine, 2000) have led to “the valorization of methodological bricolage” and have “pushed ethnography to the limits of its classic aesthetic” (Marcus, 2009, p. 181). These contemporary methods have enabled ethnographers to study cultural practices within and across multiple “on-line” and “off-line” spaces. Such methods align well – and often deliberately – with the concepts of actor-network theory (Coiro, Knobel, Lankshear, & Leu, 2014; Landri, 2013; Marcus, 1995), offering alternative approaches to data collection and analysis that remain “agnostic about the ‘real’ existence of places and categories” (Leander & McKim, 2003, p. 63).

Whereas classic “bounded” ethnographies often use images and artefacts as evidence of face-to-face interaction with human research subjects, I adhere closely to the ANT principle of generalised symmetry and treat such objects (including texts, such as
academic publications) not only as evidence of human interaction or contextual background, but as lively actors in their own right. Using the theoretical concepts from ANT, I attempt to weave together a narrative that shows how interview transcripts, health forms, grant documents, policy provisions, user interfaces, academic publications and scholarly theories all participated with humans in enacting design practice across multiple “knowing spaces” (Law, 2017). Through my participant observation, document review, and the text analysis described above, I will explore how these textual artefacts were linked, both with respect to the meaning of their contents, and to their situated contexts of production and consumption (Hine, 2000).

As described in the prior sections, a variety of data sources and analytic strategies were required to trace the trajectory of the HAT through Callon’s four moments of translation. This is consistent with the connective ethnography conducted by Dirkson et al. (2010), who also employed an assortment of data sources and analytic tools to “follow connections between texts, people and objects,” and capture the complexities of “work practices that are in this day and age so inherently more technology-saturated” (p. 1059). The ethnographic methods in this thesis were adapted continually to bring the distributed, heterogeneous sites of design practice into the same frame of study (Marcus, 1995), consistent with calls for “mobile” methods of ethnography that “plot, document, monitor and juxtapose places on the go” (Büscher and Urry, 2009, p. 108). It was by “moving” my ethnographic methods in this way that I was able to be “moved by, and to move with” (Ibid., p. 103) the HAT, resulting in an ethnographic narrative that is “composite, multi-method, mobile” (Marcus, 1995, p. 103).

Hine writes, “the engagement from sustained immersion in a particular place is replaced, in part, by the sensitivity of the ethnographer to mobility across a heterogeneous landscape and the differential engagements which this enables and requires” (2000, p. 61). With these differential engagements, the ethnographer becomes “nomadic”, “distributed”, and “embodied” as she co-constructs an emergent and fluid field of study relations with her study subjects (Landri, 2013, pp. 249-250). These mobile, heterogeneous ethnographic research practices:

[…] exist, actually and conceptually, outside, or as an exception to, the longstanding regulative norms of immersion and participation by the anthropologist mainly on the subjects’ terms in fieldwork. They are neither the literal and figurative space of the subject, nor that of the engaged observer, but a third space. (Marcus, 2013, p. 206)
Rabinow has argued that ethnographic writings are also “social facts” – they too are products of specific sets of discourse and practices (1986). I assert that if the narrative voice of my praxiography is “free and indirect” in its ethnographic style (Sperber, 1981), it is precisely because this voice is situated as part of a larger set of research practices that are themselves mobile, heterogeneous, and relational.

3.5 Researcher positionality

Chiseri-Strater contends that all researchers are positioned in relation to others, by their personal demographics and past experiences, and this positionality “affects the entire ethnographic process; from data collection, theory construction, and methodological understanding, through the creation of the narrative voice and over all writing of the ethnography” (1996, p. 117). Readers of ethnographies should be able to “understand what researchers were positioned to know and what they were not positioned to know and why” (Ibid., p. 116). Rather than proceed with a litany of ascriptive and affiliative personal attributes, I will try to hinge my choices about what to self-disclose around what I think might offer a better understanding of the study informants (human and non-human) and the methodology and ethics of the research context. Given the performative conceptual underpinnings of my research, it seems theoretically consistent, if not instructive, to introduce my positionality from a practice perspective. Upon entry into the mProject, what were the initial knowledge practices that mediated my relations with study participants, both human and non-human?

Let us begin with the methodology. Mol has described praxiography as “empirical philosophy” (2002, p. 1). Having never engaged in the study of philosophy or social theory prior to this doctoral work, I set out to enact the practice of empirical philosophy with an initial knowledge repertoire that largely supported the “empirical” side of this praxiography. That is, in this thesis, it is a close familiarity with the empirical that has helped me arrive at an understanding and appreciation of philosophical concepts in the ANT tradition. I will begin this section by disclosing this familiarity with the empirical, highlighting the way it has shaped my positionality as a researcher. I sketch these insights in hindsight, drawing from events during my research that either surprised and delighted me, or were cause for hesitation or concern.

I begin by describing how my experience in international development facilitated my access to different mProject actors. My work in the 1990’s as a field researcher in a nutritional survey of sharecropper families in Northeast Brazil, as a refugee relief worker
with Save the Children in Hong Kong, and as a member of a Washington DC delegation charged with monitoring the implementation of potable water projects across Haiti, provided me with a useful repertoire of terminology and administrative procedures associated with development projects, multi-lateral funders, NGOs and government ministries. Because of these prior work experiences, I could perceive the sociomaterial linkages between global and national policy-making institutions and local operations; and if the logistical and emotional hardships during my field visit to Kenya were inevitable, they were not completely alien and therefore manageable.

Another set of practices that influenced my relations with mProject participants was my prior training and experience in public health informatics. My graduate education in statistics, epidemiology, and study design, along with my nine years of work experience in information systems, clinical performance measurement and programme evaluation facilitated my interactions with the Kenyan counterparts based at the AMREF headquarters in Nairobi. Several of these individuals were credentialed with Master’s degrees in Public Health, the same academic credential I earned in the United States. I recognised the tools they used, their work sites, their reporting structures, as well as the discourse on performance and evidence and I felt I could empathise with both the challenging and rewarding aspects of their work as public health practitioners.

My prior professional experience also involved close collaborations with primary care providers serving the homeless, pregnant women with HIV, the frail elderly, and other groups of chronically-ill patients. I was surprised at how this work in the clinics and hospitals of New York City and Washington DC facilitated my interactions with some of the Kenyan CHWs and the patients that they served. This “clinical repertoire” provided me with questions that I could ask, ways to create rapport, opportunities for dialogue. I recognised certain aspects of their health care experience – the child health booklets, the crowded and noisy waiting rooms, the compassion fatigue, the antiseptic smell of the labor ward in a remote village clinic. I felt comfortable probing the CHWs about the challenges of delivering care, and about their aspirations for themselves and their communities.

I found this familiarity to be both inspirational and disturbing when placed in the context of the grinding living conditions that these individuals endured. Even if “skilled deliveries” are globally advocated as “best practice”, it troubled me when Makueni women were chastised for not enduring 45 minutes on the back of a moped to give birth in a “skilled health facility”. And I was disheartened when Kibera CHWs would refer to
a wheelbarrow or an aluminum ladder as the “ambulance”. Such instances served as sobering reminders that whatever commonalities I experienced with these study participants would always be offset by the stark disparities in our socio-economic status.

If the practices described above facilitated my access to the mProject, helping me to become an “outsider-within” this mobile learning intervention, they otherwise conflicted with my practices as a researcher studying education and technology. My repertoires related to international development and public health were acquired through work that is often associated with “practitioners” or “study subjects”, as opposed to academic researchers. If my prior training and work experience made it easy to access a research site composed largely of female CHWs and AMREF practitioners in the mProject study setting, it established a disconnect that separated me from the sociomaterial practices of the lead investigators of the project – both male and both supervisors of my doctoral studies. Instead of a researcher, my initial expertise established me as a practitioner with a formal background in the domain of public health, not educational technology. I was familiar early on with the politics, the technical terms, administrative routines, as well as the mundane and often over-looked work associated with the study subjects of the mProject, but I had yet to learn about the theoretical concepts, patterns of activities, and traditions of scholarship associated with the UK practice of academic research on educational technology.

While my background in international development and public health may have been the source of alienation with respect to the investigators of the mProject, my interactions with these same individuals, in their roles as doctoral supervisors, were occasions to establish positive working relationships and assemble my repertoire as both a doctoral student and researcher. The early tutorials, my readings and writing, and the administrative requirements associated with the doctoral degree were opportunities to develop new affinities and shared understandings. As described below, this common experience, developed over the course of two years, eventually facilitated my access into the laboratory life of their mProject, and shaped the formal and informal protocols that we developed to address the ethical considerations of my doctoral research.

3.6 Access to the field

Prior to gaining access to the mProject that was run by my supervisors, I had approached nine different international organisations with my research proposal and had failed to convince them of the benefits of allowing me to conduct my research (refer to
Appendix B for more description). All representatives were highly receptive to the proposition of doctoral research in mobile learning, but they envisioned that I would be introducing mobile phones into their on-going community-based programs, or that I would be conducting an impact evaluation of a mobile phone project that had already been deployed. I did not succeed in conveying how developing ICTD theory would be of value to their operations, and my emergent analytic approach was incompatible with their need for pre-defined “deliverables”.

It was therefore a rare and valuable opportunity to conduct a praxiography of the mProject, although this did require me to continually negotiate my shifting positionality in relation to my supervisors, who were also lead investigators of the intervention. No doubt, “studying up” introduces configurations of power with inherent methodological and ethical consequences (Gusterson, 1997; Nader, 1969), all the more so when doctoral supervisors are implicated as the objects of their students’ research. If unorthodox, my approach is not unprecedented, and my methodology draws from another praxiography of educational technology that was similarly performed by a doctoral student embedded in the research projects of her supervisor (Rimpiläinen, 2012). Irrespective of how and where the empirical data is collected, power asymmetries always exist in the supervisory relationship and influence the way doctoral research is performed (Green, 2005; Manathunga, 2007). In any case, questions as to how these power relations might have compromised the validity of my study are moot, given that the stance of my thesis is ontological rather than epistemological, and I make no claim to a singular reality (Mol, 2002). Rather than seeking to eliminate power imbalances in relation to my supervisors, I attended to them through my research methods and my writing style, modulating perhaps the emancipatory, “critical force of studying up [in order to] also offer the chance to incite new conversations about power” (Gusterson, 1997, p. 117). My efforts to remedy ethical concerns through methodological interventions will be described in more detail in the next subsection.

3.7 Research ethics

The research in this thesis was subject to the review of three separate IRB approval processes. It conformed with the clearances granted to the overall mProject by the ethics committees at UCL Institute of Education and AMREF Health Africa. My study protocol was also granted its own separate ethics approval for student research from the Research Ethics Committee at UCL Institute of Education and follows the BERA Ethical
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Guidelines for Research (2011). Application forms, approved briefing sheets and informed consent forms are included in Appendix C. These documents specify the measures that I took in concert with my doctoral supervisors/mProject principal investigators to ensure that my research was conducted in an ethically responsible manner. This strategy complied with the basic stipulations mandated by all three IRB panels, while adding an additional set of provisions to address ethical issues related to conducting a multi-sited ethnography of design practice. With the exception of the travel to Kenya, my praxiography of the mProject was self-funded.

As discussed earlier, my positionality continually changed in correspondence with the trajectory of the HAT. In moving across different sites of knowledge production to “locate” design practice, I had to continually renegotiate my identity in relation to various study subjects, including my doctoral supervisors, the Kenyan NGO, the CHWs and the patients that they served. Marcus describes the distinct ethical issues associated with multi-sited ethnography:

[O]ne finds oneself with all sorts of cross-cutting and contradictory personal commitments [...] In certain sites, one seems to be working with, and in others one seems to be working against, changing sets of subjects. (1995, p. 113).

As will be described in the following sub-sections, I integrated a range of measures into my data collection, analysis, and writing practices to address the “shifting power valences” that were enacted as I followed the HAT across diverse and geographically-dispersed sites of knowledge production.

3.7.1 Ethics in the collection of data

Guidelines at UCL and AMREF Health Africa both require informed consent before data are collected, guarantees of confidentiality and anonymity for participants, as well as the right of participants to withdraw and have their data removed. To protect the privacy and anonymity of Kenyan study participants, these interviewees were assigned pseudonyms and there are no direct quotations from interviews and meeting transcripts that can be directly attributed to specific individuals. Documents that are quoted directly in this thesis are not confidential and are available in the public domain. Anonymised datasets from the mProject are also available to the research community for additional analysis through the UKDataService Reshare initiative, as specified in the original mProject Case for Support.
While these IRB procedures safeguarded the anonymity of study participants in Kenya, it was not possible to provide the academic researchers (my supervisors) with identical protections. Alternative measures were devised to address ethical issues that arose with respect to those individuals and their practices. For example, the monthly tutorials for my doctoral research served as regular occasions to monitor and negotiate concerns as they arose in relation to my data collection practices. However, as will be discussed below, I attended to the ethical issues of “studying up” more substantively through my methods of data analysis and my writing style, extending considerations of ethics beyond the issues of privacy, anonymity, and informed consent (Beaulieu & Estalella, 2012).

3.7.2 Ethics and data analysis

I have discussed how in following the HAT to study design practice, my aim is to illustrate streams of activities that link humans and non-humans into the socio-technical systems of ICTD projects. In this way, my multi-sited, connective ethnography of practice can be considered a non-representational approach to social research that concerns itself with “the fleeting, viscous, lively, embodied, material, more-than-human, precognitive, non-discursive dimensions of spatially and temporally complex lifeworlds” (Vannini, 2015, p. 318). This is a departure from genres of realist ethnography that seek primarily to represent the intentions or identities of given study subjects and thereby produce case studies that can be generalised to other populations. When incorporating excerpts of interviews and recordings into my ethnographic narrative, I do not assert that these texts are illustrative of general principles or true identities, nor do I claim to “give voice” to various study participants. My narrative seeks to argue instead that such traces relate with each other and with an array of heterogeneous actors that include people, phones, policy, academic papers, as well as actor-network theory and the other concepts assembled into my own “theoretical rigging”. Pursuing this “non-representationalist style” of analysis, I have assigned pseudonyms to the project, the token of my analysis, and to the enlisted actors, not so much to ensure their anonymity (as this is not possible in many cases), as to attempt to disclose and value the contributions of these study participants without “colonising their traces” or making them “fodder for yet more interpretation” (Thrift, 2000, p.213).
Furthermore, in negotiating these multiple sites of knowledge as I bring the relations of design to the foreground, I have endeavored to practice the ethos described by Tsing in her widely-cited study of global connections in Indonesian forestry:

My ethnographic involvement with activists taught me habits of restraint and care: There are lots of things that I will not research or write about. I do not mean that I have white-washed my account, but rather that I have made choices about the kinds of research topics that seem appropriate, and indeed, useful to building a public culture of international respect and collaboration. 2005, p. xii

My methods deliberately “cut” a certain kind of network, not as way of closing controversies or asserting definitive explanations, but to instead explore the relations that enacted this particular network, to examine paths not taken, and to identify some of the novel configurations of practices that are possible within such wicked problems in ICTD projects, where “things can always be other than they are” (Jenkins, 2010). As discussed in the prior chapter, the theoretical foundations of my thesis are ontological, not epistemological. My methodology is meant to intervene on reality, add additional layers – it does not claim the authority to represent it.

3.7.3 Ethics, writing and feminist reflexivity

With this non-representationalist approach incorporated into my methods of analysis, the writing stages of my research assumed important ethical dimensions. As Puig de la Bellacasa asserts, ethical research practices in STS require “attention to the workings and consequences of our ‘semiotic technologies’ – that is, to practices and arts of fabricating meaning with signs, words, ideas, descriptions, theories” (2012, p. 199). This means “paying close attention to how we value the writing that already exists in the field, and how our mediation affects the material gathered and the value of the ethnographer’s contribution” (Beaulieu, 2010, p. 460). Beaulieu describes how ethical writing practices involved making her presence as a researcher more visible, using language deliberately and reflexively, and explicitly acknowledging her relations and responsibilities to the participants in her research (Ibid.).

Accordingly, I used writing practices as a methodological tool to signal my presence as a researcher. Throughout my empirical narrative, I explicate the theoretical concepts that I applied iteratively to cut the network that enacted design practice. As described above, my praxiography “cut a network” and “created a world”, one of many worlds in the fluid and disorderly cosmos described in Chapter 2. As Kenney observes, “to do Science and Technology Studies (STS) research is to participate in the collective
activity of making and unmaking technoscientific worlds” (2015, p. 1). As discussed earlier, praxiography is its own form of participation, its own intervention on reality, and through the HAT, the token of my analysis, I myself became entangled in the mobile learning intervention for CHWs. In this narrative I will not, as Latour suggests, adopt a neutral “infra-language” in an attempt to obscure my positionalities with respect to the rest of the mProject actors. Rather than try to mask this entanglement with deliberately “general” and “banal” discourse that seeks to let “the vocabulary of the actors be heard loud and clear” (Ibid.), I tried to demarcate my presence in the first person with a thick and vivid writing style that serves to constantly remind the reader (and myself), that what this thesis offers is inevitably a personal and partial account of the mProject actor-network.

As stated earlier, Law asserts that the focus on sociomaterial practice in material-semiotic research “means that theory, method, and the empirical get rolled together with social institutions (and sometimes objects)” (2017, p. 32). Given this premise –and the aims of my doctoral research– my thesis will depart from the literary form of the scientific report and instead adopts the conventions of the humanistic essay in HCI (Bardzell & Bardzell, 2016):

Whereas a scientific report is structured to demand consent from its reader (e.g. through its providing of evidence, which is rigourously collected and narrowly interpreted), essays are more likely to demand a thoughtful response, engagement, reflection – but not necessarily (or even likely) agreement. That is, the essay invites us to change how we think about a domain. This does not require proof so much as provocation that is hard to dismiss (even if one is inclined to disagree with it). Ibid. p. 27-28

Whereas scientific reports attempt to establish proof by partitioning prior scholarship, new empirical data and inferences into separate written sections (e.g. introduction, literature review, methods, results, findings, conclusion), STS case studies resemble humanistic essays and assemble prior written work, data and analysis together as “part of the same weave” (Law, 2017, p. 32).

Because the argument in an STS case study is not built according to the more familiar logical structure of the scientific report, I have drawn from writing practices in US legal scholarship to help the reader evaluate the persuasiveness of the claims that are made throughout the chapters that follow. In addition to deploying the signal phrases that precede propositional statements, I have applied the system of citation signals in Table 3-5 to further indicate how I intend my cited material to support the claims of each sentence.
Consistent with approaches to assessing the authority and strength of legal arguments, (cf., *The Bluebook*, 2016; Martin, 2017), these conventions demarcate the relationships between cited sources and the text of my thesis so that the reader is able to: (1) identify the data source or publication that is being referenced; (2) locate the data source or publication; and (3) ascertain how the referenced material relates to the arguments that are developed in thesis.

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Being reflexive and transparent about methods and supporting sources does not simply grant researchers intellectual absolution or administrative clearance to proceed on an individually-charted course of action. Haraway argues for a feminist reflexivity about research methods that goes “beyond self-vision as a cure for self-invisibility” (1997, p. 33), that avoids facile relativisms and that “requires more than acknowledged and self-critical partiality” (1988, p. 585). In adopting Haraway’s version of reflexivity, I affirm the ethico-political dimensions of my research methods and acknowledge my role as a “circumstantial activist” (Marcus, 1995) who continually and deliberately renegotiated her positionality as she traveled across diverse sites of knowledge production. As such, my research practices are non-innocent and implicated into power relations with the collective of actors that constituted design practice in the mProject. I will not attempt to address the ethico-political implications of these relations with a dialogic or polyphonic narrative that would purport to let all “voices” be heard (Marcus, 1997). Instead, I adopt a “free and indirect style” – not to assert a classic god’s eye view from nowhere (Haraway, 1988) – but to assume responsibility for my own, mobile and partial knowledge-making practices. In this spirit, laying bare the details and limits of my research methods should
not be read as a confessional or a disclaimer, but as an invitation and appeal for new critique and additional empirical material – alternative “world-making practices” that directly extend my work in generative and innovative directions.

3.8 Summary

Understanding success and failure in ICTD projects requires new theoretical insights into the contexts of design and use. To generate these insights, I conceptualised design as situated practice and conducted a praxiography of the distributed, heterogeneous, and emergent laboratory life in a mobile learning intervention for Kenyan CHWs. Described as the ethnographic study of practice, Mol likens praxiography to the “materials and methods sections” of scientific papers:

[…] these specify as much as possible about the practices of investigation. They instantiate the recognition that the practices forcing an object to speak are crucial to what may be said about it. (2002, p. 158)

This chapter has specified my own methods and materials for conducting a praxiography: it is in a sense the “methods and materials section” for studying the methods and materials of design practice in the mProject. I have described how classic ANT concepts provide the “minimal theoretical rigging” to embark on my empirical case study: follow the HAT as analytic token through the four moments of translation.

In the next chapter, I embark on my empirical journey with this “minimal equipment” for bringing into view design practice in the mProject. During the first moment of translation, known as problematisation, researchers propose an initial design solution in a grant application that establishes a tenuous alliance of humans and non-humans. This initial configuration of identities and interests sets the stage for the subsequent entanglements of HAT, the token I will follow to show how humans and non-humans participated in design practice. As with any scientific apparatus, my own equipment to describe ICTD design will require adjustments, tinkering, and additional components to improve its sensitivity to the empirical data. As the narrative unfolds into the subsequent chapters, additional post-ANT methods will therefore be added to my “theoretical technology” to “loosen the network” and respond to the unexpected events that emerged during the laboratory life of a research intervention for Kenyan CHWs.
In an ANT-inspired praxiography, an ethnographer’s observations remain fixed on practices, constantly attuned to “the happening of things”, to the performances of an emergent network of socio-material associations, and the enactment of relations between a contingent set of human and non-human actors. As discussed in the prior chapter, there are methods for training the ethnographic gaze to discern and articulate the complexities and dynamics of such practice. These methods can be thought of as the “equipment” that an ethnographer can use to conduct a praxiography of laboratory life.

For my research, I set out with only minimal “theoretical rigging” to conduct this praxiography of ICTD design in the mProject. This consisted of following an analytic token through Callon’s four moments of translation. By the time my “analytic token”, the HAT, enters this narrative of ICTD design, Callon’s first moment of translation has already taken place: UK-based academic researchers have formulated their problematistation. This chapter describes that process. I present the first moment as a set of negotiations that these researchers initiate in relation to several other actors, each with
different identities and numerous, shifting interests. The researchers’ negotiations temporarily converge to fix the initial parameters of a design solution that is proposed in a grant application, reifying a tenuous alliance of different actors and setting the stage for the subsequent entanglements of the HAT that unfold in three subsequent chapters on *interessement*, *enrolment*, and *mobilisation*.

In this chapter on problematisation, I introduce these researchers as *the Academics* and describe their role as “entrepreneurs” in an undertaking to design a mobile learning intervention. I continue with an account of how these entrepreneurs engaged in the *inter-definition of actors*, formulating the design problem and identifying the people and things necessary to arrive at a solution. Section 4.4 explores how the Academics attempted to establish themselves as the *obligatory passage point*, persuading the others that it was in their interests to participate in their plan. The chapter concludes with the culmination of the first moment of translation – the Academics’ problematisation results in the establishment of a provisional “system of alliances, or associations, between entities, thereby defining their identity and what they want” (1984, p. 206).

### 4.1 The Academics

While the principle of generalised symmetry asserts that all actors – be they people or things – have the potential to fuel the dynamics of translation and forge its eventual outcomes, this account of problematisation will be launched by human actors. Beginning this narrative from a human perspective aligns with Callon’s seminal paper that focused on scientists (1984), and is consistent with ANT accounts that opt to “start with heroes or near heroes” (Sørensen, 2010, p. 66), or with the “entrepreneurs” who must “gradually enlist participants […] from a range of locations” in order to achieve their own programmatic goals (Star & Griesemer, 1989, p. 389). Out of the many actors engaged in this particular ICTD project, I single out one set of “entrepreneurs”, the Academics in the mProject, to generate my description of problematisation. This is a deliberate methodological choice, conditioned by the ready access I had to these particular actors, and premised on the observation that it is the Academics who eventually enlist the analytic token – the HAT – that I have previously designated to “cut the network” and shape the narrative trajectory of my research.

Chapters 1 and 2 described how researchers like the Academics have encountered the wicked problem of designing for ICTD projects. This wicked problem can be conceptualised as a controversy, one that may be analytically unpacked using the
concepts and sensibilities of ANT. Controversies in STS involve many distinct actors – scientists, bureaucrats, industrialists, users, and others – each with their own interests, each continually trying to advance different technical solutions, implementation strategies, and applications (Callon, 1981). There is, then, at any given point during translation, “an abundance of problematisations” (Callon, 1980, p. 199), whereby many different “entrepreneurs” from separate social worlds simultaneously attempt to conduct negotiations to promote their own interests (Star & Griesemer, 1989). In situating my analysis of problematisation principally from the position of the Academics, I do not assert the “epistemological primacy” of their practices and perspectives in relation to others (Ibid., p. 389). Problematisation does not generate “pregiven data” corresponding to a “true” baseline state, but is rather presented as a hypothetical formulation that is imposed by a given entrepreneur and eventually weakened, confirmed, or transformed by others as a socio-material assemblage is enacted (Callon, 1984, p. 228). Presenting the Academics’ problematisation is neither an ontological claim on my part about the “real” identities and interests of other actors, nor an evaluative statement about the suitability of the Academics’ strategies.

With these methodological caveats now in place, my narrative of problematisation opens with the Academics as the “entrepreneurs” or “heterogeneous engineers” of a mobile learning intervention in Kenya. I begin by describing how these “heterogeneous engineers” successfully submitted a grant application to the DFID-ESRC Joint Scheme and enlisted several actors to serve as the social and material “bits and parts” of their plan to design and evaluate a mobile learning intervention. This plan is sketched out in the Academics’ grant submission that builds their case for research funding (Table 3-1, mProject documents #5 & #6). The grant submission contains sections entitled Case for Support and Pathways to Impact which provide a basic overview of: (1) the Academics’ definition of the design challenge; (2) the actors that are needed to implement the Academics’ solution; as well as (3) the ways in which such actors are implicated and invested in the Academics’ formulation of the problem.

4.2 The Academics formulate the ICTD design problem

The stated aims of the DFID-ESRC Joint Scheme were to “contribute to a more robust conceptual and empirical basis for development” and “enhance the quality and impact of social science research which contributes to the achievement of the Millennium Development Goals (MDGs)” (ESRC-DFIDa, 2011, p. 2). Ratified more than a decade
earlier by 189 different nations, these eight Millennium Development Goals comprised the backbone of “an unprecedented agreement – among developed countries, developing countries, and international agencies – to work towards a world in which sustaining development and eliminating poverty would have highest priority” (World Bank, 2003, p. 7). The Academics explicitly aligned their grant proposal with ongoing efforts to address the Millennium Development Goals related to health, making specific reference in their Case for Support to “Goal 4: Reducing Childhood Mortality”; “Goal 5: Improving Maternal Health”; and “Goal 6: Combatting HIV/AIDS, Malaria and Other Diseases”. The Academics’ identified a:

serious paucity of research detailing the process by which mobile learning can be embedded within existing primary healthcare structures to lessen CHWs’ exclusion and resulting capability deprivation. (Table 3-1, mProject document #5, Rationale, para. 4)

The Academics further asserted that a research project to demonstrate “the design of mobile applications for improving the supervisor-CHW relationship” and “the use of mobile devices for supervision” (Ibid., Rationale, para. 4) would contribute substantially to the “body of evidence on the effectiveness of mobile-based activities to increase CHWs’ capabilities” (Ibid., Introduction, para. 1).

In the grant application, the Academics outlined the scholarly theories and methodologies that they would use to design and evaluate the mProject for learning with mobile phones. They did not offer expertise in public health to support the CHWs, but were instead researchers in educational and learning technologies. One Academic brought close to five years of project experience researching the novel use of mobile phones for the professional training of veterinarians, doctors, and nurses in the UK, Nigeria, and Kenya. The Academics stated their intention to draw from prior educational research on “mobile learning” and “collaborative knowledge-building”, as well as utilise the “Conversational Framework” (Laurillard, 2009) to design, build, and evaluate mobile learning opportunities for CHWs in Kenya (Table 3-1, mProject document #5, Theoretical Framework, para. 1).

From the outset, there was a strong commitment to closely engage with CHWs. The Academics specified, “PAR [Participatory Action Research] will support our highly collaborative approach to intervention design” (Ibid., Overall approach and methods of data collection, para. 2). In the Case for Support, this heavy emphasis on user participation appeared to be instrumentally motivated – engaging the CHWs in the design
and evaluation process was seen to increase the likelihood that the research project would be deemed successful. For example, when justifying the use of Participatory Action Research, the Academics wrote:

These methodological underpinnings are vital to the project, so as to understand the processes through which supervision takes place, and how this affects CHWs’ subsequent provision of health care access; an intervention that failed to take account of this would fail at the point of implementation because it was not fit for purpose. (Ibid., Overall approach and methods of data collection, para. 2).

Their rationale for adopting Participatory Action Research made specific reference to an academic paper by White, Suchowierska, & Campbell (2004). This medical journal article suggested that user participation was desirable because it:

[…] often increases relevance of research and improves its social validity while maintaining the standards of scientific rigor […] Some benefits of involving participants may include development of more pertinent research questions, user-friendly instruments, acceptable interventions, thorough data analyses, and effective dissemination strategies. Using the PAR [Participatory Action Research] approach could improve the credibility and validity of research, increase utilization and sustainability of research-based programs, and enhance empowerment of consumers. (p. S3)

The Academics’ adoption of Participatory Action Research as the means to achieve project-related ends was similarly melded with aspirations to empower CHWs and the communities they represented. There were normative dimensions to the Academics’ rationale for collaborating so closely with CHWs: though not specifically mentioned in the grant application, subsequent talks and submitted papers by the Academics framed the adoption of Participatory Action Research in terms of social justice (see Table 3-1, mProject document #40). This work makes specific reference to anthropologist-physician Paul Farmer (2005) and his writing on appropriate technology, preferential options for the poor and pragmatic solidarity. What would be considered instrumental to the success of the research project was also therefore viewed as inherently emancipatory for the CHWs.

4.3 The Academics’ inter-definition of the actors

As described earlier, Law and Callon describe problematisation as a process whereby an actor, seeking to advance his own objectives, constructs a simplified cartography of a complex world, a reductionist “interest map” that “attributes relatively stable interests to other actors whilst ignoring the endless complexities in their motives,
aims, and actions as practically unimportant” (1982, p. 617-618). Extending this cartographic metaphor further, it might be said that the Academics, in formulating the design problem and specifying their research methodology, chose their final destination and mode of transport – but certain actors were implicated with those choices. To get to where they wanted to go – to specify the design solution – the Academics had to also identify these actors and understand the terrain that was formed by the diversity and commonalities of their interests. They had to engage in the *inter-definition of the actors* that corresponded to their proposed Participatory Action Research project on mobile learning. Beginning with the mobile phone, this chapter continues with a description of these other actors, followed by an account of how the Academics defined the interests of those actors in relation to their own research objectives.

4.3.1 The mobile phone

In his foundational account of the mechanisms of translation (1984), Callon employs scallops from the St. Brieuc Bay to illustrate the principle of generalised symmetry – this ANT contention that notions of “participation” and “participant” apply to non-humans just as much as they do to humans (Sørensen, 2010). In my narrative of the mProject, the mobile phone assumed the conceptual role that is played by Callon’s molluscs. The mobile phone was the non-human actor that figured prominently (but not exclusively) in the Academic’s plan to train CHWs in Kenya. Just as the fishermen and scientists in Callon’s account are assembled together by the prospect of increasing the production of scallops, the actors in this story were likewise seduced by the promises of a non-human actor – in this case, the mobile phone. Without scallops or mobile phones, narratives of fishermen, CHWs, or research scientists would have unfolded in an entirely different fashion, if indeed they unfolded at all.

The agency that Callon attributes to scallops, and by extension, to objects such as mobile phones, is not to be conflated with anthropomorphism:

> The reasons for the conduct of scallops – whether these lie in their genes, in divinely ordained schemes or anything else – matter little! *The only thing that counts is the definition of their conduct by the various actors identified.* (1984, p. 228, italics mine)

Accordingly, the ANT principle of generalised symmetry seeks “to pluralize what it means to speak of agency,” not by imputing intentionality, free-will, or responsibility to machines, rocks, seat belts, and other non-humans, nor by asserting that such “objects”
exert causality in a deterministic manner (Sayes, 2014, p. 141). Instead, the plurality in this conceptualisation of agency is derived from Latour’s proposition that:

[…] there might exist many metaphysical shades between full causality and sheer inexistence. In addition to “determining” and serving as a “back-drop for human action”; things might authorize, allow, afford, encourage, permit, suggest, influence, block, render possible, forbid, and so on. (2005, p. 72)

In the framework of my research, the capacity of non-humans such as mobile phones to participate are, therefore, expressed as a function of “the retinue of relations in which it is entangled” (Adams & Thompson, 2011, p. 737).

In relation to the funding agencies, for instance, the mobile phone acted as an object of research, something to be analysed using the methods of the social sciences. Citing innovations such as electronic financial services and the use of social media for political mobilisation, as well as emerging concerns about technology divides and the failures of information security, funders asserted that growing global access to ICTs created “the potential to impact on development in both positive and negative ways” – they identified agential properties of ICTs that potentially advanced the Millennium Development Goals yet remained poorly understood, and therefore issued a call for research proposals to explore “the full impact of ICTs across different groups of people” (ESRC-DFIDa, 2011, p. 7).

The funders proposed eight over-arching research questions under the theme of “ICT as a resource in the reduction of poverty” (Ibid., p.6). Three of these questions corresponded explicitly to the Academics’ areas of expertise in mobile educational technology for health providers:

- What are the links between ICT and socio-economic development and how are these changing?
- Does ICT have the potential to promote development in a more equitable way, and if so how can this potential be enhanced?
- How can ICT improve the access of poor communities to health care, education and other areas of social service provision? How can ICT facilitate self care/care at home?

The Academics responded with a proposal to build upon “recent advances in mHealth (e.g. http://www.mhealthalliance.org)” and the academic literature on the use of mobile phones for learning (Table 3-1, mProject document #5, Rationale, para. 3). They proposed to address the need for more research on ICTs in development by answering the following research question:
How can the participatory development of a practice-based mobile learning intervention for CHWs and their supervisors improve the health care access of communities?

The Academics enlisted the mobile phone as an object of research in the disciplinary field of educational technology.

Enlisting the participation of the mobile phone not only responded to the priorities of the Joint-Scheme funding agencies, but also resonated with a clarion call urging the global health sector to “harness the power of mobile technology” in support of health programmes around the world (Vital Wave Consulting, 2009, p.22). What was this “power of mobile technology” exactly? What did the device “do” to make itself so appealing to global health actors? Academic review papers and institutional material (e.g. Vital Wave Consulting, 2009; Free, Phillips, Watson, Galli, Felix, Edwards, Patel, & Haines, 2013; Callan, Miller, Sithole, Dagget, & Altman, 2011; Källander, Tibenderana, Akpogheneta, Strachan, Hill, ten Ashbroek, Conteh, Kirkwood, & Meek, 2013) alluded to four distinct but inter-related performances of the mobile that established its initial appeal: (1) It provided voice communication; (2) It stored and received data; (3) It was widely popular and available to diverse users in developing countries; and (4) It was portable.

There were great expectations in the global health community when it claimed, “this explosion of mobile phone usage has the potential to improve health service delivery on a massive scale” (Vital Wave Consulting, 2009, p. 7). The global health sector sought to enlist the mobile phone as a tool to facilitate the widespread deployment of six types of mHealth services: (1) community education and awareness; (2) remote data collection; (3) remote monitoring; (4) disease and epidemic outbreak tracking; (5) diagnostic and treatment support; and (6) communication and training for healthcare workers (Vital Wave Consulting, 2009; Labrique, Vasudevan, Kochi, Fabricant, & Mehl, 2013). Several on-going projects designed specifically for CHW users illustrated how attributes of the mobile phone – its declining prices and increasing data storage and transfer capacities, as well its enhanced computing power – could be directed towards activities to strengthen the health system (Derenzi, Borriello, Jackson, Kumar, Parikh, Virk, & Lesh, 2011). It was suggested that a mobile phone would enable CHWs to receive and send “rich forms of data” beyond SMS to include “pictures, audio, video, or geoposition information”, allowing them to better communicate with patients and other providers, as well as engage more effectively in health surveillance and reporting activities (Ibid., p. 407).
These widely-adopted devices were also implicated in strategies to rapidly train the roughly 5 million CHWs that were needed worldwide to achieve the Millennium Development Goals for health (see Callan et al., 2011). A first wave of pilot mobile learning projects in a variety of developing country settings established a proof of concept, demonstrating how these devices could “enable workers to learn new treatment procedures, test their knowledge after training courses, take certification exams remotely, look up information in medical reference publications, and trade ideas on crucial diagnostic and treatment decisions” (Ibid., p. 6-7). Drawing from these early projects, a report concluded that there was a wealth of existing content for health worker training and learning, but in order to enlist the participation of the mobile phone successfully, this training material needed to be made “suitable for mobile applications” (Ibid. p. 30). For these actors in the global health sector, the design problem involved harnessing and coaxing the mobile phone to “deliver content” effectively and efficiently so as to train and support CHWs in their roles as workers in the health system.

In the mProject, the Academics’ problematisation of mobile learning differed from that of the global health sector, aligning more with the educational researchers who had also been intrigued with what a mobile phone “does.” They too had been drawn to the way it enabled voice communication, to its capacity to store and receive data, and to the manner in which it captivated so many users, accompanying them anytime and anywhere (see Looi et al., 2010). These scholars wished to research how such hand-held devices might be marshaled for the purpose of teaching and learning in a “rapidly-evolving world” (Sharples, 2000, p. 177), both inside and outside of the classroom (e.g., Roschelle & Pea, 2002; Traxler, 2007). Their track record with hand-held computing devices extended back to the 1980s, predating the mobile learning activities in the global health community, but this work had been focused on learners in industrialised country settings (e.g., Kukulska-Hulme, Sharples, Milrad, Arnedillo-Sanchez, & Vavoula, 2009).

Mobile devices appealed especially to educational researchers who studied in the field of lifelong learning. Lifelong learning is viewed as fundamentally collaborative instead of competitive, taking place not only in classrooms, but also in the workplace, at home, and at play (Sharples, 2000). This is a research domain that asserts:

 [...] it is not feasible to equip learners at school, college or university with all the knowledge and skills they need to prosper throughout their lifetimes. Therefore, people will need continually to enhance their knowledge and skills, in order to address immediate problems and to participate in a process of continuous vocational and professional development. The new educational
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...imperative is to empower people to manage their own learning in a variety of contexts throughout their lifetimes. (Ibid., p. 178)

The premise was that to empower learners, mobile devices would need to be:

- **highly portable**, so that they can be available wherever the user needs to learn;
- **individual**, adapting to the learner’s abilities, knowledge and learning styles and designed to support personal learning, rather than general office work;
- **unobtrusive**, so that the learner can capture situations and retrieve knowledge without the technology obtruding on the situation;
- **available** anywhere, to enable communication with teachers, experts and peers;
- **adaptable** to the context of learning and the learner's evolving skills and knowledge;
- **persistent**, to manage learning throughout a lifetime, so that the learner's personal accumulation of resources and knowledge will be immediately accessible despite changes in technology;
- **useful**, suited to everyday needs for communication, reference, work and learning;
- **easy to use** by people with no previous experience of the technology.

(Ibid., p. 178-179)

These scholars had explored how “features” such as data storage, processor speed, interface design, battery life, and connectivity – attributes emanating from material constellations of metal, fiberglass, wire, and plastic – might offer novel approaches in informal workplace learning that alter “the balance between training and performance support” (Traxler, 2007, p. 5). In this way, what worked as “content” for a mobile learning intervention was not necessarily limited to curricula, training manuals, and lesson plans typically delivered in a classroom, but could also include job aids that provided “just-in-time knowledge and information to help individuals with tasks by directing, guiding, and enhancing performance” (Florez-Arango et al., 2011, p. 131).

These educational scholars further suspected that what mobile devices could actually “do” in the realm of learning and teaching extended beyond delivering educational content (see Roschelle & Pea, 2002). They believed the portability of the mobile phone could “support new learning activities that go beyond traditional classroom practices,” challenging “views of formal education as the transmission or construction of knowledge within constraints set by a curriculum” (Kukulska-Hulme et al. 2009. p.9).

There was great interest in studying how the introduction of mobile phones altered learning itself, rather than understanding how the technology helped or hindered the achievement of identified learning objectives.

The Academics brought this educational understanding to their problematisation of mobile learning for Kenyan CHWs. In their Case for Support, they enlisted the mobile
phone as an object of research in educational technology (Table 3-1, mProject document #5). They knew that the mobile phone in Kenya could provide voice communication, that it stored and received data, that it was very popular and highly portable. They suspected that the mobile phone would support learning and supervision of CHWs, but unlike their colleagues in the global health sector, they were unwilling to specify ex ante the manner in which they expected such changes to occur. In their view, what the mobile phone should actually “do”, how it participated in relation to training and supervision, could not be determined until it fell into the hands of another set of actors, the CHWs, who also had to be enlisted by the Academics. The CHWs had to be convinced to “embed” the mobile phones into their professional activities. Only then would it be possible for the Academics to determine the extent to which the mobile phone was highly portable, individual, unobtrusive, available, adaptable, persistent, useful, and easy to use, so as to participate in empowering CHWs as learners in their role as health cadres. Only then could the Academics answer their research question and help build a more robust conceptual and empirical basis for international development, and the achievement of the Millennium Development Goals.

4.3.2 The CHWs

CHWs were considered key players in one the several “flagship projects” that made up Kenya’s Vision 2030, a comprehensive government blueprint of economic, political, and social reforms directed at transforming the poverty-ridden nation into a middle-income economy (Oyore, 2010). A Ministry of Health policy document called the Community Health Strategy stipulated how these volunteer health workers were to support the fragile national health system as it struggled with the “growing demand for care, in the face of deepening poverty and dwindling resources” (Ministry of Health, 2006, p.1). Policymakers asserted that because of their dual and overlapping roles in both the community and the formal health system, CHWs were uniquely positioned to serve as agents of social and health change (see Perry & Crigler, 2014; Naimoli, Frymus, Quain, & Roseman, 2012). In publications related to CHWs, the metaphor of a “link” or a “lynchpin” was often employed in reference to these individuals (e.g., McCollum, Otisu, Mireku, Theobald, Koning, Hussein, & Taegtmeyer, 2015; Perez & Martinez, 2008): it was envisioned that by delivering locally-based services such as household visits, health campaigns, data collection, and patient referrals, CHWs would succeed in connecting their local communities to the formal health system.
The World Health Organisation estimated a global shortage of 4.3 million health workers and strongly advocated for the wide-scale training and support of CHWs to alleviate what was broadly viewed as a human resource crisis (World Health Organisation, 2006). Because gaps in the global health workforce were considered a key barrier to achieving the Millennium Development Goals, large scale national CHW programs were strongly endorsed by global and national policy-makers (see Global Health Workforce Alliance, 2010; Tulenko et al., 2013). Accompanying this resurgence of policy interest in CHW programs were calls for innovative and evidence-based strategies to recruit, train, motivate, and retain these health workers in order to improve their delivery of health services (e.g., Rowe, de Savigny, Lanata, & Victora, 2005; Brunie, Wamala-Mucheri, Otterness, Akol, Chen, Bufumbo, & Weaver, 2014; Haines et al., 2007; Raven, Akweongo, Baba, Baine, Sall, Buzuzi, & Martineau, 2015).

The Academics cited a policy document stating that there was evidence that CHWs were capable of performing basic but essential healthcare procedures, but that: “they do not consistently provide services likely to have substantial health impact, and the quality of services is sometimes poor” (Lehmann & Sanders, 2007, p. v). These shortcomings were attributed to: (1) factors related to “capacity building” that included recruitment and training; (2) “motivational considerations” related to financial and non-monetary incentives; and (3) aspects of the “working environment” such as workload, adequate supplies and equipment, respect from colleagues and the community, as well as supportive supervision (Jaskiewicz & Tulenko, 2012). The Academics opted to direct their efforts in educational technology towards improving the supervisory relationship between CHWs and their supervisors, as part of creating what was referred to as a more “enabling work environment” (Ibid., p. 3).

To justify this focus on supervision, the Academics’ Case for Support (Table 3-1, mProject document #5) cited a technical report claiming that strong supportive supervision was one of the key approaches to improving the “quality of health care and the performance of health care providers,” particularly in developing countries (Marquez & Kean, 2002, p. 3). To “empower health providers to monitor and improve their own performance,” this vision of effective supervision focused on continuous communication, problem-solving, and teamwork that:

- occurs in multiple places: on the job, both formally and informally; in one-on-one meetings; in peer discussions; in meetings outside the work site’ and when health workers review their own performance against standards. (Ibid., p. 1)
The Academics claimed that “supervision and peer support has proved difficult to design, organize and implement, especially for CHWs in inaccessible areas” due to travel considerations, poorly defined supervisory activities, and competing job demands on the supervisor (Table 3-1, mProject document #5, Rationale, para. 2).

The Community Health Strategy for Kenya allocated one Community Health Extension Worker (CHEW) to supervise and support every twenty-five CHWs. These salaried, facility-based health professionals were to serve as “coaches” for the CHWs and “provide continuing training […] through demonstration and instruction based on immediate learning needs” (Ministry of Health, 2006, pp. 9–10). In practice, interaction between CHWs and their supervisors was reportedly sporadic and supervisors had not received the Ministry guidelines and protocols on supervision as expected; there were no “supportive supervision checklist indicators” or other supervision tools available (Mireku, Kiruki, McCollum, Taegtmeyer, De Koning, & Otiso, 2014). The Academics contended that barriers to effective supervision – the geographic distances, the heavy workloads, the cost of transport, the time constraints – as well as poorly-defined supervisory structures often left the CHWs feeling “isolated from their supervisor and the primary care system in general, meaning that their problems often go unaddressed” (Table 3-1, mProject document #5, Rationale, para. 2). The Academics believed that CHWs wanted better supervision from their CHEWs and would therefore agree to embed the mobile phone into their work practices. They enlisted the CHWs to participate as the learners in their mobile learning research project, anticipating that these individuals would agree to participate in their plan as learners not only because they wished to improve their performance as health workers, but also because they too were drawn to the possibilities presented by the mobile phone. At this point, the Academics did not posit any other factors that would motivate the CHWs to participate as learners.

4.3.3 The Kenyan NGO

Prior to the mProject, the Academics had not worked closely with CHWs in Kenya. To apply the Participatory Action Research methodology, the Academics required a local intermediary with experience and relationships to the Kenyan CHWs. There was a need for others to “act as the critical bridge between the research project staff and Community Health Workers” (Table 3-1, mProject document #12, para. 1). The Academics’ idea for the mobile learning intervention in Kenya was developed in concert with representatives of AMREF Health Africa, a well-established NGO with headquarters
in Nairobi, referred to henceforth as the Kenyan NGO. It was a series of face-to-face meetings in London with these Kenyan development administrators that prompted the Academics to write the Joint Scheme grant proposal, when it was agreed that a shared interest in mobile phones and distance education for health workers would lead to mutually beneficial work.

The representatives that were named in the Academics’ grant submission were based in the Directorate of Capacity Building within this large Kenyan NGO. The Academics looked to these NGO representatives to connect their UK-based research team to the Kenyan CHWs and their communities, as well as to Ministry stakeholders. In the grant application, the Academics named certain individuals from the Kenyan NGO as Co-Principal Investigators of the mProject, and the Case for Support highlighted the Kenyan NGO’s “long-standing networks” that would provide “access to communities and policymakers” (Table 3-1, mProject document #5, Implementation Strategy, para. 1). The Kenyan NGO had gained recognition in the global health sector through a widely-replicated initiative that utilised computer workstations to train and credential thousands of Kenyan nurses in 110 e-Learning centers across the country. As an extension to its computer-based e-Learning programme, the Kenyan NGO had begun to investigate the use of mobile devices in its training operations for CHWs. The Academics’ mProject was part of a growing portfolio of Kenyan NGO “mHealth learning” initiatives which also included a larger, high profile CHW training effort sponsored by a local telecommunications operator and a global private consulting firm. Through its corporate social responsibility program, this consulting firm had been the major sponsor of the highly-recognized e-Learning centers for nurses. Together with the Dutch Lottery Fund, the firm had also agreed to co-finance a new Kenyan NGO m-learning project for nurses and midwives in Kenya, Tanzania, and Uganda.

As an actor in the global health sector, the Kenyan NGO positioned itself strategically as an African-based organization with strong ties that began at the local level and spanned the entire international development arena. In one of its institutional publications, readily identifiable by its bold, black and red page layout, it asserted:

“Much of [our] credibility with local communities and African governments stems from the relationship and trust that the organisation has built over the past 54 years. [Our organisation] learns from, influences and partners with communities and community organisations; local and national governments as well as ministries of health; national and international NGOs and networks; global, regional institutions and donors to build long-term relationships and to
ensure solutions are holistic and address the breadth of the communities’ health needs.” (Table 3-1, mProject document #3, p. 12)

Relations with government, international donors, and the private sector were said to be grounded in an organisational commitment to local actors, affirming that the “power to transform Africa’s health lies within its communities” (Ibid., p. 12). Combined with an extensive network of development partnerships, this local engagement was viewed as part of the Kenyan NGO’s “specialised approach” to achieving its vision of “lasting health change in Africa where communities have the knowledge, skills, and means to maintain good health and break the cycle of poor health and poverty” (Ibid.). The stated organizational mission of the Kenyan NGO was:

to ensure that every African can enjoy the right to good health by helping to create vibrant networks of informed communities that work with empowered health care providers in strong health systems.

Its organizational priorities were outlined in a strategic plan known as Strategy 2007-2017 (Table 3-1, mProject document #2), and were to be implemented in accordance with the directives of a corporate business plan entitled *Transforming communities from within by improving the health of women and children* (Table 3-1, mProject document #4). This business plan focused on strengthening three “health systems building blocks” in order to improve the health of women and children. These building blocks included: (1) Human Resources for Health, (2) Community Systems Strengthening and (3) Health Management Information Systems, with a focus on “evidence-based advocacy, operational research and policy change” (Ibid., p. 5).

The Kenyan NGO’s strategic plan was also linked to a “strong component of community empowerment”. Having recognised that gaps in community participation “persist in areas such as programme design, monitoring and evaluation, and mutual accountability,” the strategic plan called for the following “shifts”:

• Starting from what exists within communities: [Our organisation] must stop going into communities with its own set agenda. Instead, […] projects and programmes must be ‘community demand-driven’.

• Understanding the communities holistically: [Our organisation] must first study communities and be responsive to what has been learned.

• Working with communities to jointly undertake needs assessment, health systems research and monitoring and evaluation: The use of community resources and social capital will be critically important.
• Adding value to community structures and systems for greater institutional strength and sustainability

• Monitoring and measuring the impact of interventions with the communities (Table 3-1, mProject document #7)

It was envisioned that these efforts would help place “grassroots” people (communities) at the center of development,” such that “communities would cease to be passive beneficiaries of change and instead become drivers of that change” (Ibid.).

In their dual roles as health cadres and members of the community, CHWs played a pivotal role in this strategy for community empowerment – the Kenyan NGO also released a position paper claiming that CHW programmes were “vulnerable unless they are driven, owned by and firmly embedded in the communities themselves” (Table 3-1, mProject document #1). This document re-affirmed the key role that these volunteers played in advancing Millennium Development Goals 4, 5, and 6, as well as the need for large-scale health programmes to alleviate the health worker crisis. In alignment with the Academics’ research proposal, the Kenyan NGO position paper further stated, “CHWs cannot be stuck in the field and left on their own to work without supervisory and support services […] supervision capacity has to be built, credited and rewarded” (Ibid.). It further advocated that “Community Health Workers are carefully selected, appropriately trained, regularly receive refresher courses and – very importantly – are adequately supervised and continuously supported.”

With these organisational imperatives and a long track record of rolling out distance learning programs, the Academic anticipated that the Kenyan NGO would serve as an effective local intermediary and would facilitate access to the local CHWs. The Academics were able to enlist the Kenyan NGO based on their shared interest in another key actor in their research plan: the mobile phone itself. The Kenyan NGO’s position paper on CHWs stated:

The CHW’s most important tool should be his or her phone. The mobile phone can call the ambulance, get advice from a nurse in the clinic, or access a "smart" SMS system to retrieve patient information, get advice (Table 3-1, document #1)

Like the Academics, the NGO counterpart was intrigued with the potential of using mobile phones to supervise and thereby empower CHWs as health care providers in a struggling national health system.
4.3.4 **Partitioning reality into policy, practice, and research**

The Academics’ identified the actors – the mobile phone, the CHWs, and the Kenyan NGO – that would be enlisted to respond to the Call Specification of the ESRC-DFID Joint Scheme. To investigate “ICT as a resource in the reduction of poverty” (ESRC-DFID, 2011a, p. 6), the Academics propose to answer the following research question:

How can the participatory development of a practice-based mobile learning intervention for CHWs and their supervisors improve the health care access of communities?

There were several sub-questions to explore as part of answering this research question (Appendix D). In posing these questions, the Academics responded to the call for research on ICTs and poverty reduction in a way that capitalised on their expertise in mobile learning, while ensuring that the scope of the proposed work reflected the size of their requested project budget.

This specification of a design problem, along with a set of affiliated actors, emerged out of the process that Callon has called the “inter-definition of actors” (1984). In this process the entrepreneurs demarcate their area of investigation in relation to: 1) the other areas of uncertainty that would be left unanalysed; and 2) the areas of certainty that they consider “irrefutable and firmly established” and therefore also remain unanalysed (Callon, 1980, pp. 206). Accordingly, the Academics’ partitioned the field of ICTD into what Callon describes as a particular “construction of reality” which delineates “scientific, technical, and economic,” defines the “links between machines and scientific phenomena,” and differentiates policy, research, and practice (Ibid., pp. 206–207). This apportionment is illustrated in Figure 4-1 which presents the Academics’ inter-definition of the actors for their research plan to design, implement, and evaluate a mobile learning intervention for Kenyan CHWs and their supervisors.

Figure 4-1 illustrates how the envisioned performances of the implicated actors would take place in three different domains by Callon (1980), corresponding to the areas of: (1) policy, (2) research/science, and (3) practice. For the Academics, the policy domain was a region of certainty. These entrepreneurs accepted the assertion that the eradication of global poverty could be realised through the provision of health care, as operationalised by Millennium Development Goals 4, 5, and 6. They also accepted the claims that the advancement of those Goals had been hindered by shortages of trained health providers, and that CHW programmes could address those gaps in the workforce.
Momentum in the \textit{policy} domain created funding opportunities for the Academics to research the use of mobile phones as a resource for poverty reduction: the mobile phone was therefore an actor that occupied space in both the \textit{policy} sphere and in the domain of \textit{research/science} related to ICTD.

The participation of the Academics, on the other hand, rested entirely within the realm of the \textit{research/science} domain, where the young discipline of ICTD constituted a region of uncertainty for these entrepreneurs. To carve out the terrain of their investigation, the Academics “objectified” this zone of the unknown. According to Callon, this necessarily “involves making choices, imposing associations, deductions and consequently leaving empty spaces, laying aside questions without a reply” (Ibid., p. 207). These deliberations are indicated by the solid arrows in Figure 4-1, which trace the Academics’ formulation of the design problem and the positioning of enlisted actors in relation to unexamined areas of uncertainty, as well as areas of certainty that remained unchallenged. Consistent with the Academics’ backgrounds in educational technology, the aim of their research plan was to engage the participation of the mobile phone in order to support the communication and training of health workers, leaving other potential health system functions, such as remote data collection and diagnostic treatment and support, outside the scope of the study. Furthermore, the Academics’ theoretical grounding in mobile learning and educational technology led them to bypass potential applications in m-health education that corresponded to formal learning scenarios, dismissing the potential of providing medical references and delivering remote certification exams in favour of applications that promoted peer learning and other yet-to-be defined approaches to informal, workplace learning.

This interest in workplace learning brought the proposed research into the domain of \textit{practice} shown in Figure 4-1, where the Academics applied their theoretical background in mobile learning research to the health care setting in Kenya. This domain of \textit{practice} comprised another area of uncertainty that was to be partially incorporated into the terrain of the Academics’ research investigation. Their research focus on peer learning and other new, unidentified forms of informal education aligned specifically with the provision of supportive supervision for CHWs, as part of the Kenyan NGO’s field operations in Human Resources for Health. The Academics’ hypothesised that by promoting the practice of supportive supervision, a mobile learning intervention could create a more enabling work environment for CHWs, enhancing their work practices in
Figure 4.1: Identification of the actors by the academics
order to empower them in their dual roles as health providers and community leaders. This interest in workplace learning brought the proposed research into the domain of practice shown in Figure 4-1, where the Academics applied their theoretical background in mobile learning research to the health care setting in Kenya. This domain of practice comprised another area of uncertainty that was to be partially incorporated into the terrain of the Academics’ research investigation. Their research focus on peer learning and other new, unidentified forms of informal education aligned specifically with the provision of supportive supervision for CHWs, as part of the Kenyan NGO’s field operations in Human Resources for Health. The Academics’ hypothesised that by promoting the practice of supportive supervision, a mobile learning intervention could create a more enabling work environment for CHWs, enhancing their work practices in order to empower them in their dual roles as health providers and community leaders.

In the domain of practice, largely occupied by the activities of the Kenyan NGO and the CHWs, the research proposed by the Academics again deliberately left certain activities out of their formulation of design problem. Their plan focused largely on supportive supervision, and did not explore other aspects of Human Resources for Health, such as recruitment, incentives, and adequate supplies and equipment aimed at capacity building and CHW motivation; and the Academics’ considered that the NGO’s remaining core activities, namely Community Systems Strengthening and Health Management Information Systems, were not directly relevant to their research goals and these “health system building blocks” are therefore not shown in Figure 4-1.

4.4 The Academics become an obligatory point of passage

Problematisation is comprised of a “double movement”, involving both the inter-definition of actors and the establishment of the entrepreneur as an obligatory point of passage through which all other actors must pass (Callon, 1984, p. 204). My account of the inter-definition of actors in the previous section described how the Academics identified the set of entities that were implicated in their research plan, and how positioning these entities in domains of policy, research/science, and practice generated certain claims about identities and relationships between mobile phones, CHWs and Kenyan NGO. In this section, I present the next dimension of the first moment of translation, the obligatory passage point, exploring how the Academics defined the identities and relationships of the enlisted actors more specifically in relation to the
mProject, creating an internal logic that made the interests of each actor seem ineluctably aligned with a decision to participate in their mobile learning research intervention.

To investigate how the entrepreneurs in this ANT narrative approached this second facet of problematisation – to reconstruct the Academics’ formulation of what each actor stood to gain in knowing the answer to the mProject research question, it is instructive to revisit the “Pathways to Impact” section (Table 3-1, mProject document #6) of the Academics’ successful Joint Scheme grant submission. Here, the funding agencies required grant applicants to answer three questions about their projects: (1) “Who will benefit from the research?” (2) “How will they benefit from the research?” and (3) “What will be done to ensure that they will have the opportunity to benefit from the research?” (ESRC-DFID, 2011b., p. 5-6). The Academics’ response to these questions served as the basis with which to construct Figure 4-2 illustrating how the interests of the Kenyan NGO, the mobile phone, and the CHW were operationalised in order to make our entrepreneurs, and their research project, seem “indispensable” in addressing those interests.

The Academics considered the CHWs to be one of the “direct beneficiaries” of their research project, stating in the Pathways to Impact submission that these actors “will benefit from increased communication with their supervisors thus improving their integration with the local primary healthcare system” (Table 3-1, mProject document #6, How will they benefit?, para. 2). They believed that the CHWs sought better supervisory support to develop knowledge and skills that would improve their performance in the health system and empower them in their role as health cadres. These entrepreneurs expected that the CHWs would value the opportunity to have a mobile phone that provided them with “a pedagogically rich” learning experience that would feature “a useful mobile portfolio of their practice”, easily accessible reference material, and the ability to share practice-related questions and resources with their colleagues (Ibid.). In this document, they further claimed that by providing a forum for genuine collaboration, their implementation of the Participatory Action Research approach would ensure that the design of the mobile intervention ultimately reflected the interests of the CHWs, serving as another avenue to empower these volunteer cadres in the health system.

Like the Academics, the Kenyan NGO also expressed the desire to empower CHWs (refer to Section 4.3.3). Its organizational imperatives to partner with the communities it served were highly compatible with the Participatory Action Research approach described in the Academics’ Case for Support. The Kenyan NGO was also
named as a direct beneficiary in the Academics’ research plan (Table 3-1, mProject document #6). In the grant application, the Academics noted that the Kenyan NGO had implemented a highly regarded e-learning programme to train and credential thousands of nurses in Sub-Saharan Africa, and that it wished to build on this reputation by adopting mobile phones to train and supervise roughly 2000 CHWs in Kenya over two years. When the Academics prepared their grant proposal, the Kenyan NGO was just beginning to roll out its mobile learning programmes for CHWs. The Academics anticipated that the Kenyan NGO’s efforts would be strengthened – if the organisation supplemented its experience in Human Resources for Health with the expertise that the Academics brought from the field of educational technology. They expected the research project to benefit the Kenyan NGO by providing a local, “grounded dataset” that would include “detailed information about the nature and frequency of the two-way interaction between CHWs and their supervisors,” as well as the “evidence-base of how CHW service delivery is improved by the intervention” (Ibid., para. 1). They further claimed that the mProject would provide the Kenyan NGO with the “specifics of on-the-ground support structures needed”
to implement the organisation’s other mobile learning initiatives (Ibid.). Finally, the Academics stated their belief that the operational experience that would be gained in running this project, as well as the data it generated, would position the Kenyan NGO to provide valuable public policy input on the integration of mobile tools into CHW training programmes across the nation.

While it is relatively straightforward to concede that Callon’s French scallops might be driven by some Darwinian forces to “perpetuate themselves”, a few more analytic maneouevres are required to discern how our Academics viewed the “goals and desires” of a compelling, but non-living entity that is the mobile phone. To begin, it was evident that the Academics’ plan would not work without the cooperation of the mobile phone. The device’s technological features, cost, and connectivity placed constraints on how any eventual application would perform, and shaped the way in which the mobile application would be embedded into the practices of the CHWs and the Kenyan NGO. The Academics express, albeit indirectly, certain aspirations for their research project when stating their intention to draw from the Kenyan NGO’s experience and:

[…] policy expertise in developing their nurse training eLearning programme in a public-private partnership with [a global consulting firm], the Nursing Council of Kenya and the MOPHS and then passing it over to the Nursing Council to scale-up and run independently. (Ibid., Impact through engagement and communication, para. 1)

The Academics refrained from pre-defining the desired educational or health-related outcomes of the mobile learning intervention – their adherence to the Participatory Action Research methodology ensured that this remained the purview of the CHWs. But this stated intention suggested that whatever the specific outcomes, the Academics shared with their ICTD colleagues the desire to develop an intervention that generated socio-economic development in a sustainable and scalable manner. If the mobile phone was to propagate along those lines, if it was to become a viable tool for addressing the health-related Millennium Development Goals and advancing the eradication of poverty, it would have to host an application for whatever intervention was proposed by the CHWs in the context of the mProject.

In this way, the Academics made the case that if the CHWs wished to receive better supervisory support and advance professionally, if the Kenyan NGO wished to expand its capacity to train and supervise health workers with mobile phones, if the mobile was to become a sustainable and scalable tool to advance the Millennium Development Goals, then they would all have to know the answer to the Academics’
research question: “How can the participatory development of a practice-based mobile learning intervention for CHWs and their supervisors improve the health care access of communities?” – and they would all have to recognise that it was in their best interests to associate with each other in order to answer that question.

When the Academics prepared the grant application, they addressed only one obstacle that interfered with the enlisted actors’ ability to achieve their interests: funding. At this early stage of translation, they had not explored the other factors that could potentially interfere with the Kenyan NGO’s ability to expand its m-learning capacity, with the mobile phone’s ability to host a sustainable and scalable learning application, or with the CHWs ability to benefit from supportive supervision. These issues were research questions to be addressed once the mProject had begun.

At this point, the Academics encountered little resistance from the enlisted actors, but the barriers to participating in the research plan were relatively low when the grant proposal was written. The only engagement required of the Kenyan NGO at this stage was an organisational commitment to participate were the grant to be funded; and for the Academics, the participation of the CHWs and mobile phones was implicit in the involvement of the Kenyan NGO. Otherwise, the highly favorable policy environment, a shared interest around the ambiguous yet compelling notion of empowerment, and the uncertain nature of CHW practices were sufficient conditions for the Academics to secure this limited, passive cooperation from the Kenyan NGO. Trials of strength between actors, as conceptualised by Law (1986), will emerge in the later chapters of this thesis, when more active engagement is required from the different actors, and disconnects between the different problematisations of ICTD become more readily apparent. “All these problematisations come to life, they complete each other, expose each other, join together, separate […]” (Callon, 1980, p. 206).

4.5 Summary

As discussed in earlier chapters, this thesis conceptualises a design as “the representation of an intentional future” that is enacted through situated action and is premised on assumptions about users and their environments (Heeks, 2002, p. 105). In this chapter, I deployed the classic ANT concept of problematisation as a device to bring this situated action into view. The Academics’ “subjective perceptions of reality” (Ibid., 104) were presented in terms of the inter-definition of actors, illustrated in Figure 4-1. The Academics’ “subjective expectations” or “intended future” (Ibid.) can be then
understood as the socio-technical system illustrated subsequently in Figure 4-2 which positions the mProject as an obligatory passage point for mobile phones, CHWs, and a Kenyan NGO. This problematisation is what Callon describes as a “system of alliances” (1984, p. 206) that is based here on the promises and possibilities of mobile phones, CHWs, and a Kenyan NGO. At the end of problematisation, these promises and possibilities are only that – “the entities identified and the relationships envisaged have not been tested” (Ibid.). The Academics’ “system of alliances” – their problematisation of ICTD – remains a proposition, reified in a grant proposal to the ESRC-DFID Joint Scheme.

Additional negotiations and materials will be required to move reality closer to the Academics’ intended future, since each enlisted actor forms their own, concurrent problematisation of the situation, “defining problems, identifying and organizing what is certain, repressing what cannot be analysed,” (Callon, 1980, p. 207). Those negotiations are introduced in the next chapter, as part of my account of the second moment of translation, referred to as *interessement*. During this phase, the Academics will incorporate additional human and non-human actors to draw the mobile phones, CHWs, and the Kenyan NGO closer to their mProject. One of these *devices of interessement* is the HAT, also known as the Malawi Development Assessment Tool. Beginning in the next chapter, this HAT will also be integrated into my theoretical rigging as an analytic “token” (Latour, 1987) to trace the enactment of design practice in this Participatory Action Research project for ICTD.
5 Interessement

The prior chapter described how a group of Academics constructed a problematisation in response to a call for new research on “ICT as a resource in the reduction of poverty” (ESRC-DFIDa, 2011, p. 7). Callon asserts that such problematisations do not exist in isolation and each enlisted actor also “organises and problematises reality in his own original manner in keeping with his own idiosyncrasies, his own background and the particular conditions which he finds himself” (1980, p. 287). Such alternative problematisations were left relatively unchallenged when the Academics submitted their grant proposal – the implications of participating in their mProject were sufficiently ambiguous and the alliance that was materialised by that proposal did not yet demand substantial concessions or inputs on the part of enlisted actors. It was when the grant was awarded and the research funds disbursed that the Academics began actively reconciling their problematisation with those of other actors, marking the beginning of the second moment of translation.

Callon contends that during the second moment of translation, the heterogeneous engineer or entrepreneur enlists devices of interessement to “impose and stabilize the
identity of the other actors” (1984, p. 207-208). In this chapter, I describe how the Academics worked to solidify their Participatory Action Research project as an obligatory point of passage by incorporating several additional human and non-human actors, including the analytic token of my investigation, the HAT. Section 5.1 begins by describing the origins and initial features of this public health diagnostic tool. Section 5.2 describes how activities related to Participatory Action Research brought the HAT to bear on the design of the Academics’ mProject and drew the CHWs closer to the mProject. In Sections 5.3 and 5.4, I describe how the HAT served as a device to interesse the mobile phones and the Kenyan NGO. In the final section of this chapter, I introduce theoretical scholarship in feminist theory (Barad, 1998) to demonstrate how the Academics’ problematisation, as reified during interessement, can be understood as a material-discursive apparatus for mobile learning. I then follow the HAT into the subsequent chapter on enrolment to explore the extent to which this token enacted the controversies over the politics of design practice in an ICTD project.

5.1 The HAT: the origins of “the analytic token”

As an object that is routinely-used in health settings, the HAT can be described as a black box (cf. Latour, 1987), or a punctualisation (cf. Law, 1992) that embodies “relatively standardized sets of organizational relations, social technologies, boundary protocols, organizational forms” that are often invisible and taken for granted (Ibid., p. 385). Suchman asserts that the “affiliative power” or ability of these artefacts to materialise relations with other actors “is tied in important ways to their mystery, to questions remaining unanswered about just how they came into being and what kinds of virtuosity were involved in their creation” (2005, p. 380). She contends that the “material resistances of objects are inseparable from the arrangements through which they materialise in practice,” and this “constitution of objects is a strategic resource in the alignment of professional identities and organizational positionings” (Ibid, p. 381). It is therefore instructive to trace some of the HAT’s socio-material provenance, to understand better its ensuing strengths and weaknesses as a device of interessement for drawing enlisted actors closer to the Academics’ mProject.

The HAT was not expressly created to serve as an educational resource, but was instead conceived as a health screening tool, a scientifically-validated checklist to assess the developmental milestones of children in rural Malawi (Gladstone et al., 2010). This object emerged out of the work practices of academic pediatricians and statisticians from
the UK and Malawi, roughly at the same time that the mProject was funded. The developers of the HAT wanted to produce a culturally-appropriate diagnostic instrument to monitor child development in low resource, rural regions of Africa. In their research publications (e.g. Gladstone et al, 2010; Gladstone, Lancaster, Jones, Maleta, Mtitimila, Ashorn, Smyth, 2008), these public health researchers argued that assessment tools from industrialised, Western settings often incorporated behaviours and objects that did not correspond to the cultural context of rural Africa. They contended that well-established instruments, such as the Denver II and the Denver Developmental Screening Test (DDST) could not therefore be expected to yield useful findings for populations living in those areas. Their work resulted in the materialisation of: (1) the HAT; (2) a basket containing a prescribed set of physical objects, referred to as a developmental kit; and (3) a user’s manual.

The HAT, known as the Malawi Development Assessment Tool, was a graphic, highly illustrated, questionnaire-like instrument that consisted of 136 items (refer to Appendix E). An item was a text phrase, often supported with illustrations, that prompted a researcher or health worker to ascertain a specific developmental milestone in a child, either by eliciting information from the parents, or by directly observing the child. Each item corresponded to an isolated task or behaviour that was expected to be observed in a child of a certain age. The items were divided equally into four domains corresponding to the different areas of child development: gross motor, fine motor, language, and social. Every domain was presented on its own separate A4 page in a grid format, with individual squares of the grid containing separate assessment items. Observed tasks and behaviours gradually became more challenging as one followed the items from left to right across each successive row of the grid. Responses could then be compiled in a systematic manner to generate a global pass or fail determination of whether a child was progressing normally.

The developmental kit associated with the HAT was comprised of a small basket of props that were more suited to the local environment:

In all domains of Western tests (such as the DDST) [Denver Development Screening Test], there are some items which are culturally inappropriate for a rural African population […] the pink doll in the DDST kit was terrifying to most children when used in piloting; many children had never seen anything like it and many screamed. It would have been unlikely that we would have been able to get them to sit down and “feed the doll”. Some of the naming questions in the Language section of the DDST or Denver II have pictures of objects that children, at least in the part of rural Africa studied, have never seen before, such
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as a horse and a car. This makes it difficult for them to name them, especially as many children have also never seen a book at their age, or pictorial representations of many objects. (Gladstone et al., 2008, p. 28)

The developmental kit included 17 locally-appropriate, readily-available props, such as a pencil or ballpoint pen, string, dried maize, and Chitenje cloth. The user’s manual (refer to Appendix F) was a 36-page document which provided a photo of the developmental kit and itemised the objects to be included in the basket. The user’s manual offered guidance on how to administer the assessment tool, providing a brief description on how to ascertain each specific skill or behavior in the child. There were also detailed instructions on how to score the HAT to determine whether a child was progressing normally.

The HAT was part of a category of instruments known as norm-referenced tests. As McCauley and Swisher have described (1984), norm-referenced tests evaluate an individual’s performance in relation to a large number of carefully selected people constituting what is called the “normative” or “reference” population. For the HAT to be useful in detecting developmental delays and disabilities in children of rural Africa, the public health researchers had to construct a reference population comprised of rural African children (as opposed to children from industrialised settings), who were progressing normally through their developmental milestones but were otherwise comparable to the delayed children. Their scientific reports (e.g. Gladstone et al., 2010) describe how the HAT was enacted as a norm-referenced test. The public health researchers recruited 1513 healthy children of mothers attending health clinics in four sites of Malawi. Local health workers administered the HAT to these children and the researchers performed logistic regression analysis to statistically manipulate their responses into normal reference ranges, that is, the age ranges at which one would expect any normal developing Malawi child to be able to perform a given item. From these normal reference ranges, the researchers then established the decision rule for the pass/fail determination on the HAT: Any child was deemed to have failed the HAT and require follow-up services should he or she fail two or more items in any one domain at an age in which 90% of the healthy Malawian children would have been expected to pass.

In the course of pilot testing the HAT and constructing the reference population, the researchers reported that Malawian health workers with limited education could easily conduct an entire HAT assessment with a child in 30-35 minutes (Gladstone, 2010). Moving forward, the creators of the HAT foresaw two broad applications for their
instrument. In the immediate term, they suggested that the tool would support “research practice” by generating valid outcome measurements to monitor and evaluate the numerous internationally-funded child development programmes in resource-constrained environments. In the longer term, the HAT was envisioned as “a clinical tool in early identification of neurodevelopmental problems” for young children from rural African settings (Ibid., p. 12). By providing health workers with a set of specific instructions on how to assess development in young children, tools such as the HAT could facilitate the identification of delayed and disabled children so that they could be directed to supportive social and healthcare services, where such care was available (Fischer, Morris, & Martines, 2014; Scherzer, Chhagan, Kauchali, & Susser, 2012).

Although this health research team took deliberate measures to ensure that local health workers could readily administer the HAT, they did not explicitly design this tool to be a training resource for health workers per se. Granted, the user’s manual that accompanied the HAT did serve as a resource on how to assess child development, and the pilot testing and construction of the reference group did serve as a sort of practicum for health workers, de facto. But at this stage, the HAT was an object of research in the public health arena. The qualitative and quantitative analysis that the health researchers conducted around the HAT was aimed at improving and evaluating its validity in detecting delayed and disabled children – its sensitivity, specificity, and positive predictive value – rather than enhancing or measuring the learning outcomes of the health workers who happened to be administering the tool. As such, the HAT did not bear material resemblance to the curricula, modules, training manuals, and lesson plans typically used to build health worker capacity in developing countries.

As a material artefact in this context, the HAT corresponds to what is referred to as a medical practice protocol. Also known as algorithms, clinical guidelines, standards, or best practices, these tools “have in common that they are or can be read as a set of instructions telling medical personnel to do A in situation B” and as “practice policies” that regulate the actions of providers with greater or lesser degrees of success (Berg, 1997, p. 1081). The production of a protocol itself is a sociomaterial performance, a temporary achievement whereby:

Multiple trajectories come together in a moment, including protocol designers, funding agencies, the different group of doctors involved, patients’ hopes and desires, organizational facilities, laboratory capabilities, drug companies, and the patients’ organs’ own resilience. (Fenwick, 2014, p. 49)
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While advocates contend that such protocols rendered clinical practice more “scientific”, thereby enhancing the quality of care and the professional legitimacy of certain provider groups, detractors assert that such guidelines lead to the “de-skilling” of clinicians who risk losing their skills when they are no longer required to reflect on their practice (Berg, 1997). “Creating protocols,” observes Berg, “is an ambivalent endeavor” (Ibid., p. 1087) in that the ensuing performances of such artefacts emerge out of “the turmoil of relationships among […] myriad non-human as well as human elements that shape, moment to moment, particular dynamics of context” (Fenwick, 2014, p. 46). These humans and non-humans generate effects that are always contingent upon the “particular limitations of bodies, instruments, other conflicting protocols, and organisational settings” (Ibid.). Such entanglements would become all the more complex as the HAT moved beyond the domain of health and encountered a different set of actors engaged in research on mobile learning for CHWs in Kenya.

What were the events that brought this paper-based tool for assessing child development to bear on an ICTD project for mobile learning? An ANT-inspired response to this question begins with the assertion that the HAT was enlisted by the Academics to act as one of several devices of interessément – as what Suchman calls “an affiliative object” (2005) to draw the interests and practices of CHWs and mobile phones closer to the mProject. The HAT’s focus on childhood development milestones corresponded to a specific training need that the CHWs themselves identified during a “co-design workshop”, as part of the Academics’ overall Participatory Action Research approach. Having described the genesis of the HAT as an artefact of research in the health arena, I will now set out to show how the HAT was brought into the realm of mobile learning research through the Academics’ Participatory Action Research activities, devices of interessément in their own right.

5.2 The HAT as a device to interessé CHWs

The co-design workshops for the mProject took place at the International Training Centre in the Nairobi headquarters of the Kenyan NGO. The Academics planned this workshop “to promote inclusivity of all parties relevant to the [mProject],” bringing together CHWs, their supervisors, and community leaders “[…] to identify the specific areas in which the mobile application would help them in learning, support, and supervision” (Table 3-1, mProject document #19, p. 14-15). A group of 18 CHWs and their supervisors travelled from Kibera and Makueni to the International Training Centre
(see Table 3-1, mProject document #13). They joined the Academics and the Kenyan NGO for a two-day workshop with a stated agenda to: (1) build a collaborative understanding of CHW practices in the field and (2) co-design a mobile phone application that corresponded to the CHWs’ self-identified training needs.

The Kenyan NGO helped to select the invitees and reserved a ground floor conference room with large windows opening on to the verdant central courtyard. It arranged for the audio-visual equipment, the office supplies, lunch, and refreshments. This co-design workshop was part of the Academics’ Participatory Action Research approach, which was comprised of:

three, four-monthly cycles of design, development, implementation and evaluation in order to iteratively design, trial and improve a series of increasingly sophisticated mobile prototypes and activities (Table 3-1, mProject document #5, Overall approach and methods of data collection, para. 5).

In the weeks leading up to this co-design workshop, the Academics completed a ten-day site visit to the urban settlements of Kibera, followed by a four-day visit to the rural Makueni site. The Kenyan NGO supported this fieldwork by recruiting and selecting participants, and arranging travel and meeting logistics. The Academics prepared field reports with photos (see Table 3-1, mProject documents #10, #11, #16 & #17). These documents describe how they “shadowed” the CHWs and interviewed these volunteer workers, their supervisors, public health officers, and administrators of the Kenyan NGO, in addition to conducting focus groups with community leaders. These written accounts also summarise the practices that CHWs and their supervisors enacted in their communities and as part of the formal health system.

At the Training Centre, the Academics opened the co-design workshop (see Table 3-1, mProject documents #13 & #14) with a report of these field visits to Kibera and Makueni. They presented a summary of CHW-supervisor practices using graphic representations called “mind maps” (refer to Appendix G) and invited the 18 workshop attendees to critique these visualisations, with the aim of building a shared vision of CHW practices. The attendees were then divided into three groups and asked to identify potential areas of work that would form the basis of the new mobile learning application. Each group was given marker pens and a large flip chart and instructed to prepare a presentation naming some specific health topics of interest. They were asked to describe their current knowledge of the topics, to explain why they wished to know more about the topics, and then to envision how the supervisory relationship would function in
relation to those topics. The attendees eventually decided to design a new mobile application related to the developmental milestones in young children, expressing the desire to learn about the stages of normal childhood development and to identify the danger signs that would warrant referrals to the health facility (see Table 3-1, mProject document # 15). In consultation with the Kenyan NGO, the Academics used this decision as the basis for developing possible design scenarios with mobile technology.

The Academics organised this co-design workshop, along with the other techniques of Participatory Action Research, to ensure that all stakeholders:

- participate in the entire research process, with the priorities of the CHWs and their supervisors addressed through genuine collaboration and co-construction of knowledge. (Table 3-1, mProject document #5, Outcomes, para. 1)

But participation is not isolated to these discrete design and implementation events, nor is it “premised by physical presence or intentional interaction” (Andersen, Danholt, Halskov, Hansen & Lauritsen, 2015, p. 251). As established in the Theoretical Foundations of this thesis (refer to Chapter 2), participation in ICTD is instead viewed as Andersen et al. have suggested – as “a relational and heterogeneous network achievement running through specific design processes and projects” (Ibid., p. 253), enacted by people and artefacts in multiple, unpredictable ways that are often independent of the designer’s aims and interventions.

To the extent that it succeeded in enacting the participation of the CHWs and their supervisors, the co-design workshop itself became a participant in the Academics’ plan, serving as a device of interessement in the mProject. In giving the health workers control over the design and implementation of the mobile learning intervention, the workshop was a strategy, a tool to draw the health workers closer to the Academics’ problematisation. When the CHWs came to the Training Centre, they were as Callon has written: “[…] ‘extracted’ from their context,” physically “disassociated” from the competing demands of their work settings (1984, p. 208). The workshop came in between the CHWs and “all other entities who want to define their identities otherwise” (Ibid.). But the workshop would only last two days and then the CHWs would return to their workplaces in Kibera and Makueni: the agency of the workshop as a device of interessement would therefore be ephemeral.

If the participation of the CHWs in the mProject was to be prolonged, more durable inscriptions would need to emerge out of the co-design workshop, and these artefacts would have to maintain the associations that had been formed over the course of
the workshop. As Law observes, “Thoughts are cheap but they don’t last long, and speech lasts very little longer. But when we start to perform relations – and in particular when we embody them in inanimate materials such as texts…they may last longer” (2003, p. 6). The deployment of the HAT would sustain the engagement of the CHWs in the Academics’ problematisation, acting as a material artefact to respond to the attendees’ expressed interest in child development milestones. With its individual assessment items, developmental kit, instruction manual, statistical protocols, and associated health practices involving patients, parents, providers and health researchers, the HAT extended the performances of the co-design workshop, serving as a more durable device of interessement to engage the participation of the CHWs.

5.3 The HAT as a device to interesse the mobile phone

In enlisting the HAT as a device of interessement, the Academics defined the initial morphology of the heterogeneous network that would constitute the mProject. The emergence of socio-material relations, as Hopwood et al. assert, “is not random or devoid of shaping by phenomena that pre-exist them” (2014, p. 5). Drawing from practice theory, they point to the concept of prefiguration to suggest that material arrays and their associated human activities can enable or constrain certain courses of action: while they do not determine the future, they can organize or structure the unfolding of subsequent associations between actors. During this second moment of translation, the HAT configured an initial pattern of relations that the Academics eventually attempted to extend and stabilise, with the aim of achieving a punctualisation that strengthened the practices for health workers in a sustainable and scalable manner. With its embedded sociomaterial legacy as a health diagnostic instrument, the HAT was enlisted by the Academics to enact new performances with actors in the field of educational technology, serving as a device of interessement to not only engage the CHWs and their supervisors, but to also draw another enlisted actor, the mobile phone, closer to Academics’ problematisation.

As discussed in Chapter 4, the mobile phone’s broad appeal in both the global health sector and among educational researchers rested in its ability to provide voice communication, its capacity to store and receive data, its ubiquity, as well as its portability. However, the mobile phone was not invented specifically to address problems in education. As Laurillard suggests, “design-like practice” was needed to leverage technology to serve learning and instruction objectives given that:
Teaching does not invent its tools; it uses those invented by others. The academy had language but didn’t invent writing – traders did that. It had writing but didn’t invent books – administrators did that. It didn’t invent computers – engineers did that. It didn’t invent the Internet – the military did that. It did invent the Web, but not for teaching purposes […] We have to conclude that it is not a natural part of teaching for its practitioners to invent tools for improvement of practice. (2002, p. 150)

For the mobile phone to participate in the Academics’ problematisation, some amount of *bricolage* was therefore required to engage this non-human actor to serve the aims of teaching and learning. In contrast to the “orthodox, centralized, and staged view of software development,” *bricolage* entails the “highly-situated” tinkering that “exploit[s], in full, the local context and resources at hand” (Ciborra, 2002, p. 49).

As part of tinkering with the mobile phone, the Academics enlisted the HAT as a design actor that would interest this ICT, channeling its technological capabilities towards a mobile learning intervention built according to the design principles of the “Conversational Framework”. Drawing on elements from instructionism, constructionism, socio-cultural learning, and collaborative learning, this conceptual model was said to provide “a strong theoretical statement about the nature of formal learning, and the requirements this imposes on learning design” (Laurillard, 2009, p. 6). Rather than an explanatory theory, it was intended to be a framework for making design choices for educational technology, whereby user requirements would be dimensioned according to the scope of desired learning outcomes, and aligned with learning theory on what it took to achieve such outcomes. For the Academics, the HAT enacted two notable performances in relation to mobile phones and the user requirements of CHWs, as articulated through the Conversational Framework.

First, the HAT geared the mobile phone’s data transfer capabilities towards educational objectives by *providing the concepts* that the learner, in this case the CHW, would need to understand about child development – that child development is a multi-dimensional process involving gross motor skills, language and hearing skills, fine motor skills and visuo-perception, and social skills – that there is an age-related sequence of specific behaviors and skills associated with each of these different dimensions – that a child of a certain age is expected to hold his head up, grasp an object, sit up etc. These concepts had been validated in Malawi by physician-researchers according to the scientific principles of epidemiology and statistics, as well as clinical experience. As such, the HAT constituted the body of knowledge, the repertoire of facts that had been
accumulated in the fields of paediatric medicine, developmental disabilities, and public health. By virtue of enlisting the HAT, the Academics drew these experts closer to their problematisation as well, anticipating that this affiliation would enhance the credibility and effectiveness of the HAT vis-à-vis the CHWs and their work practices.

Secondly, in helping to materialise what the Conversation Framework calls a “task-practice environment for learners’ needs,” the HAT also oriented the portability of the mobile phone to serve the mProject’s pedagogical aims. It not only provided the concepts on developmental milestones which made up the “discursive” learning transactions between teacher and learner – “articulating theory, ideas, concepts, and forms of representation,” but also laid out the specifications for “experiential” learning exchanges that entailed “acting on the world, experimenting and practicing on goal-oriented tasks” (Laurillard, 2009, p. 8). Because the HAT was created as a diagnostic tool for health providers, concepts on child development were organised and presented in a format resembling a job aid with direct relevance to the work of a CHW. A job aid is defined as “an external device or cognitive artifact that provides just-in-time knowledge and information to help individuals with tasks by directing, guiding, and enhancing performance” (Florez-Arango, Iyengar, Dunn, & Zhang, 2011, p. 131). With the HAT, explicit knowledge about childhood development came bundled in the form of a scientifically-validated protocol that CHWs could use to guide their work with the children in their catchment areas. As instructional content, the HAT therefore embodied the “how” as well as the “what” of child development. In administering the HAT during the course of their routine household visits, it was expected that CHWs would be able to develop “their conceptual understanding through repeated attempts to achieve a goal, reflecting on how well their action succeeded in achieving that goal” in a process akin to “everyday learning” (Laurillard, 2009, p. 8).

Because the concepts on childhood development milestones had been identified by the CHWs and their supervisors as a priority area, enlisting the HAT would address some of the participatory imperatives of the Academics’ research question:

How can the participatory development of a practice-based mobile learning intervention for CHWs and their supervisors improve the health care access of communities?

The HAT’s socio-material origins as a diagnostic instrument in health would also enable this device of interessement to participate in the creation of a “task-practice environment for learners’ needs”, corresponding to the Academics’ aim to promote learning that was
embedded in the CHWs’ practices, in contrast to the formal, cognitively-oriented training workshops that took place away from their work settings. But as will be further explored in the following chapter on enrolment, a “practice-based” intervention is difficult to implement because, as Barad describes, “the world kicks back” (1998, p. 112): the complex ecology of relations between humans and objects that constitutes “practices” rarely, if ever, submits itself to the control of humans and their designerly intent.

5.4 The HAT as a device to interesse the Kenyan NGO

The HAT was enlisted by the Academics to draw the CHWs and mobile phones closer to their problematisation, but the remaining actor in their plan, the Kenyan NGO, was not swayed one way or another by this device of interessement. The Academics’ efforts to induce the cooperation of the Kenyan NGO commenced prior to the launching of the site visits in Kibera and Makueni, before the co-design workshops took place. Research funds were to be transferred from the UK to Kenya; a Kenyan research assistant was to be recruited for the Nairobi headquarters; the Academics’ research protocol had to be submitted for review and approved by the Kenyan NGO’s Ethics and Scientific Review Committee – these were also devices of interessement, activities that the Academics undertook to induce the Kenyan NGO accept their “definitions of the problem and the prescribed actions and roles within it” (Shiga, 2007, p. 42). These mechanisms did not immediately draw the Kenyan NGO closer to the Academics’ problematisation. It took time for these devices of interessement to be put in place. These devices of interessement resisted and unexpectedly delayed the project – there were forms to complete, candidates to interview, committees to meet.

Other than the waiting, there was an additional accommodation that the Academics made, so that these administrative procedures would perform as devices to interesse the Kenyan NGO. Following its review of the Academics’ research protocol, the Kenyan NGO’s Ethics and Scientific Review Committee prepared a letter requesting several revisions, the first among them in relation to the following stated issue:

[…] you indicate that: The improved mobile-based supervision and training will link CHWs to the local primary health care system so that they can be effective in reducing poverty through the access to health care. Poverty reduction per se is not a key duty or responsibility of the CHW, and a focus on this responsibility for CHWs will distract/sidetrack the investigation from seeking the right answers to mobile CHWs. (Table 3-1, mProject document #25, emphasis Kenyan NGO’s)
For the Kenyan NGO, the term “poverty reduction” carried certain accountabilities corresponding to the targets established in the Millennium Development Goals:

Goal 1 – Eradicate extreme poverty and hunger:

- Target 1.A: Halve, between 1990 and 2015, the proportion of people whose income is less than US$ 1.25 a day
- Target 1.B: Achieve full and productive employment and decent work for all, including women and young people
- Target 1.C: Halve between 1990 and 2015, the proportion of people who suffer from hunger

While Target 1.C, appeared to fall in the remit of both the CHWs and the Kenyan NGO, the first two targets did not. As illustrated in Figure 4.1 in the prior chapter, the Academics did not attribute the term “poverty reduction” explicitly with targets of Goal 1, but rather with an over-arching, discursive aim of all Millennium Development Goals. In this way, the “region of certainty” (refer to Figure 4.1) corresponding to the Academics’ policy framework was challenged: the Kenyan NGO did not accept the assertion that the provision of health care, as operationalised by Goals 4, 5, and 6, would necessarily contribute to “poverty alleviation”. ICTs directed at CHWs in the health system could not be expected to lead to the achievement of Goal 1. To bring the Kenyan NGO into their problematisation, the Academics’ revised protocol remained focused on health outcomes and did not articulate poverty alleviation explicitly as an expected impact, irrespective of the policy and research practices that had established such linkages.

The HAT did not draw the Kenyan NGO closer to the Academics’ problematisation. When the Academics debriefed the Kenyan NGO on the outcomes of the Participatory Action Research workshops, it was advised that the content on child developmental milestones should be produced in line with the existing government curriculum for CHWs (Table 3-1, mProject document #15). However, there was no official curriculum available. Module 8 of a Ministry of Health training manual for CHWs issued in 2007 did address disability, but its objectives were solely to:

1. Name the common disabilities and their possible causes and understand ways of preventing or reducing disability; and

2. Describe the purpose of rehabilitation and understand their roles in the rehabilitation process.
Although Ministry of Health officials gave their verbal support for additional CHW training on childhood disability, the most current training manual published in 2013 did not include disabilities (Ministry of Public Health and Sanitation, 2013). While childhood disabilities were identified by the Kenyan CHWs as a priority issue, the concern was not explicitly addressed in the Millennium Development Goals. In a United Nations report, Groce confirmed that:

> There is a striking gap in the current MDGs: persons with disabilities, that is, the estimated 1 billion people worldwide who live with one or more physical, sensory, intellectual or mental health impairment are not mentioned in any of the 8 Goals or the attendant 21 Targets or 60 Indicators [...] The fact that persons with disabilities are not included in any of the MDGs and attendant Targets or Indicators represents a lost opportunity to address the pressing social, educational, health and economic concerns of millions of the world’s more marginalized citizens. (2011, p. 1)

In addressing childhood development milestones, then, the HAT did not materialise the priorities of the Millennium Development Goals and would not readily respond to the accountability mechanisms driving the international development agenda and shaping the operations of health ministries and NGOs.

But the Kenyan NGO was not only accountable to its donors; there was also the internal mandate to support “a community-driven and community-based approach to Primary Health Care that empowers individuals and communities” (Table 3-1, mProject document #7). The HAT corresponded to a priority that had been identified by the CHWs. Since CHWs were well-respected members of their communities, and there was an organisational commitment to support community-oriented efforts, the Kenyan NGO did not obstruct the Academics’ efforts. Even if the Kenyan NGO itself was not interested by the HAT, it did not actively discourage or encourage this device of intérêtement from drawing the CHWs closer to the mProject.

### 5.5 The HAT and the material-discursive apparatus for mobile learning

As discussed in the previous chapter, problematisation involved the construction of a specific reality that apportioned a set of humans and non-humans into the realms of policy, research, and practice (refer to Figure 4-1). The problematisation designated what the Academics considered irrefutable, what remained uncertain, what was to be analysed, and what was to be left un-examined. “Problems are identified and rendered autonomous; established facts are stated; links are postulated; whole sections of reality are pushed back into the shadows” (Callon, 1980, p. 209). As Callon contends, all problematisations share
this general structure, and each problematisation is engaged in a continuous struggle to assert its definition of the problem to be solved, its methodology for resolving this problem, and its accounts of why solving the problem matters.

The first moment of translation culminated with the reification of the Academics’ problematisation in the form of a Joint Scheme grant proposal to finance the mProject. In the second moment of translation, “interessement devices extend and materialize the hypothesis made by researchers” (Callon, 1984, p. 209). With the successful bid and disbursement of research funds, the Academics further instantiated their problematisation by enlisting the HAT as a device to interesse CHWs and mobile phones. Callon’s classic account of translation (1984) asserts that devices of interessement work through “force”, “seduction” or “simple solicitation” (p. 209), but provides few other details to describe how such devices materialise the problematisations of researchers. I therefore turn to later writings in feminist theory by Barad (1998) to demonstrate how interessement led to the assembly of a material-discursive apparatus that further reified the Academics’ plan to design, build, deploy, and evaluate a mobile learning intervention.

5.5.1 The material-discursive apparatus as an observing instrument

Barad’s theoretical articulation of the material-discursive apparatus provides a mechanism for understanding how the materiality, relationality, and performativity of scientific practices might constitute a dynamic socio-technical system. Her analysis begins with the observing instruments used in quantum physics during the early 20th century. That light would exhibit both wave-like and particle-like behavior would seem contradictory, if light were an object endowed with well-defined, intrinsic properties and its ontological nature singular. Niels Bohr’s resolution of the wave-particle duality hinges on the observing instruments that generated these seemingly conflicting experimental results. Light’s existence as a wave or particle, he asserted, is inextricably tied to the observing instrument. Bohr designates the term phenomenon to refer to the specific interaction between an object and the physical apparatus that is used to generate an observation. Descriptive concepts, such as “wave” and “particle”, derive their meaning from two incompatible sets of experimental conditions that “refer to different mutually exclusive phenomena, and not to independent physical objects” (Barad, 1998, p. 97). Departing from the scientific paradigm equating objectivity with observer-independence, Bohr then reformulates the classical notion of the “objective” to connote the “permanent
marks – such as a spot on a photographic plate” – that are left when an object and the observing apparatus combine to produce a *phenomenon*.

While Bohr specifies that there are no inherent distinctions between the object and the observing instrument, he is less explicit about what would constitute the observing instrument itself. Clearly, the materiality of the experimental set-up is implicated, but Bohr also writes that the apparatus emerges out of a certain set of *observational practices*. Little more is elaborated about the nature of those practices and Bohr does not provide details on how or why certain practices come to matter in the assembly of such an instrument. Barad argues for further elaboration of these *observational practices* and for the articulation of a process to describe how they lead to the materialisation of an apparatus:

If a computer interface is hooked up to a given instrument, is the computer part of the apparatus? Is the printer attached to the computer part of the apparatus? Is the paper that is fed into the printer? Is the person who feeds in the paper? How about the person who reads the marks on the paper? How about the community of scientists who judge the significance of the experiment and indicate their support or lack of support for future funding? What precisely constitutes the limits of the apparatus that gives meaning to certain concepts at the exclusion of others? (1998, p. 98).

To answer this question, she extends Bohr’s framework by turning to the writings of Foucault. Foucault does not focus on the natural sciences or directly address the specific roles of non-human entities (as in the philosophical investigations of Bohr), but instead offers a more comprehensive theoretical mechanism to describe how *observational practices* relate to the physical apparatus. Foucault also develops a theory of the apparatus in relation to power, which provides a useful way to conceptualise *politics*, as it is later operationalised in my narrative on enrolment in the next chapter.

Barad examines Foucault’s work on “*apparatuses of observation,*” “*apparatuses of production,*” and “*disciplinary apparatuses,*” terms all referring to the material arrangements “that instantiate particular discourses, where ‘discourses,’ are not merely ‘groups of signs’ but ‘practices that systematically form the objects of which they speak’ (*Archeology 49*)” (Foucault 1972, as cited in Barad, 1998, p. 103). By synthesising the writings of Foucault with those of Bohr, Barad advances the conceptualisation of the material-discursive apparatus – an observing instrument that materialises over time through *discourses*, which she describes as “particular practices that are perpetually open to rearrangements, rearticulations, and other reworkings” (Ibid. p. 102). These reconfigurations of practices are brought about through “intra-action” with other
apparatuses, constituting what Barad calls “power-knowledge systems,” or “boundary
drawing projects that make some identities/attributes intelligible, to the exclusion of
others” (Ibid., p. 106).

Discourses corresponding to different knowledge practices therefore converge,
albeit temporarily, through the materialisation of a physical apparatus that “makes a cut”
between what is considered the object of observation and what are considered the
subjects, or agencies of observation; between what is viewed as human, as opposed to
non-human. The physical apparatus constrains what can be observed or measured, and
delimits the set of concepts that are available to describe both the object and the
“permanent marks” of the phenomena that it generates as it intra-acts with the apparatus.
The attribution of (subject-object) roles and the meaning of descriptive concepts emerge
out of specific power relationships that link together the entities of an apparatus, but these
norms are never static or completely efficacious. “The juncture of contradictory
discursive demands on the subject prevents the subject from following them in strict
obedience” (Ibid., p. 111). The next chapter will demonstrate how the distribution of
power corresponding to the politics of any given apparatus always engenders some
struggle and resistance in relation to other apparatuses.

Artefacts in an apparatus are therefore not simply passive tools to be appropriated
by humans to fulfill human aims and ambitions: they instead participate actively with
humans to enact material-discursive practices. These practices carve out the boundaries
of what can be perceived and shape the contours and limits of humanist aspirations. Barad
employs the piezoelectric transducer in the ultrasound machine to demonstrate how this
conceptualisation of artefacts is part of an ontological claim and not merely a
metaphorical description. She contends that by virtue of its dual role as a transmitter and
a receiver, the piezoelectric transducer operates as “a material instrument, the ‘soul’ of
an observing apparatus, through which, not simply signals, but discourses (in a
Foucaultian sense) operate” (Ibid, p. 89). Here, Barad draws from Foucault’s
conceptualisation of the soul, which is said to materialise via a “certain technology of
power over the body,” even as this soul imposes its own allocations of power back onto
the human body, constituting both “the effect and instrument of a political anatomy”. In
likening the bi-directional piezoelectric transducer to a “soul” of a material-discursive
apparatus, Barad extends Foucault’s analysis, which focused largely on the constitution
of human bodies and neglected to examine materiality in relation to non-human bodies.
With its dual ability to transform electric signals into sound waves and vice versa, Barad contends that the transducer of the ultrasound machine acts as “a prosthetic device for making and bridging boundaries,” serving as a “machine interface to the body” that delegates specific roles to a fetus under observation and to the technicians, doctors, engineers, scientists, and pregnant women who act as agencies of observation (Ibid. 100-101). By tracing the physical mechanics of producing a sonogram image – the acoustic impedances, beam resolutions, sonar frequencies, tissue types, interface geometry, sample thickness – in relation to the observational practices of allopathic medicine and its gender politics, she contends that producing a sonogram image is at least as complex as the process of interpreting one. Barad’s coupling of artefacts to discursive practices in the observing apparatus is therefore an attempt to fully account for how the “very atoms that make up biological body come to matter”; to ascertain how the physical aspect of an artefact “make(s) itself felt” without asserting this materiality as a “natural uncontested ground or bedrock” (Ibid. p. 106).

5.5.2 Assembling the material-discursive apparatus

Barad describes how all material-discursive apparatuses limit what is seen and produced in accordance with its own “technoscientific, medical, economic, political, biological, and cultural, etc. development […] in intra-action with other historically and culturally specific apparatuses” (1998, p. 109). In the same way, a problematisation that is instantiated during interessement imposes certain definitions and material relationships to ensure that a specific partitioning of reality prevails. Like the material-discursive apparatus, the Academics’ specification of the problematisation and its subsequent materialisation in the second moment of translation constrained what could be seen, and also assigned roles and attributes to different entities. During interessement, the Academics’ problematisation was transformed into a material-discursive apparatus that took as its object of observation the CHW, who was assigned the attributes of a learner. The apparatus built around the CHW as learner entailed mobile phone practices that aimed to strengthen the health system by improving communication and training for health workers. These technology-based enhancements involved peer learning and practice-based approaches to learning and supervision. Enhancing the work environment for CHWs in this way was expected to improve CHW practices, thereby empowering them as providers of health care and as leaders in their communities. Empowering CHWs as learners in the workplace was in alignment with the global health policy and research
agenda, which had established that: 1) the empowerment of CHWs would help to alleviate health worker shortages; 2) alleviating the health worker shortages would address the health-related Millennium Development Goals; and 3) addressing the health-related Goals would contribute to the alleviation of poverty.

In the Academics’ material-discursive apparatus for mobile learning, the patients, mobile phones, and CHEW supervisors were assigned different roles in association with the training and support of CHWs as learners. Patients, for instance, were to serve as part of a practicum for CHWs, constituting what the Conversational Framework calls the “task-practice environment for learners’ needs” (Laurillard, 2002, p. 11). The role of the teacher was to be assumed by the CHEW supervisors who would define and reinforce the concepts to be learned, in compliance with the policies and procedures of the Kenya Ministry of Health, and would thereby develop their own supervisory skills through the questions asked by the CHWs and the “products” that these learners generated “as evidence of their current conceptual understanding” (Ibid., p. 11). Through its voice capability, data exchange capacities, ubiquity, and portability, the mobile phone was expected to deliver a “pedagogically rich learning experience” that would meet the requirements of the CHWs; and produce the digital traces – the permanent marks – that could support and document such a learning experience in the form of a “mobile portfolio of their practice” (Table 3-1, mProject document #6, How will they benefit?, para. 1).

Sørensen (2010) has described how theoretical concepts such as collaborative learning and constructivism served as components, or “connection points” (p.38), that linked a virtual platform to her own research on technology in educational practice:

These capacities for connecting were achieved on the one hand through the way in which components were already formed – through literature, discussions, and the epistemic cultures […] in which the research process was entangled – As well as through the specific shape of Karlskrona2 [the virtual platform]. (Ibid., p. 36)

In a similar way, the learning experience in the Academics’ research proposal was described as “pedagogically rich” because it drew from the scholarship in education and technology. These theoretical concepts were reifications of knowledge practices constituted through prior academic research. The learning experience for CHWs, as problematised by the Academics, was to be experiential rather than instructional, collaborative instead of individual; and consistent with Conversational Framework, the HAT would enroll the mobile phone to provide a “pervasive conversational learning
space” that enabled “continual conversation, with the external world and its artefacts, with oneself, and with other learners and teachers” (Sharples, 2002, p. 508-509).

The mobile phones would not merely open channels for CHWs and their supervisors to communicate with each other, but once coupled with the HAT through a software application, which I will call the HATApp, these phones would acquire a “system of language” enabling the phones to also converse with users. In a pedagogically rich learning experience, the integration of the HAT into the mobile phone was to generate:

A shared language (among learners, and between learners and computer systems), a means to capture and share phenomena, and a method of expressing and conversing about abstract representations of the phenomena. (Ibid., p. 507)

Just as certain computer programs, theatre scripts, and political manifestos were thought to provide the impetus for specific thoughts, feelings, and/or behaviors among various sets of actors (Ibid.), the HAT would instantiate a mutual language that would enable the mobile phones, CHWs, and their supervisors to engage in conversation with one another.

5.5.3 The HAT and the material-discursive apparatus for mobile learning

Through the language of the HAT, the phones were to guide the CHWs in constructing an understanding of childhood development, one where the activities of each successive household visit were undertaken in relation with the expertise reified in the HAT protocol and its associated basket of props, as well in relation to the experience acquired during prior patient encounters. Loaded on to the mobile phone, the HATApp would deliver the contents of the HAT through age-specific sequences of pale blue and yellow screens – visual compositions of drop-down menus, icons, buttons, and black and white sans serif typography that prompted the CHWs to engage in what Sharples calls “learning actions” (2002). Selecting “Create” from the menu of the opening display would launch a succession of screens to steer the CHW during the course of their child assessments, initiating a dialogue that would support the CHWs in undertaking their household visits in a structured, temporally-ordered fashion. Not only its text, offered verbatim, but also the layout and sequencing of these screens would invite the CHW to investigate her environment: “Is there a child under 6 in this household?” “Have you seen this child before?” “When is her birthday?” “What is her household like?” “Does she stretch to be picked up?” “Can she roll over from back to front?” Interested by the HAT, the mobile phone would encourage the CHWs to perform these “learning actions” in
conjunction with the props in the developmental kit, and these practices constituted experiential workplace learning on childhood development milestones. The discrete “learning actions” correspond to what Barad calls *phenomena, instances of wholeness* (1998, p. 95) when the agencies of observation, as designated by material-discursive apparatus of the Academics’ problematisation, *intra-acted* with its object of observation – the CHW as learner.

Through HATApp, the mobile phone would not only partake in the enactment of these “learning actions”, but would also provide the material means with which to record these phenomena. Two distinct, but inter-related moves were involved in the CHW’s response to the dialogue initiated by the mobile phone. First, the CHW needed to explore the work environment in the manner prompted by the screens: she would engage with the household, with the basket of props that accompany the HAT, with a parent, and with a child under the age of six. These interactions would trigger the second component of the CHW’s response: depending on what was encountered in the work setting, the CHW would tap on various areas of the mobile phone’s 4-inch screen to view different menu items; to enter birthdates, names, household numbers or comments about the child; to select buttons indicating “Pass” or “Fail”; to instruct the phone to display the next screen. This human contact with the mobile phone is what would instigate the production of the “permanent marks” of the CHWs’ encounters with the physical apparatus, capturing the phenomena of the Academics’ problematisation in the form of digital data that could eventually be compiled to generate external representations of the “learning actions”.

“To be able to engage in a productive conversation,” claims Sharples, “all parties need access to a common external representation of the subject matter that allows them to identify and discuss topics” (2002, p. 507). Such representations, known as “learning descriptions”, would reify the knowledge that was constructed through the performance of “learning actions”. In the case of the mProject, “learning descriptions” would be realised through various visualisations of the digital data left behind after a child assessment. Consistent with the Conversational Framework, these displays on the mobile phone were meant to move the learning conversations beyond the basic level of commands and instructions for “learning actions” from the HAT protocol, and enable the learner to engage in reflection with herself – as well as with others – on the knowledge constructed during the course of assessing child development milestones.

The screen shown in Figure 5-1 provides an example of a “learning description” that could be generated using the digital traces or “permanent marks” created by CHWs
in “intra-action” with the other actors in the Academics’ material-discursive apparatus. At this stage, the CHW has gone through a series of eight individual screens corresponding to each of the HAT items appearing under the heading labeled “Task”. In each of those prior screens, the CHW’s engagement with her work environment has led her to tap on a portion of the screen labeled “Fail” (as opposed to “Pass”). Running the HATApp software on the mobile phone allows each of these bodily gestures to be captured digitally and this data can then be compiled to produce the summary screen shown below. Each Task/Scoring pair constitutes a permanent mark of a distinct “learning action”. The HATApp software also runs the HAT algorithm so that the phone can generate an assessment of the child’s overall developmental status, which is shown under the heading “Result,” where in all eight instances, the field is populated with the categorical variable “Delayed” (as opposed to “Normal”). This “learning description” is presented as a screen on the mobile phone, as part of a “Child Development Area Record,” and is compiled for each childhood assessment performed by the CHW. This screen serves as a material artefact of the knowledge that was constructed during the administration of the HAT, a visualisation of a series of “learning actions” enacted as the CHW engages with the material-discursive apparatus specified in the Academics’ problematisation.

Figure 5-1 HATApp displays a learning description on the mobile phone
As a “learning description”, the screen in Figure 5-1 could support conversational learning in several possible ways. The CHW, for instance, could retrieve this screen to help initiate a dialogue with himself, engaging in self-reflection about what has happened during the administration of the HAT protocol: “Was it easy to establish rapport with the child and the caregiver?” “Were the props in the basket appropriate?” “Did the assessment proceed smoothly?” “What was the general health status of the child? These types of interrogations could generate new understandings that informed a set of subsequent actions. For example, the CHW might then tap the bottom left corner of the screen in Figure 5-1 to place a voice call that initiates a verbal conversation with the CHEW supervisor or a CHW peer.

Another move might be to proceed to the screen in Figure 5-2, where the CHW could engage in a further dialogue with the mobile phone, registering her level of agreement with the machine-generated assessment of the child’s overall developmental status. Finally, the CHW might advance to the screen shown in Figure 5-3, and having tapped on “My Notes,” enter additional text describing her reflections into the Child Development Record. All three possible moves leave additional digital traces of new “learning actions” that extend the Child Development Area Record as a text-based “learning description” that the mobile phone automatically sends to the CHEW supervisors for feedback.
The HAT was materially embedded into the mobile phone in the form of an application, and served as a “machine interface” between the practices of the CHWs and the circuitry of the mobile phone. Installed by the Academics as a device of intersese, the HAT was the equivalent of the piezoelectric transducer in ultra-sonography (cf. Barad, 1998). It provided a window into the practices of the CHWs, but this view did not encompass all of the CHWs’ activities as health care workers or as leaders in the community. The HAT constrained the Academics’ material-discursive apparatus so that its view of the CHWs as learner was limited to their practices around household visits and, arguably, referral-making. Moreover, the HAT was a child development assessment tool: only the CHW practices related to household visits with children under the age of six years were incorporated into the material-discursive apparatus, and then the only health conditions considered were those related to developmental milestones. Just as different ultrasound transducers possess different resonant frequencies to address different applications, the HAT addressed a very specific area of CHW practices, learning, and identity.
5.6 Summary

During the second moment of translation, several devices of interessement were introduced to draw mobile phones, CHWs, and Kenyan NGO closer to the Academics’ problematisation. The disbursement of funds, the recruitment of a local Kenyan research assistant, and the ethics approval of the research protocol were material conditions that helped to interesse the Kenyan NGO. By conducting the PAR workshop, the Academics also drew the CHWs closer to the mProject. The HAT was introduced as a device of interessement to extend the effects of the co-design workshops and engage the participation of CHWs and mobile phones. The Academics’ partitioning of reality, their “subjective expectations” or “intended future” (Heeks, 2002, p. 104), was now instantiated not only through a grant proposal to the Joint Scheme funders, but through the new human and non-human actors that were enlisted during interessement to “lock the other actors [i.e., the mobile phones, CHWs, and the Kenyan NGO] into the roles that had been proposed for them” (Callon, 1984, p. 196).

Following the HAT as an analytic token during the second moment of translation did not generate sufficiently detailed accounts of how devices of interessement worked to materialise the Academics’ plans for a mobile learning intervention. To elaborate the mechanisms of interessement, Barad’s theoretical work on the material-discursive apparatus and piezoelectric transducer was therefore incorporated into my initially “minimal theoretical rigging”. I demonstrated how enlisted actors and devices of interessement could be understood as components in the Academics’ material-discursive apparatus to study mobile learning in ICTD. With the HAT functioning as the “soul” of this material-discursive apparatus, the mProject operated as a socio-technical system that constrained what could be observed and assigned specific roles and attributes to enlisted actors, leading to a distinct allocation of power. As will be presented in the next chapter, this allocation of power corresponds to the politics of the Academics, which were tested during the trials of strength that ensued during enrolment, Callon’s third moment of translation.
In the prior chapter, the HAT – the analytic token of this account – was enlisted by the Academics as a device of interessement to make allies out of the CHWs and the mobile phone. In doing so, they established a set of material conditions aimed at drawing these enlisted actors closer towards the obligatory passage point that had been defined during the first moment of translation. By the end of the second moment of translation, the HAT was installed as a device of interessement in a material-discursive apparatus for practice-based mobile learning. However, its ability to draw the CHWs and mobile phone closer to the mProject was not yet demonstrated. “Interessement helps corner the entities to be enrolled,” but “success is never assured […] the device of interessement does not necessarily lead to alliances, that is, to actual enrolment” (Callon, 1984, p. 211).

It is during the third moment of translation that the HAT’s success in enrolling the CHWs and the mobile phone was tested. Enrolment is presented here as a series of negotiations aimed at resolving the conflicting politics that unfolded during the roll out of the Academics’ mobile learning research intervention. I will show how these trials of strength tested the success of the HAT as a device of interessement (cf. Callon & Douglas,
Theorising the design-reality gap

2012; Law & Douglas, 2012). They reflected a struggle to determine the ontologies that would prevail in the enactment of the mProject – in light of the HAT’s *multiplicity* and the attendant constellations of divergent and wide-ranging knowledge practices. This framing of enrolment builds from Barad’s theoretical work on power and the material-discursive apparatus (1998), which was introduced in the last chapter and is revisited here in the first section. I continue by demonstrating how controversy emerged when the politics of the Academics’ material-discursive apparatus for ICTD impinged on the actual practices of mobile phones and CHWs. This chapter concludes with an account of how the Academics’ apparatus itself was changed as the HAT encountered new actors and acquired an additional identity during enrolment: that of an advocacy tool.

6.1 Power and the material-discursive apparatus

Callon viewed translation as a process to elucidate how science and technology shapes the evolution of power structures. He claimed, for instance, that “understanding what sociologists generally call power relationships means describing the way in which actors are defined, associated and simultaneously obliged to remain faithful to their alliances” (1984, p. 224). Fox (2000) contends that this conceptualisation of translation drew from Foucault, who described power as a “moving substrate of force relations which, by virtue of their inequality, constantly engender states of power, but the latter are always local and unstable” (1984, p. 93). Power is therefore considered an emergent effect constituted through the local practices of different people and objects, rather than an entity to be possessed and wielded over others. The prior chapter demonstrated how problematisations, as materialised through devices of interessement, can be understood as material-discursive apparatuses that distribute power across gatherings of human and non-human actors in distinct ways.

Barad uses the case of ultrasound technology to further illustrate this power dynamic. She notes how obstetric ultrasonography is not a singular practice, but a complex array of highly specialised, local knowledge practices involving:

- medical needs; design constraints (including legal, economic, biomedical, physics and engineering ones); market factors, political issues, other R&D projects using similar materials; the educational background of the engineers and scientists […] the workplace environment of the engineering firm or lab; particular hospital or clinic environments where the technology is used; receptivity of the medical community and the patient community to the technology; legal, economic, cultural, religious, political, and spatial constraints on its uses […] and the nature of training of technicians and physicians who use the technology. (1998, p. 102)
Rather than a transparent and neutral tool for monitoring a developing fetus in a woman’s uterus, ultrasound technology is conceptualised as a material-discursive apparatus whereby many knowledge practices are assembled into a performance that not only produces a sonogram image – those “permanent marks” on a computer screen – but also generates the descriptive terminology that is used to interpret and give meaning to that image.

Through interactions with the material artefacts of ultrasound technology, different roles are distributed to different entities shaping how various technicians, physicians, engineers, and scientists form and enact parts of the apparatus: these actors are, so to speak “instrumentalised.” Meanwhile, the fetus assumes the role of an object of observation and is assigned certain attributes, such as gender, that carry certain consequences, depending on the socio-economic and cultural context. This delegation of roles and attributes, argues Barad, corresponds to a distribution of power that reflects the politics of medicalized birthing practices – practices that become controversial when they assign autonomy and human attributes to the fetus while reducing pregnant women to de-humanized, “technomaternal environments” (Ibid.). Subversion, resistance, opposition, and revolutions are identified as strategies that may be adopted to reconfigure the material-discursive apparatus of obstetric ultrasound technology, which, in Barad’s framework, is constantly susceptible to socio-material shifts and rearrangements that can challenge the hegemony of allopathic medicine.

6.2 Boundaries, attributes, and the allocation of power in the mProject

Barad shows how in imposing constraints on what is observable and in defining the roles and attributes of enlisted actors, all material-discursive apparatuses allocate power and create inevitable and often deliberate exclusions. Accordingly, the enlistment of the HAT as a device of interessement meant that many CHW practices were not to be incorporated into the Academics’ problematisation (refer to Section 5.5). The mProject did not, for example, address the data collection activities or health campaigns that often occupied the CHWs and were endorsed by the Ministry of Health’s Community Health Strategy. Similarly, the CHWs’ ongoing work practices related to hygiene and sanitation, ante- and post-natal care, HIV/AIDS, and malaria were not incorporated into the Academics’ problematisation, nor did their material-discursive apparatus include the CHWs’ community-oriented practices as emergency responders, conflict mediators, and
patient advocates. In keeping with the emancipatory ethos of the Participatory Action Research methodology, the HAT was enlisted in response to the CHWs’ expressed desire for training on child development, but its incorporation into the Academics’ problematisation led to the exclusion of most ongoing CHW practices and added new duties and responsibilities for these individuals (refer to Section 5.2).

Enlisting the HAT was a participatory design move that also corresponded to the Academics’ objective to develop a “practice-based mobile learning intervention” (see Table 3-1, mProject document #5). Supported by scholarship in mobile learning, this practice-based orientation led to other exclusions, this time related to the format of the m-health training to be introduced. The putative advantages of mobile learning were considered “at odds with formal learning with its cohorts, courses, semesters, assessments, and campuses, and with its monitoring and evaluation regimes” (Traxler, 2007, p. 2). In the scholarly literature, mobile learning was viewed as more suitably applied in the work/community setting, outside of the classroom or training center. In relying on the HAT as a gateway into the practices of CHWs, the “innovative practice-based tool” (Table 3-1, mProject document #5, Rationale, para. 2) envisioned in the Academics’ problematisation was not to be a deployment to digitise medical references, assess post-training knowledge or administer certification exams. Their apparatus was not intended to support instructionist pedagogies nor the “presentational and testing capabilities” of the mobile phone that supported “predictable learning through multiple-choice questions, […] right/wrong feedback, and […] further presentation on that basis” (Laurillard, 2009, p. 7). Other than the initial training sessions on how to use the HATApp, classroom-based, instructionist approaches would not be part of the “pedagogically rich” mobile learning experience (cf. Roschelle, 2003, p. 260) that was anticipated for the mProject.

As discussed in the previous chapter, the integration of the HAT into the mobile phone enacted these constraints and exclusions, and constituted what Barad has called “the soul” (1998, p. 89) of the Academics’ material-discursive apparatus. Like the piezoelectric transducer, the HAT was an interface between the social and the material; between the practices of the CHWs and the hardware of the mobile phone. And like the piezoelectric transducer, the HAT altered – and was altered by – the Academics’ problematisation, acting as a material conduit “through which not simply signals, but discourses […] operate” (Ibid.). Through the HAT, the Academics’ problematisation delegated power among local actors in accordance with the emancipatory politics of
Participatory Action Research and mobile learning, but it did not seek to disrupt the global health policy and research agenda of the Millennium Development Goals. Avgerou suggests that such a distribution of power is consistent with a distinct discourse relating to the contested notions of ICT innovation and socio-economic development (2010). This discourse combines a social embeddedness approach to ICT innovation (as opposed to transfer and diffusion) with a progressive approach to development (as opposed to disruptive). In privileging local perspectives to the design and deployment of technology, this discourse may question prevailing international development ideologies and policies, but does not seek to undermine or overturn them. As Avgerou elaborates:

There may be obstacles in the harnessing of the developmental potential, stemming from historically-developed social orders, such as over-centralized public administration and authoritarian hierarchies, but the belief expressed in this discourse is that these can be addressed with empowering democratic ICT policies and appropriate professional practices, such as user participation. (2010, p. 9)

In the ways that have been described, these politics of ICT innovation and international development were embedded in this Academics’ problematisation of the mProject. But as this Chapter will describe, this particular distribution of power encountered resistance during the third moment of translation, and the HAT’s performance as a device of interessement was challenged by the competing concerns and activities of alternative problematisations aiming to “cut the network” in different ways. These challenges corresponded to the “trials of strength” that took place during enrolment, which I will describe in the next sections using Barad’s theoretical work on the “rearrangements, rearticulations, and other reworkings” that come about through the intra-action of different material-discursive apparatuses (1998, p. 102).

6.3 Overcoming trials of strength – bringing reality closer to design

“To describe enrolment,” asserts Callon, is “[…] to describe the group of multilateral negotiations, trials of strengths and tricks that accompany the interessements and enable them to succeed” (1984, p. 211). In the classic case of Callon’s scallops, the towlines that were enlisted as devices of interessement encountered hostile elements in the ocean environment. The currents, predators, as well as the positioning and composition of the towlines themselves (i.e. was natural horsehair better than straw, broom, or vegetable horsehair?) presented trials that tested the strength of these devices as they sought to draw the scallops closer to the researchers’ problematisation. Sørensen has argued that similar
trials of strength take place when designing digital technology for educational practice (2010). These battles illustrate how “technology is constructed from the components that are ‘inside’ the software, as well as by opponents that challenge the technology from ‘outside’” (Ibid., p. 51). She describes technology design as comprised of trials of strength involving the “practical, contingent, and heterogeneous interplay” (Ibid., p. 39) of human and non-human elements as they form associations and disengage from the actors that undermine the stability of the newly forming network. The following sub-sections demonstrate how the HAT’s trials of strength emerged as the competing politics of multiple problematisations all converged upon the mobile phones and CHWs and introduced new actors to the mProject.

6.3.1 Enrolling the mobile phone – artefacts have politics

“The issues that divide or unite people in society,” asserts Winner, “are settled not only in the institutions and practices of politics proper, but also, and less obviously, in tangible arrangements of steel and concrete, wires and transistors, nuts and bolts” (1980, p. 128). As with any material artefact, the mobile phone was accordingly endowed with the politics of its own sociomaterial legacy, one that distributed power in ways that engendered a particular set of resistances during the third moment of translation. Like the HAT, the mobile phone was itself the network achievement of certain material arrays and associated human activities. But whereas the HAT was initially sedimented out of the sociomaterial practices of academic public health research, the materialisation of the mobile phone emerged from a different material-discursive apparatus advanced by handset manufacturers in the telecommunications industry. The mobile phone was manufactured as a retail product, a confection produced to generate corporate profits by appealing to the desires and purchasing power of individual consumers. Its rapid uptake on the African continent was achieved through an “elegant and complex combination of infrastructure, networks, regulators, markets and handsets” (Donner, 2010, p. 3) corresponding to the effective, albeit uneven, establishment of connectivity across the region, and growing recognition that the four billion people at the “bottom of the economic pyramid” (BOP) constituted an untapped market for multi-national firms (Hosman & Fife, 2012). The private sector now viewed the poor as “excluded from the modernity of globalised civil society, including consumption and choice” and embraced the socio-economic concept of the BOP, urging industry to advocate on behalf of the marginalised “by challenging the barriers that prevent them from realizing their human
potential […] for the unleashing of their creative and productive potential as part of an inclusive capitalist system, free of paternalism toward the poor” (Financial Times, n.d.).

In keeping with this notion of inclusive capitalism, the Huawei Y360 was a budget smartphone marketed to the BOP market segment. It was recruited by the Academics to provide an Internet connection not typically available on the basic handsets that most CHWs already owned. With its rounded edges and rubbery black casing, the rugged, compact Android smartphone would fit securely in the palm of an adult hand to deliver Internet, voice and messaging functionalities, a simple camera, 4 gigabytes of storage space, a battery that provided nearly 7 hours of talk time, as well as a screen that was “not too small for navigating menus and apps, and browsing photos, web pages, etc” (“Huawei Ascend Y360 (Y3) review,” 2015). Consumer reports cautioned that the “entry level product” could be “laggy, especially when opening apps,” but nevertheless offered “more than you might expect” given its low retail price, and was “well worth a look if your budget is really tight.” The review continued, “If all you do is play simple games, check emails and social media, and browse mobile friendly websites, you’ll be OK” (Ibid., 2015).

But the Academics envisioned a more extensive and socially-engaged role for Huawei Y360. In their problematisation, the mobile phone was not simply merchandise to be purchased by consumers based on their personal preferences and willingness to pay. Rather, it was to be interessed by the HAT into a material-discursive apparatus related to educational technology and thereby serve as a learning resource issued free of charge to CHWs to support their work practices. As described in the last chapter, the paper-based HAT now took the form of the HATApp, a web-based, software application that operated on the mobile phone. This application integrated the contents of the HAT with the hardware of the Huawei Y360 in order to draw the mobile phones closer to the Academics’ problematisation, transforming this consumer product into a training resource that would deliver a “pedagogically rich learning experience” to CHWs.

Consistent with the family of ICTD projects that aimed to weave new technologies into local social systems, the HAT conferred an “embedded directionality” to the mobile phone, corresponding to what Donner describes as “an intentionality […] to alter social structures and to enable and guide action toward more desirable outcomes and social states” (2010, p. 4). He argues that these desirable outcomes and social states correspond to the “spirit of the feature set,” the “official line” of a technology that presents “[…] the general intent with regard to values and goals underlying a given set of structural
features,” providing a “[...] normative frame with regard to behaviors that are appropriate in the context of the technology” (Ibid.). In the form of a software application, the HAT interessed the mobile phone so that it would promote “learning actions” (refer to Section 5.3). These “learning actions” were expected to empower the CHWs by enhancing their knowledge about child development milestones. In the ways described earlier, these learning practices were embedded into the workplace of the CHWs and focused on a health topic of expressed interest to these learners, constituting the Academics’ conception of what was entailed in a collaborative, “pedagogically rich” and participatory intervention.

There were obstacles early on in the third moment of translation that prevented the HAT from materialising via the HATApp, the web-based software application for the mobile phone (see Table 3-1, mProject document #31 & #32). Getting the HAT to work on the Huawei Y360 required some additional bricolage to overcome trials of strength related to the energy and telecommunications infrastructure in Kenya. To display the HAT on their screens, for instance, the phones required electrical power, and the rechargeable batteries that powered the phones required a source of alternating current. Although offered as a BOP product, the Huawei Y360 was equipped with standard chargers that presumed physical and financial access to the central electricity grid, which was not the case in the remote village of Makueni. According to an international development report, only 20% of Kenyan households were connected to the electricity grid, and access was as low as 5% in rural settings (United States Agency for International Development, 2015). A report commissioned by the International Finance Corporation further observed:

There are currently 34 million people in Kenya who lack formal access to energy and over 19 million off-grid mobile SIM connections. Put simply, many Kenyans have a phone before they have a place to charge it. (GSMA, 2012, p. 1)

The mProject bypassed the central electricity grid, abandoning the chargers that accompanied the Huawei Y360 and procuring new solar chargers that converted the more readily available light energy into the 5 volts of direct current needed to charge the batteries of a mobile phone.

The HAT had to make other accommodations before it could be placed between the mobile phones and “all other entities who want(ed) to define their identities otherwise” (Callon, 1984, p. 208). For example, the HAT’s four, page-sized grids could not be effectively viewed on the small screens of the mobile phones. It would not be
possible to incorporate this device of intéressement into the phone without modifying the original format of the child health protocol. The grids from the paper-based version were therefore abandoned and the individual assessment items were displayed separately in sequential order, grouped by domain, according to the age of the patient, which the CHW would enter into the first screen. As described in the last chapter the mobile phones, once charged, were not simply meant to display or unilaterally deliver the HAT as content for users to consume, but would instead deploy the text and illustrations of the HAT to solicit successive interactions with the users.

The HAT also engaged the mobile phone in the recording of these encounters, in the creation and storage of their “permanent marks” within a database on an Internet server, for later use in case management, supervisory support, and research analysis. But to participate in this manner – to display the HAT, as well as to capture and transfer data – the mobile phone required connection to the Internet to run the web-based HATApp. This Internet access proved to be intermittent in Makueni, so that the child assessments that were performed by CHWs did not leave their digital traces and could not be retrieved for later use. To mitigate the consequences of the unstable Internet connection, the Academics modified the hardware of the mobile phone so that it could deploy the HAT (in the format of the HATApp) offline and store any child assessment data in its internal memory until Internet connectivity was resumed and the data could be transferred to the server (see Table 3-1, mProject document #31).

With these connectivity issues resolved, it was ultimately the mobile phone’s sociomaterial heritage as an embodiment of “consumerism and choice,” that would present the HAT with its most intractable trial of strength. The Huawei Y360 offered features beyond those that were initially co-opted through the HAT. At this stage, there were functionalities, such as the camera and audio recorder, that were not formally integrated into the Academics’ problematisation. Plus, the use of Internet and voice services was not restricted to the operation of the HATApp. CHWs were deliberately given considerable liberty in the way they could use these features of the phone, as part of the Academics’ participatory approach and emphasis on collaborative knowledge building. But this freedom compromised the performance of the HAT as a device of intéressement, challenging its ability to enroll the mobile phone to achieve the aims of an ICTD project. As Donner has observed:

A development application residing on or accessed via a mobile phone constantly has to share the limelight with the phone’s connection, entertainment,
and self-expression functions. It must compete for attention and utility with not only other development-related activities, but with calls to mom, ringtones, and BBC news sports scores. Your users likely learned their mobile skills pursuing these expression and entertainment functions, and they may evaluate your application by similar standards […] does your public health reporting tool look as sharp and run as smoothly as that downloadable game?” (2009, p. 98)

Beyond the HATApp, the remaining features of the mobile phone were more aligned with its origins as a consumer commodity and “facilitator of user choice,” than with a “causal agent” in an intervention for socio-economic change (Ibid.). As a device of interessement, the HAT was unable to suppress the Huawei Y360’s performances as an “amplifier of human action” (Donner, 2010, p. 3). Even though the interessement of the mobile phone by the HAT achieved an embedded directionality that promoted certain “learning actions”, the mobile phone would continue to function as an “enabler of human freedom,” whereby “[…] some calls or text messages individuals might choose to make might lead to beneficial development outcomes,” while others would not (Ibid., p. 4).

6.3.2 Enrolling the CHWs

Within the market-oriented problematisation enacted by global handset manufacturers, the mobile phone was assigned the attributes of a commodity and the CHW assumed the role of a customer. This was not the only allocation of attributes and roles that competed with the politics of the mProject. There were other material-discursive apparatuses that had already allocated different identities to the CHWs. Encounters with these alternative problematisations were linked to the Academics’ vision of a “practice-based mobile learning intervention,” one that operationalised the concept of practice in terms of “work-related” and “work-located” activities (cf. Institute of Education, 2007, p. 3). Such work-based articulations of practice assigned CHWs with overlapping identities as cadres of the formal health system, challenging the HAT as it attempted to enroll the CHWs as learners and objects of a progressive educational intervention.

Through their work practices as cadres of the formal health system, the CHWs were already entangled in a competing material-discursive apparatus corresponding to the priorities of the Kenyan health ministry and its Community Health Strategy (Ministry of Health, 2006). This alternative problematisation involved the recruitment of CHWs to remedy Kenya’s deteriorating health indicators, a decline that had been attributed to regional disparities in health services and a shortage of professional health workers (see
Mireku et al., 2014). In this context, CHWs were subjected to a role in the health workforce, and the community became an object of observation/intervention. Training interventions were strategies to enhance CHW performance within the formal health system, rather than to promote learning outcomes per se (see Hongoro & McPake, 2004; Raven et al., 2015). This performance was to be monitored against the formal job description that was assigned to the CHWs, and involved the delivery of frontline, “Level 1” services to “assist communities in assessing their situations, identifying gaps and reflecting on the causes of the gaps in order to take action” (Ministry of Health, 2007, pp. 9–10).

In this context, the rhetoric of empowerment was directed not at the CHW as learner or consumer, but at the community – conceived here as citizens who were committed to improving their personal and collective health status. As stated in the Community Health Strategy:

[a] major intended impact of the approach is that the communities will thereby be empowered to demand their rights and seek accountability from the formal system for the efficiency and effectiveness of health and other services.

(Ministry of Health, 2006, p. 2)

Empowering the CHW as a learner was not necessarily discouraged, but was nonetheless viewed as inadequate if it did not, in turn, achieve health gains that empowered the community. With the community thus defined as the object of a health intervention, the delegation of roles and attributes would differ from that of an educational intervention for health workers. It would subject CHWs to the role of a service provider, a category of “human resource for health” (see Global Health Workforce Alliance, 2010) that would effectively and efficiently deliver vital public health services to a community in need.

Through the practices of human resources management outlined in the Community Health Strategy, the CHWs would be supported to ensure that they were “able to effectively contribute to health programmes.” As described in a Kenya strategy paper:

Effective management of the human resources for health (HRH) aims to ensure that adequate numbers of appropriately skilled and motivated workers are available to deliver public health services. In order to meet the numerical staffing requirements and to ensure that staff are used optimally, a number of HR policies and practices need to be in place and operating effectively. These include HR information systems, recruitment, deployment, performance management, and training and development (including in-service training/continuous professional development). (Ministry of Health, 2005, pp. 15–16)
In a material-discursive apparatus where CHWs “learn” in order to “deliver”, the CHEWs that supervised them served not so much as teachers than as line managers. Consistent with the human resource management approach, supervisory efforts to communicate information about health guidelines, to promote planned events, to build teams, as well as to coach and solve problems, were considered part of the “key requirements or inputs needed for CHWs to be productive in providing essential health services (outputs) to the communities they serve” (Jaskiewicz & Tulenko, 2012, p. 2). Through the practices of quality assurance, supervisors would engage in the “continuous monitoring and improvement of CHW performance through measurement, feedback, and learning” (Crigler, Gergen, & Perry, 2014, p. 10–6) to ensure that CHW activities adhered to a “strategy of the firm” that was articulated in the policies of the formal health system.

The strengthening of the health workforce was articulated in the Community Health Strategy, the policy document which the Ministry of Health had positioned as an alternative obligatory passage point for CHWs and mobile phones. In the Ministry of Health’s problematisation to empower the community, the HAT was enacted not as a health assessment tool to detect cases, nor as “content” with which to generate experiential learning opportunities for CHWs. In this setting, the HAT functioned instead as a *job aid* to interresse the CHWs and mobile phones to the Ministry’s Community Health Strategy. As a device of interressement, the HAT would draw in mobile phones and CHWs by enhancing their productivity and improving performance, ensuring “that CHWs practise within the limits of what they can achieve and for what they have been trained” (Jaskiewicz & Tulenko, 2012, p. 4). These practice-based supports were expected to enhance the performance of CHWs without removing them from the work setting and were considered less expensive than formal off-site training (Ibid.). Job aids were expected to lead to greater worker productivity, not only by building the capacity and motivation of CHWs, but by fostering an “enabling work environment” that preserved “client time” and enhanced the CHW’s credibility vis-à-vis patients (Ibid.).

The HAT’s performances as a job aid succeeded in drawing the CHWs towards the Community Health Strategy, entangling them into the practices of human resources management that were envisioned by the formal health system. This affiliation did not conflict immediately with the HAT’s ability to interresse the CHWs as learners. Embedded into the Huawei Y360 in the form of an application, a job aid such as the HAT could offer a promising avenue for improved learning by providing “point-of-care clinical information and decision support”: 
Studies have shown that even well-motivated CHWs using paper-based job aids demonstrate less-than-desirable rates of treatment and diagnosis errors, and low protocol compliance […] Cognitive science and learning theory provide evidence that presenting information with rich media including text, audio, and visual aids such as images, video or animations, in the context of learning can enhance understanding, decrease complexity, and reduce cognitive load. (Florez-Arango, Iyengar, Dunn, & Zhang, 2011, p. 131)

In the way that it prompted the CHW to engage in such protocol-driven learning actions, the instantiation of the HAT in the mobile phone application aligned well with the following rationale for adopting mobile phone based job aids to implement clinical guidelines:

Breaking complex guidelines into smaller, more understandable chunks, presenting them interactively in a structured fashion is a plausible way to enhance their usability. In addition, to compensate for literacy and educational deficits, it is reasonable to supplement textual information with audio, voiced instructions, images and video (including animations). (Iyengar & Florez-Arango, 2013, p. 115)

Accordingly, the sequence of HATApp user screens and layout of prompts generated learning actions that were compatible with the enactments of the HAT as both a job aid within the Community Health Strategy and as educational content in the Academics’ mProject.

However, the “pedagogically rich” learning envisioned by the Academics required learning actions that extended beyond what could be achieved through a job aid. Within the material-discursive apparatus advanced by the Ministry of Health, adherence to a clinical algorithm was viewed as a pedagogically adequate learning experience for CHWs, so long as CHW practices led to measurable health outcomes that empowered the community. By contrast, such compliance with the commands and instructions of the HAT was considered necessary but not sufficient to successfully interesse the CHWs into the mProject. There was, in the Academics’ problematisation, the added expectation that basic learning actions emerging out of the HAT’s performances as a job aid would feed into subsequent learning actions, ones where CHWs would engage in “reflection” with themselves, with their supervisors, and with other CHWs (refer to Section 5.5.3).

To better support these reflective learning actions digitally, the HATApp was coupled with a WhatsApp mobile messaging learning forum during enrolment (see Table 3-1, mProject document #33, #52). Prior to this coupling, CHWs could utilise the HATApp’s comments fields to engage in text-based digital learning interactions with their supervisors, but they were not able to supplement this communication with photos
or other media. The CHWs could resort to the generic SMS and voice features of the mobile phone in order to augment their text messaging with other media or to communicate with their peers. But those SMS interactions and calls were subject to additional user fees, and the voice conversations did not leave behind substantial “permanent marks” of those learning actions. In addition, the HATApp privileged one-to-one digital and voice interactions, and did not provide the capability to readily support group-based learning exchanges of interest to the Academics.

Adding a WhatsApp learning forum as a component of the Academics’ mobile learning intervention supplemented the forms of conversation that had been made available through HATApp, thereby strengthening the HAT as a device to interest and empower the CHWs as learners. It was estimated that 49% of mobile phone users in Kenya were already using WhatsApp as their preferred mobile messaging tool (Adika, 2014). The mobile phone application required a mobile Internet connection to operate and could be downloaded for a $US 0.99 annual subscription fee. With no upper limit on the number or length of messages sent or received, CHWs and their supervisors could send and receive text messages, photos, videos, and audio recordings without incurring additional costs other than the cost of data. The functionalities of WhatsApp readily supported 1- and 2-way interaction at the one-to-many, many-to-one, or many-to-many levels, enabling the learning forum to promote learning conversations that were not possible with the one-to-one exchanges that were supported by the HATApp (Table 3-1, mProject document #52).

Access to the closed WhatsApp learning group was controlled by an mProject study manager. Otherwise, communication was informally monitored by the CHEW supervisors. There was no fixed schedule for posting new content and all members were encouraged to send messages to the group at any time. These media-rich, text-based postings show how the WhatsApp learning forum extended the HAT’s performances as both a job aid and a pedagogically rich learning intervention. Through these mobile messaging capabilities, CHWs would be able to engage in additional learning conversations not only with their supervisors, but with groups of their fellow CHWs – and in that process, leave behind durable inscriptions of those phenomena in the form of digital text messages, photos, and other media (Ibid.).
6.3.3 Enrolling the community

As described in previous chapters, the Academics’ early problematisation included mobile phones, CHWs, and the Kenyan NGO. Community members were considered beyond the remit of the mProject; as patients of the CHWs, they would fall within the domain of the health sector. Yet the mProject was a work-based training program, and the performances of the HAT as a training resource were enacted within the boundaries of the larger, more intricate material-discursive apparatus known as the Community Health Strategy. The identities of the CHWs as health providers could not be readily dismissed. If the HAT was to succeed in drawing the CHWs in as learners in the workplace, this device of interessement would also have to acknowledge their accountabilities to the formal health system and to the communities that they served, and with this, their identities as health cadres.

As described in Section 5.5, the HAT was enlisted to interesse mobile phones by providing a “script” or “mutual language” to create “a pervasive conversational learning space,” one where CHWs could continually converse “with the external world and its artefacts, with oneself, and with other learners and teachers” (Sharples, 2002, p. 507-509). In a work-based environment, the “external world” of a CHW was inhabited not only by artefacts, but by humans, and the HAT had to attend more closely to the way these learning conversations engaged with the patients in the community. The learning conversations would need to be linked to the delivery of Level 1 services that were stipulated in the Community Health Strategy. To meet the needs and expectations of the community in this way, the identity of the HAT as a job aid also had to be leveraged to interesse community members, thereby expanding the frontiers of the “conversational learning space” to better accommodate the practices of human resource management for health.

As with the CHWs and the mobile phones, there were trials of strength as the HAT attempted to interesse these community members. As discussed earlier, the installation of the HAT as the “soul” of the Academics’ material-discursive apparatus constrained the view of the CHWs’ practice environment so that it only included children under 6 years of age. Depending on the demographics of the CHW’s service area, it would be challenging for the HAT to encounter the targeted members of the community during the course of a normal CHW workday. To strengthen the ability of the HAT to interesse the community, a quota was set whereby each CHW was permitted to deviate from their
normal work routine in order to assess a minimum of fifteen children over the course of one month; and their supervisors were tasked with a new responsibility for verifying the existence of these children to ensure that the CHWs had actually seen the child (Table 3-1, mProject document #29).

Once these young community members were identified, the Academics’ problematisation homed in on the administration of the HAT, competing with the CHWs’ delivery of other routine preventative health services. These exclusions further challenged the HAT’s ability to interesse the members of the community. There were trials of strength between the HAT and other pressing health initiatives, such as water and sanitation, malaria, and AIDS, that pulled the local community away from the mProject with its exclusive focus on developmental milestones (Ibid.). This conflict was discernable in the exchanges of the WhatsApp learning group, where posted messages related to the full range of routine CHW practices, rather than focusing solely on the administration of the HAT. As one CHW posted:

My Thot [sic] is, I feel we've lost focus. Our main focus was developmental milestones in [children] under five, but I feel the group has focused more on environmental issues hence missing the point. (WhatsApp Forum, post on October 18, 2014, YCHW5)

As a device of interessement, the HAT never succeeded in completely detaching the community from the other health initiatives; it did not “interrupt all potential competing associations […] to construct a system of alliances” in the manner hypothesised by Callon (1984, p. 211). The CHWs dovetailed the administration of the HAT with the provision of Level 1 services that related to healthy child development, including activities to promote breast-feeding, proper water and sanitation, hygiene, ventilation, and nutrition (Table 3-1, mProject document #29). Coordinating CHW responsibilities in this way stretched the boundaries of the Academics’ problematisation to overcome this trial of strength, but a certain degree of tension would persist as a result of this expansion, due to time and resource constraints exerted on the CHWs.

Embedded into their daily activities as such, the HAT enhanced the credibility of the CHWs in the eyes of their patients, drawing these members of the community closer to the Academics’ efforts and those of the formal health system. The community itself had not always been receptive to the outreach services that were offered to them. Delivering the HAT through the Huawei Y360 would confer status to the CHWs, in so
much as the phone itself was a material artefact that legitimised the work that they performed:

They [the community members] consider it [the phone] as something of importance. It’s a kind of promotion to me as a CHW because […] I used to visit them carrying books but now it is different […] they are encouraging me with the phone […] They are very happy also and some even seek to learn how the application works. They are appreciating. (Table 3-2, mProject interview #28).

The HAT’s sociomaterial origins as a scientifically-validated health protocol also drew the community closer to the mProject. The truth claims that were linked to this heritage conveyed credibility to the CHWs in their identities as health care practitioners. One CHW observed:

It is easy when you visit the households to go through the phone guiding you, giving you the correct information. When you feed the correct information, even the phone is responding well and you are able to tell the true information to the CHEWs [supervisors] and the mother. (Table 3-2, mProject interview #31)

Another CHW described how the structured delivery of the HAT’s content via the phone application helped to streamline and fine tune the CHWs’ performances as a provider, which added further legitimacy to their identities as health cadres:

Using the tool? Actually it has made me feel […] that I have that trust […] because it has made my work easier, especially when I’m doing my [assessments of] child development milestones […] It has [been] said that it [my work] is flowing. So it makes the parent from that particular household actually have that feeling this guy knows what he is doing; he is focused; he is going step by step. (Table 3-3, photoelicitation interview recording #2)

In this way, the HAT functioned as a “textual thing” (Fenwick & Edwards, 2010, p. 8) in that both its materiality as a mobile phone hosted application, as well as the informational and discursive aspects of its content, enacted performances to enlist the community as allies.

As recounted in the previous chapter on interessement, introducing the HAT into the mProject was viewed as a participatory design move because it addressed a priority area that was identified by CHWs and their supervisors. By helping these health workers to use mobile phones to learn about a topic of their choice, the Academics expected to empower these health workers. Up to now, the trials of strength that challenged the HAT as a device of interessement were overcome through subversion and resistance. The incorporation of certain additional components, such as the solar chargers, the application cache to deliver content after periods of being offline, and the WhatsApp learning forum were all work-arounds that subverted the distributions of power that had been asserted by
broader actors in the energy, telecommunications, and health sectors. These technical enhancements, along with specific modifications in the work routines of the CHWs, enabled the HAT to resist complete domination by the imperatives of the Community Health Strategy. So even as the HAT participated in the mProject as a job aid to enhance CHW productivity, it persisted in enacting the learning conversations that were originally championed in the Academics’ material-discursive apparatus for mobile learning.

6.4 Overcoming trials of strength: bringing design closer to reality

The situated action described above can be understood as what Heeks calls “actuality improvisations” (2002, p. 108). As the prior section recounts, these sociomaterial practices drew the “reality on the ground” closer to the Academics’ material-discursive apparatus for mobile learning. But when the reality of such ICT deployments inevitably “kicks back” (Barad, 1998, p. 112), situated action may also achieve the inverse effect – it can alter the components of the original problematisation to bring it closer to the conditions of the field. Heeks calls this form of situated action “design improvisations” and suggests that these forms of sociomaterial practice are influenced by “explicit components” related to the materiality of ICTs, as well as “implicit components” having to do with assumptions about the values or knowledge of local users (2002, p. 108).

During the third moment of translation, the Academics carried out design improvisations in an effort to draw the mProject closer to certain compelling sociomaterial conditions encountered during the deployment of the mobile learning intervention. With the continued roll out of the mProject, the CHWs acquired additional experience in administering the HAT and earned the confidence and respect of more community members in their service areas. At first, the majority of children assessed by the CHWs were found to be developing normally and did not require referrals to a facility. In these instances, the performances of the HAT were closely aligned with the design intent of its original creators, which was to produce a preventative diagnostic tool for the early detection of developmental disabilities (see Gladstone et al., 2010). However, as the CHWs gained visibility in the community with the use of their smartphones and their newly-developed expertise, the HAT started enacting novel performances in relation to the work of the CHWs: it began drawing severely disabled children of all ages into the mProject.
Health researchers and practitioners had been calling for global action to meet the needs of such children world-wide. They had estimated that over 200 million individuals under 5 years failed “to reach their potential in cognitive development because of poverty, poor health and nutrition, and deficient care” (Grantham-McGregor, Cheung, Cueto, Glewwe, Richter, & Strupp, 2007, p. 60), and that “a majority of these children suffer the double burden of disability and its associated stigmatization, leading to a marginalized life” (Maulik & Darmstadt, 2007, p. 52). In Kibera, one CHW describes how disabled children had remained “hidden” from their communities:

As a neighbor, I’ve been there for so long, but I was not aware that this baby has disabilities. Serious. It took me a long time to understand that this baby has a disability because she [the mother] used to cover her, covering her from head [to toe] […] Nobody bothered about them [the disabled children] […] We the CHWs, we didn’t know whether in our communities there were so many kids – because every mother used to close her kid in the house.

(Table 3-3, photoelicitation interview recording #4)

The HAT’s sociomaterial performances as a “script” or “mutual language” for “pervasive conversational learning” (Sharples, 2002) amongst mobile phones, CHWs, and their supervisors now also supported a dialogue with caregivers of severely disabled children. The CHW continues:

So to me, it was; [before the mProject] it was difficult to start asking, “Why are you covering your child from head to [toe]; the whole body; [carrying your child] on your back?” […] How will she talk about [this with] me? I told her “Now we are doing a new thing. […] We are assessing children on their growth [with the HATApp]; if they had failed in some developmental milestones; if they were born with some deformities; if they had any problems with their health.” So through the talk, she introduced her child […] I am happy because [of] the introduction I brought to her and the information I brought to her. Now she is free and she is happy. (Table 3-3, photoelicitation interview recording #4)

By providing CHWs with a structure and a set of talking points to conduct a dialogue with mothers of disabled children, the HAT served as a device to interesse these marginalised members of the community; the HAT was enacted as an advocacy tool for disabled children.

Out of the ensuing activities and conversations between this particular CHW and her Kibera neighbor, the First Love Mothers (FLM) support group, emerged within the span of a few weeks (see Table 3-1, mProject documents #45 & #46). The CHW recounts:

So the mother told me, “[…] what you are doing and what you are talking, it is good” […] And from that time, she allowed me to take photos and to bring anybody who was assistance to her house; but not a person who will come to her
house and talk about her to create rumors and gossip. And since I assured her of that, everything has worked well. And now the team has grown to a big one. They were 15 mothers. Now she’s recruiting another 20. The number is now 35 […] Even now, I know there are so many kids and what we also ask ourselves is why so many children within Kibera were born with cerebral palsy during this time.

(Table 3-3, photoelicitation interview recording #4)

This mother positioned the HAT, the CHWs and the mobile phones to effectively interesse some of the most marginalised and vulnerable residents of the community. These mothers gathered in homes and community centers to exchange intimate stories of hardship and survival, undeterred by the invasive din of the industrious Kibera merchants, radios, and school children seeping in from the outside. Their narratives revolved around the feelings of isolation and blame, the constant accusations of witchcraft and moral impropriety, the challenging daily logistics of caregiving, and the egregious acts of violence and depravity that had been committed against some of the children (my fieldnotes, March 14, 2015, FLM meeting, Kibera YMCA center). The solidarity that emerged out of these brutal testimonies of human failure and material scarcity took form in a “merry-go-round” micro-credit scheme, the opening of a bank account, and an informal system of cooperative child care for members of the FLM support group (Table 3-1, mProject documents #38, #45, #46).

The supervisors of the CHWs, equally moved by the condition of the FLM group, designed a paper-based case report form with the heading “biodata of children with delayed developed milestones” to begin collecting patient information; and with the permission of the mothers, the CHWs now used their phones to take photos of the children. This would constitute the beginnings of a patient registry for disabled children in Kibera, an artefact of public health practice, defined broadly as:

an organized system that uses observational study methods to collect uniform data (clinical and other) to evaluate specified outcomes for a population defined by a particular disease, condition, or exposure, and that serves a predetermined scientific, clinical, or policy purpose(s). (Gliklich et al., 2014, p. 1)

The Kibera health workers used this nascent registry to begin identifying disabled children, to define their clinical and psycho-social needs, and to direct them to appropriate treatment and support services from the formal health system, the public education system, and the local NGOs with expertise in caring for special needs children.

In Makueni, the mProject team also engaged in the creation of a similar registry for disabled children. Here, the CHWs and their supervisors had also been gathering the
names of the children who needed referrals for disability services. Some children were identified using the HATApp, but most disabilities were severe enough to be quickly ascertained without the support of the mobile phone application. The CHWs often sent photos of the children to the WhatsApp learning group, soliciting advice about referral options and presenting these digital traces to their supervisors as forms of what the CHWs and their supervisors considered to be “evidence” for their work (Table 3-1, mProject #52). The information collected by the CHWs was consolidated into a master list, handwritten in blue and black ink on two sheets of lined white paper. This list was made up of four columns, corresponding to the childrens’ first names, their last names, their age, and short descriptions of their conditions. They ranged from 2 to 19 years old, and next to each of the thirty-two names, beneath the heading “disability”, were various text phrases:

- eyes - partially blind
- paralysed on one side
- one plastic leg becoming short
- can’t talk, can’t seem to hear
- can hear, but not speak
- can’t write
- keeps salivating
- keeps fainting
- mental disability

(my fieldnotes, March 20, 2015, Kasikeu dispensary)

At least twenty more children were identified during a community forum that was subsequently organised by a local school principal at the request of the health workers. Several wooden benches and desks were arranged along the exterior mud wall of the school building to form a large semi-circle, shaded under the eaves of the corrugated tin roof and a leafy canopy of nearby trees. With close to fifty attendees, some adults and children settled towards the front on the dry and dusty earth, either for shortage of seating or for lack of muscle tone to sit in an upright position (my fieldnotes, March 20, 2015, community forum, Makueni primary school). Beginning with formal introductions, a health supervisor explained:

We are here to take action, so just speak the truth […] feel free to speak the truth.” “I want you to express all your problems, so that you can be assisted.

(my field audio recording, March 20, 2015, community forum, Makueni primary school)

To which the Academics would later add:

We look forward to hearing your stories, and to discussing with you, and to learn from you what your challenges are in daily life.

(my field audio recording, March 20, 2015, community forum, Makueni primary school)

With that, the parents responded. They approached the table one by one to add their child’s name and age to the registry, and followed this with the lengthy and arduous
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patient histories that would then be distilled into short, terse summaries captured on paper with ball point pen:

reduced vision - takes too long to understand - epileptic - has mental challenge - physically challenged - hearing impaired

Like the mother in Kibera, the principal of this elementary school in Makueni strengthened the ability of the HAT to interesse the community. He allocated the time and the space for families and disabled children to assemble with the health workers. At his invitation, one of his teachers, a mother of a disabled child, presented her story to the gathering. The principal also invited a special education teacher to speak to the community and to propose a way to reify their compassion into more concrete and generative expressions of unity:

If it is possible to chip in, to come and work together to see whether we can introduce a facility, a small home. We have all this area. We have this land. We can have a small home where a teacher will take care of this child here all day and enable the mother to work for that same child. Because if they are bound like this, they will be bound forever. We are here to chip in for them and to empower them. (my field audio recording, March 20, 2015, community forum, Makueni primary school)

As with the Community Health Strategy, the rhetoric of empowerment here was directed at the local community. However, in this instance the emancipatory aspirations focused on a specific carve-out of that community: disabled children of any age. New actors were assembled, including principals, teachers, elementary schools, as well as a proposed community facility for disabled students, and this would implicate new practices that included a variety of income-generating activities, as well as the manual fabrication of mud bricks by volunteers in the community.

Meanwhile, the HAT struggled to continue its digitally-mediated dialogue with disabled children. Its script for conversational learning was stunted and too limited to respond to the emergent conditions of the CHWs work environment; the protocol was intended to help diagnose disabled children, not treat or support them. The HATApp’s prompting ended with commands to “Refer” or “Not Refer” to the Level 1 facilities; it would not prompt the CHWs to initiate learning actions across the range of social, health, and educational services for treatment and support. To extend their “shared language” with the mobile phones, new conversations appeared on WhatsApp learning group, and the CHWs also resorted to the generic voice and data capabilities of their handsets. Their referrals to Level 1 facilities made via the HATApp had led to reports of frustration and
disappointment among the parents who waited all day only to learn that local facilities were not staffed or equipped to care for their child (Fieldnotes, March 14, 2015, mProject team meeting, Nairobi): disability was not expressly incorporated into Level 1 services of the Community Health Strategy (see Ministry of Health, 2006). Confronted with the immediate plight of vulnerable children, the CHWs and their supervisors used the mobile phones to react to the health system rather than to reflect on their personal learning, and they diverted their attention away from the priorities of the formal health system as they attempted to forge new care pathways for disabled children.

6.5 The multiplicity of the HAT

This narrative of the mProject illustrates how in its travels from the context of a health research project in Malawi to an educational research project in Kenya involving mobile technology, the form and functions of the HAT evolved. The HAT not only changed materially to accommodate different actors, but also enacted different configurations of work practices among those actors it encountered. With each contact, the HAT acquired new, sometimes overlapping roles corresponding to different sets of practices. In its early life as an object of health research, the HAT participated as a clinical protocol. The researchers around it were concerned with its validity with respect to detecting disabled children (see Gladstone et al., 2010; Gladstone et al., 2008): how well did the tool distinguish disabled children from healthy ones? Can a reference population in Malawi be used to identify disabled children in Kenya? In this context, the CHWs were considered part of the intervention itself, a means of delivering the assessment, part of the methods and materials of this public health research.

Once the HAT was enlisted by the Academics, its appeal as a device of interessement rested with the concepts and practice-based skills it provided on the topic of developmental milestones. Here, the HAT functioned as educational content, the CHWs became mobile learners, and the Academics were concerned with the pedagogical and technical implications of the Conversational Framework, user requirements, and the programming work required to integrate the HAT into the mobile phone (see Table 3-1, mProject documents #5, #31, #32, #34). Once the programming work was completed and the HAT was incorporated into the smart phone as a software application, its relation to the Academics and the CHWs evolved once again. The HAT and the mobile phone constituted a job aid that could augment the CHWs productivity during household visits, and the CHWs were designated as cadres in the formal health system (see Jaskiewicz &
Tulenko, 2012), with the Ministry of Health more concerned about the HAT’s ability to improve CHW’s performance than about its role in advancing a learning experience grounded in progressive pedagogical research (cf. Ministry of Health, 2005). The HAT was also installed as one of many features of the mobile phone and therefore competed with the self-expression and entertainment functions of this BOP consumer product (cf. Donner, 2009). During enrolment, the HAT performed the roles of a clinical protocol, educational content, a job aid, a consumer choice and an advocacy tool promoting disability awareness; it was what Mol (2002) describes as “multiple” (p 6), “objects-in-practice” (p. 154), “more than one but less than many” (2002, p. 55).

This multiplicity created different configurations of practices involving additional roles and different accountabilities and interests for the mobile phone, the CHWs and the Kenyan NGO – even as it was installed as a device of interessement to draw those enlisted actors closer to the Academics’ problematisation. In this way, the CHWs, mobile phones, and the Kenyan NGO were confronted with competing demands corresponding to different sets of material-discursive practices. This multiplicity generated trials of strength; it created controversies over the identity of the HAT, the Academics’ device of interessement (Akrich, Callon, & Latour, 2002). Mol describes these controversies as “ontological politics” that raise the following questions (1999, p. 79):

- Where are the options?
- What is at stake?
- Are there really options?
- How should we choose?

By the end of enrolment, the work of the Academics was to determine how to “mediate these competing versions and their debates,” (Ibid. p. 50), thereby “attuning everything to everything else, one way or another” (Mol, 2009, p. 1757).

6.6 Summary

Enrolment can be described as a series of “trials of strength” that arose through the “intra-action” of different material-discursive apparatuses (Barad, 2007). In this chapter, Barad’s concepts, along with Mol’s elaboration of multiplicity (1999, 2002) were integrated into my theoretical equipment to illustrate how at least six different patterns of sociomaterial relations operated through a given set of people and things, enacting the material-discursive apparatuses of public health academics, educational research, healthcare, the market, the state, and the local community. These material-discursive
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apparatuses – or problematisations – assigned different roles and attributes to the same set of entities, delegating power in different ways to materialise the ontological politics of each of the HAT’s enactments. Trials of strength emerged out of the tensions between those politics: Was the mobile phone to perform as a consumer good or an ICTD? How and when should the CHWs enact the practices of a consumer, a learner, a health cadre, or a patient advocate? When was the supervisor a teacher, a line manager, or an additional patient advocate? Who was to be empowered – the CHWs, the community, or just the subset of disabled children in that community?

The enactments of the HAT made it the “material instrument” and “soul” (Barad, 1998, p. 89) of not one, but multiple observing apparatuses. The HAT acted as bidirectional conduit for the overlapping discursive practices associated with the telecommunications and energy industries, public health research, research in educational technology, human resources management for health, and advocacy for children with disabilities. These sociomaterial practices circulated through the HAT, along with streams of digital data – those permanent marks left behind when these apparatuses interacted with each other. Overcoming trials of strength during the third moment of translation involved “actuality improvisations” and “design improvisations” to bring design and reality closer together (cf. Heeks, 2002). With this situated action, the Academics’ material-discursive apparatus shifted and expanded through the enactment of new exclusions and the accommodation of additional actors such as the solar chargers, an application cache, a WhatsApp learning group, mothers of disabled children, the disabled children themselves, NGOs for special needs children, parent support groups, schools, principals, and teachers. In adding some components while removing others, the mProject can be said to have enacted a new and fragile “fluid space” (Mol & Law, 1994, p 659).

The next chapter describes this fluid space in more detail and shows how the Academics attempted to make the multiple ontologies of the HAT “hang together” to form a network durable enough to travel to other locations and domains (Fenwick & Edwards, 2010), with the aim of securing the sustainability and scalability of the mProject.
This narrative of design practice began by describing how the Academics defined a problematisation that established the mProject during the first moment of translation. Theoretical work on the material-discursive apparatus (Barad, 1998) was then introduced to elaborate Callon’s second moment of translation, demonstrating how the installment of the HAT as a device of interessement delegated certain identities to the mobile phones and CHWs. This assignment of roles and attributes conflicted with alternative configurations of practices that revolved around the HAT’s varied and simultaneous performances as a health assessment protocol, as content for e-learning, as a job aid, a consumer good and as a patient advocacy tool. During enrolment, the multiplicity of the HAT created trials of strength that were overcome by adding and removing various components. In this chapter on mobilisation, I draw from spatial theories (Edwards, Tracy, & Jordan, 2011; Mol & Law, 1994; Murdoch, 1998) to further describe the emergent boundaries and shifting terrain of the mProject and to examine the movements or displacements (Callon, 1984) that ensued as the Academics attempted to ensure the sustainability and scalability of the mProject.
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Theoretically, the relations that configure an actor-network are thought to constitute an “arrangement of priorities” (Star, 1995, p. 89), a snapshot of the social relations corresponding to the distribution of power at a given moment in time (Massey, 1991, p. 28). To understand the spatial orderings of the mProject 18 months into its roll out, Section 7.1 introduces the concepts of fluidity (Mol & Law, 1994), distribution and coordination (Mol, 2002). It portrays the Academics as fluid designers that participated in the construction of a fluid space and then describes how the Academics engaged in the work of coordination so that the multiple ontologies of HAT would “hang together” as it travelled to different spaces and places (Mol, 2002). In Section 7.3, I describe how these boundary-marking activities failed to consolidate a network that would be durable enough to extend itself to the domains championed by the formal health system and, consequently, the Kenyan NGO. The enduring controversies of this fourth moment of translation form the basis for the subsequent chapter, which argues that designing educational technology for socio-economic development is a “matter of care” (Puig de la Bellacasa, 2011).

7.1 Fluid objects, designers, and interventions

In the prior chapter, the multiplicity of the MDAT expanded the assortment of actors participating in the mProject. What began as a learning intervention to train – and thereby empower – the CHWs was now also explicitly aimed at empowering the community in general, and disabled children in particular. But the empowerment of these communities was to be achieved through distinct material-discursive apparatuses that assigned different identities to the CHWs and the mobile phones. These alternative problematisations designated varied configurations of power through a range of alternative health delivery practices. The “space” now enacted by the mProject was what Mol and Law describe as fluid, with the blurred boundaries of its practices continually contracting, expanding, and shifting:

In fluid space, it’s not possible to determine identities nice and neatly, once and for all. Or to distinguish inside and outside, this place from somewhere else. Similarity and difference aren’t like identity and non-identity […] A fluid world is a world of mixtures. Mixtures that can sometimes be separated. But not always, not necessarily. For though a sugar solution may crystallize and the kidneys separate urine from blood, the egg and the oil in mayonnaise are irreversibly altered when they are mixed. (1994, p. 660)

Fluidity is proposed by Mol and Law as but one of several possible enactments of space brought on by a heterogeneous actor-network, and is not to be construed as more effective
or virtuous in comparison to the other relatively confined and static forms of spatiality, such as “regional” and “network” spaces. Which spatial ordering is enacted, and how it endures, extends, or dissolves over time is instead a function of its particular socio-technical environment, and is to be addressed as an empirical question rather than an issue for normative deliberation.

De Laet and Mol invoked the same caveat after suggesting that technology with boundaries that are “vague and moving” rather than “clear and fixed” might travel more readily to “intractable settings which urgently need working tools” (2000, p. 225-226). While their analysis of the Zimbabwe Bush Pump explicitly eschewed the universalisms that would have installed fluidity as the new standard in technology design, the authors nevertheless demonstrated how, in their words, it can be “easy to love” objects and inventors that are fluid (Ibid., p. 252). Indeed, Redfield asserts, perhaps reflexively, that the widely-cited account of the Bush Pump has claimed the “academic affections” of “anti-colonial intellectuals” with “leftist political instincts” (2016, p. 160-171) who are duly seduced by the notion of a fluid object that “doesn’t impose itself but tries to serve, that is adaptable, flexible, and responsive“ – and are similarly enamored with the vision of its designer as the:

[…] non-classical hero who is as active as can be, and yet makes no claims to heroic actorship, [who is] fluid, dissolving into his surroundings [while] attending, being attuned, and adapting to the world-out-there. (de Laet & Mol, 2000, p. 226)

Objects that enact fluid spaces are said to come into being through the deliberate, albeit discreet work of its fluid designers:

The fluidity of the pump’s working order is not a matter of interpretation. It is built into the technology itself. This is not an accident. The Bush Pump is made that way. It is made that way by a modest inventor. (Ibid., p. 225)

In the case of the Bush Pump, the authors’ vision of the modest inventor was presented as an appealing and effective alternative to the “managerial” approaches embodied in “generals, conquerors and other exemplars of strong and solid authority” (Ibid. p. 251-252). Re-examining the first three moments of translation through the workings of the fluid Bush Pump would suggest that the Academics’ academic sensibilities, like those of their post-colonial counterparts, were taken in by the allure of the object multiple, their design practices motivated by the “fluid hero” ideal, “willing to serve and observe, able to listen, not seeking control, but rather daring to give themselves over to circumstances” (Ibid., p. 253). As the HAT travelled and traced out its sociomaterial path, the Academics
engaged in this form of servant leadership, cultivating the enactment of a fluid mobile learning intervention while seeking out the role of a “peripheral agent” and “promotor of distributed action”, one that would actively manage their own gradual “dissolution” (Ibid., p. 250-251) in anticipation of an emerging, sustainable and scalable ICTD.

This orchestrated abandonment of control was embedded into the Academics’ Joint-Scheme funding proposal. In the Outputs section of the grant submission, under the sub-heading, Translating research outcomes into usable non-academic formats, the Academics specify that “The software, applications and activities will be made freely available as open educational resources” (Table 3-1, mProject document #5). Like the inventor of the Bush Pump, the Academics claimed no patent rights for themselves or their institutions and maintained that a collaboratively-designed technology for CHW learning belonged in the public domain. Moreover, the Academics were unequivocal in their desire to delegate power away from themselves and towards users at the local level. Their rationale for adopting the Participatory Action Research approach, as reflected in the Academics problematisation described in Chapter 4, resonated with this description of the Bush Pump’s community-based, collaborative design orientation:

The true centre is elsewhere, and comes in great numbers. It is in the well-to-be made and in its prospective users. It is at the village level […] He [the Bush Pump’s inventor] is firm about the necessity of abandoning control. Implementation, he maintains, depends on those who will use the pump. It therefore requires room for their methods and insights. Without this, any pump is bound to fail. (de Laet & Mol, 2000, p. 250-251)

In relinquishing intellectual property rights and selecting the Participatory Action Research approach as the methodology for their research project, the Academics defined themselves early on as designers that would be “fluid” rather than “controlling”, and they established the potential for the development of a locally-owned, responsive educational technology that would enact a fluid space.

During the second moment of translation, the Academics continued to actively devolve their command of the mobile learning intervention while assembling the material-discursive apparatus to empower the CHWs as learners. Consistent with the Participatory Action Research methodology, the HAT was installed as a device of interessement after CHWs and their supervisors expressed their desire for additional training about child development milestones. The determination of what to learn privileged the input of local health workers over the policy provisions of the Kenyan Ministry of Health, just as the decision on where to drill prioritised the knowledge of
local water diviners over the GIS surveys and other reifications of expertise emanating out the civil engineering agencies of Zimbabwe’s capital (de Laet & Mol, 2000). And in the same manner that the Bush Pump’s inventor addressed user demands by incorporating larger casings and cylinders along with heavier pipes in order to furnish more water per stroke, the Academics would promote the uptake of their mobile learning technology by selecting a smartphone over a low-end handset, as part of delivering their pedagogically rich learning experience. Opting for the more expensive and maintenance-intensive pump was consistent with the findings of Akrich, Callon, and Latour (2002), who demonstrated that cost efficiencies alone did not always explain the successful diffusion of technologies. The Academics enlisted the Huawei Y360 along these same lines, rejecting conventional cost-benefit paradigms as they yielded to what they viewed as the design exigencies of a sustainable and scalable, practice-based educational technology for geographically isolated local health workers in resource-constrained environments.

The fluid hero in de Laet and Mol’s account was “not intent on keeping the pumps as they were delivered: intact, in shape, shining like new” (de Laet & Mol, 2000, p. 251). As the Bush Pump was implemented in the field, its form and function were allowed to evolve to overcome obstacles in the field; levers operated with missing bolts, leather seals were replaced by makeshift bits of rubber tire, steel rods served as proxies for disappearing screws, while community-wide maintenance regimes were occasionally supplanted by smaller family-run programs. Like the inventor of the Bush Pump, the Academics steered the further development of the mProject during enrolment, “not by taking command, but by trying to let go. By allowing for surprises” (de Laet & Mol, 2000, p. 250). Components were added and removed from the mobile learning intervention as the HAT encountered trials of strength that challenged its ability to interesse the mobile phones and CHWs. Wheelchairs, prosthetics, diapers, and mud bricks became implicated in a learning intervention that had already enlisted mobile phones, solar chargers, referral forms, and a child assessment tool validated by researchers in Malawi. The practices of research in public health and educational technology were fused with the delivery of an array of community health services, informal work-based learning activities, the provision of special needs support, and income generating activities. The Academics would assert:

having researchers make common cause with those in need in a very practical and realistic manner [meant] that they must be open to unexpected developments, so as any ICT4D project evolves, it will of necessity become an increasingly holistic intervention (Table 3-1, mProject document #40, p. 6).
What did the Academics’ “holistic intervention” look like 18 months into the roll out of the project? In keeping with the design principles of a fluid inventor, the Academics attempted to accommodate all of the HAT’s performances, conserving its potential to act as a health assessment protocol, as content for e-learning, as a job aid, a consumer good and as a patient advocacy tool. Like the creator of the Bush Pump who asserts, “It’s not up to me” (de Laet & Mol, 2000, p. 250), the Academics did not seek to settle the knowledge controversies that emerged out of the different enactments of the HAT. Without intervening in the conflicts emerging out of the ontological politics of the HAT, they would still be able to answer the research question that formed the obligatory passage point of their initial problematisation:

How can the participatory development of a practice-based mobile learning intervention for CHWs and their supervisors improve the health care access of communities?

But in doing so, the Academics would need to adjust their own research goals, and did so as part of their planned “cycles of design, action, reflection and re-design in order to iteratively develop and trial mobile interventions to improve CHWs' training, on-going supervision and peer learning capabilities” (Table 3-1, mProject document #5). As seen in Figure 7-1, the Academics’ updated problematisation would not only be engaged in advancing knowledge about ICTDs, and in empowering the CHWs as learners, but now also sought to empower disabled children by strengthening the identities of CHWs as service providers and leaders in their communities.

Each enactment of the HAT was brought into being through the practices of distinct socio-technical environments. The “praxiographic ‘is’ is not universal,” emphasises Mol, “It is local. It requires a spatial specification” (2002, p. 54). In a household where a child has no apparent signs of disability, the HAT was a clinical algorithm, encoded into an m-health assessment tool for the early detection of delayed developmental milestones. Within the “conversational learning space” for e-learning, the HAT was a script or mutual language that supported interactions between mobile phones, CHWs, and their learning environments. As a component in Kenya’s Community Health Strategy, the HAT was a health care protocol, embedded in mobile phone to serve as a job aid for improving the productivity of service providers. In the market economy directed at Bottom of the Pyramid users, the HAT was a consumer choice, one of many “features” of a mobile phone. For disabled children and their caregivers, the HAT did not
detect developmental delays – these are readily apparent – but instead served as an advocacy tool that CHWs could use to “gather and constitute an assembly of ‘represented’ people by giving them a voice,” as well as “legitimise themselves as representatives of these people while eliciting the emergence of health issues that they bring to the attention of other stakeholders” (Rabeharisoa, Moreira, & Akrich, 2013, p. 116). The multiplicity of the HAT corresponded to alternative configurations of embedded practices that would implicate the mobile phones, the CHWs, and their patients in a variety of ways.

7.2 The controversies in fluid spaces

Initially, the Academics did not work to resolve the incoherencies between the multiple HATs. As Fenwick and Edwards have observed, a participatory, flexible design approach is widely viewed as conducive to innovation, and such an array of contrasting material-discursive practices typically emerge out of technologies that are “shaped and customized” by workers (2010, p. 27). Furthermore, the Academics envisioned a mobile-

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**Figure 7-1** The mProject as the obligatory point of passage after enrolment

![Diagram](image)

**Entities**
- The Academics
- The Kenyan NGO
- The Mobile Phone
- The CHWs
- THE DISABLED CHILDREN

**Goals of Entities**
- Advance knowledge about ICTs for development & MDGs; empower CHWs as learners; empower CHWs as service providers; empower disabled children
- Expand m-learning capacity to train & support CHWs
- Host sustainable & scalable mobile learning app
- Improved training & supervision for professional advancement
- Improved access to health & education services

**HAT**
- Obstacle: CONSUMERISM & LIMITED CONNECTIVITY
- Obstacle: geographical distances & resource constraints
- Obstacle: LACK OF AWARENESS OF DISABILITY NEEDS

**Obligatory Passage Point**
- The mProject
  - How can the participatory development of a practice-based mobile learning intervention for CHWs and their supervisors improve the health care access of communities?
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phone based intervention that would be a “crucial tool in mediating and supporting practice”, instead of a technical conduit for delivering health care information (Table 3-1, mProject document #5, p. 2). Their research was part of a tradition of educational scholarship that viewed learning in terms of “knowledge practices” and “participation” in acts of knowing, as opposed to “knowledge transfer” and the “acquisition” of codified, commodified concepts or ideas (cf. Sfard, 1998). As such, all of the material-discursive practices in the various enactments of the HAT were potential sites of learning for CHWs and were therefore of research interest to the Academics. Instead of interfering with the multiplicity of the HAT, the Academics remained open to the fluidity of its practices, and would wait and observe, rather than attempt to suppress or privilege one enactment over the other.

In the manner of the fluid inventor, the Academics initially refrained from intervening in the conflicting performances of the HAT, anticipating that as long as these multiple enactments remained sufficiently distanced, any tensions would, as Mol describes, persist in a “pacified form” and could be “lived with” (2002, p. 87). Mol goes on to develop the spatial metaphor of distribution to describe how differences – played out here as trials of strength during enrolment – might be settled without having to solve “logical contradictions between theories” or “social conflicts between groups promoting theories” (Ibid.). All the enactments of the HAT could be accommodated without actively resolving any disagreements so long as these varied and dynamic sets of material-discursive practices did not seek to enact the same socio-technical space simultaneously. When practices of such alternative problematisations were sufficiently distributed through time and across space, the multiplicity of the HAT could be left unchecked and conflicts would remain relatively contained, if not avoided all together.

It is possible, for example, to envision a hypothetical scenario where the different ontologies of the HAT might be distributed sequentially in time along a “care pathway” for a given patient. In a more formal approach to health worker training, the HAT might be enacted first as educational content used by instructors (along with training manuals, marker pens, flip charts) to deliver “credentialed knowledge” to CHW learners prior to their encounters with patients. With training “received”, these CHWs would arguably possess the necessary skills to then perform the HAT as a health assessment tool for the early detection of disabilities (either with or without the mobile phone). A positive diagnosis for developmental delays would prompt the CHW to refer that child to the health care facility, rendering the enactment of the HAT as a job aid that improves the
productivity of the CHWs within the larger health system. Finally, the HAT would emerge as a patient advocacy tool that is used by the CHW to expand the assemblage of afflicted children and to give legitimacy to their claims on the health system. Because in this scenario the various ontologies of the HAT are distributed neatly along a time continuum that remains linear, the multiplicity of the HAT does not lead to conflicts. First, it is educational content, then it is a health assessment tool, next it is a job aid, followed by an advocacy tool.

Alternatively, another situation can be envisioned whereby the various enactments of the HAT are performed at the same point in time, but unfold with different patients in clearly delineated spaces of the CHW’s work setting. Again, traditional approaches to health worker training help illustrate this hypothetical case. In a training room, the HAT is a reification of the public health expertise that is to be transferred from a Ministry-approved instructor to the CHW learners. In households where children under six years do not show obvious signs of disability, CHWs and mobile phones help to enact the HAT as an assessment tool for the early detection of delayed development. In the Level 1 facilities, the HAT functions as a job aid that ultimately improves CHW productivity by helping them to make appropriate referrals. And in the catchment area attributed to each CHW, the HAT functions as an advocacy tool that is used by the CHW to raise awareness and advance the well-being of all disabled children, regardless of their age or the severity of their disability. If the CHWs and mobile phones can enact different forms of the HAT within fixed and separate designations of geographical space, all inconsistencies between alternative material-discursive apparatuses can co-exist at a single point in time without ever clashing. At one site, the HAT is a health assessment tool; here, it is a job aid; in another locale it is educational content; while over there, it is an advocacy tool.

However, such tidy temporal and spatial distributions were not to be had during enrolment. As Massey asserts:

Space is not static, nor time spaceless. Of course spatiality and temporality are different from each other, but neither can be conceptualized as the absence of the other. (1992, p. 80)

As described in the last chapter, the varied performances of the HAT were intricately entwined with one another at numerous moments, in numerous places. Some of these entanglements were built into the Academics’ initial problematisation, as part of its focus
on mobile learning – and the scholarly contention that knowledge practices should extend beyond the built confines of classrooms, training centers, and other conventional educational institutions (refer to Section 4.3.1). Incorporated into what was to be a practice-based intervention, the HAT’s performances as educational material were, by design, made to be almost indistinguishable from its enactments as a health assessment tool or as job aid. Embedded into the mobile phone, the HAT was to then move outside the training room and partake in the enactment of learning as the CHWs travelled through households, community centers, schools, and health clinics to carry out their duties.

While some of the contestations emerged out of the mProject’s focus on mobile learning and the knowledge practices that informed the workplace, other conflicts stemmed from the high prevalence of disabled children and the resource constraints in both Kibera and Makueni. For several of the CHWs, it was their role as patient advocate that generated the most turmoil in relation to the other roles that had been delegated to them. The high prevalence of severely disabled children, the spectrum of diagnoses, and the enormity of their needs weighed heavily on the CHWs, who were not only front-line providers but also neighbors to these individuals. The use of the HATApp decreased, as more and more disabled children were identified and the CHWs began working to identify solutions for these patients (my fieldnotes, March 20, 2015, Nairobi; Table 3-1, mProject document #51). The HAT had not interested the Ministry of Health or the Kenyan NGO. Consistent with global practice trends (Groce, 2011), the CHWs had received little training from the Ministry or NGOs about managing cases of disability, and patients often complained that the CHWs’ referrals to the link facilities failed to generate appropriate services. Moreover, many of the services that the disabled children and their families required were outside the remit of the health system. Irrespective of when and where a patient encounter took place, the HAT’s enactment as a job aid created expectations and demand that the rest of the health system was either unwilling or unable to address.

7.3 Coordinating the HAT(s) to settle differences

The lack of services in the formal health system created untenable conflicts for some of the CHWs, obliging them to continually negotiate their accountabilities as they juggled their identities as learners, care providers, health system cadres, and patient advocates. The HAT’s contrasting enactments – and their competing demands on the CHWs – were not sufficiently distributed across time and space. In a setting with so many severely disabled children and so few allocated services, the performances of the HAT
did not remain separate, but jostled with one another and struggled to impose different roles on the CHWs. The urgency of responding to the needs of those children diverted the CHWs away from using the HAT to detect milder cases of disability, to engage in e-learning, or to make effective referrals – their roles as patient advocates became paramount. The tensions emanating out of the multiplicity of the HAT would be alleviated if the Academics could articulate how the different enactments were to relate with one another. The Academics no longer maintained their stance as fluid inventors and began to actively address the multiplicity of the HAT by engaging in the work of coordination. Mol describes coordination as “the drawing together of a diversity of objects that go by a single name” (2002, p. 84). “Drawing together” the various network effects of the HAT involved the forging of new connections that would allow these multiple realities to “hang together” as a single, durable entity known as “the mProject”.

Coordination is a form of intervention involving the active manipulation of multiple realities rather than an alignment of divergent perspectives. As Mol writes, “Coordination into singularity doesn’t depend on the possibility to refer to a preexisting object. It is a task. This is what designing treatment entails” (Ibid. p. 70). To resolve the controversies that persisted during enrolment, the Academic would need to coordinate the multiple enactments of the HAT into a “patchwork singularity”, a “composite reality that is a judgment about what to do” (Ibid., p. 71-72). In attempting to tame the entanglements of the HAT, the Academics curbed their own fluidity, and that of their mProject. They assumed a more directive role and now specified how the varied enactments of the HAT were to perform in relation with one another. In doing so, the Academics carved out a composite entity, a “HAT multiple” that would “identify certain practices as learning, which also entails a value judgement about learning something worthwhile” (Fenwick & Edwards, 2010, p. 41). Such coordination work can be seen as an attempt to moor the mobility of the mProject (cf. Edwards et al., 2011), to stabilise the shifting and expanding array of network actors in order to trace out or mark the boundaries of this mobile learning intervention.

The Academics adopted a mode of coordination whereby one reality wins: they established what Mol calls a hierarchy (2002). All the manifestations of the HAT could potentially participate in the mProject, but in instances of conflict, its enactment as a patient advocacy tool would take precedence over its performances as a health assessment tool, as content for e-learning, as a consumer good, and as a job aid. They explain:
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The constant point that we needed to keep in mind was that instead of being mere observers, we were challenged to make a judgement and to take a position on the conditions of abject poverty we encountered and to justify the role of the project in alleviating them. (Table 3-1, mProject document #35, p. 3)

The Academics argued that ICTD researchers “must go beyond their usual day-to-day interactions with people who are marginalised to become advocates for them […] by effectively tackling the social and political structures that cause and prolong inequality” (Table 3-1, mProject document #40, p. 5).

In the case of the mProject, confronting social and political structures entailed the development of “support structures of direct benefit to children with neurodisabilities and their families” (Ibid., p. 11). In this modified problematisation, the researchers considered themselves “campaigners for social change”, citing their work to empower these children and their families through the (1) improvement in the monitoring and supervision of CHWs by their supervisors; (2) increased awareness at the household level on the importance of child development; (3) increases in informed referral of children with developmental delays, and (4) the establishment of parent support groups and access to an array of special needs services that were both within and beyond the mandates of the formal health system (Ibid.). In this re-articulation of the Academics’ problematisation, learning and health care delivery become practices in a material-discursive apparatus where disabled children and their families were the objects of intervention, rather than CHWs. CHWs were still implicated as learners, but their knowledge practices were instrumentalised expressly to benefit the population of disabled children in the community. The beneficiaries of the mProject were no longer CHWs as learners, but disabled children as patients.

Any coordination of multiplicity into singularity is an intrinsically political undertaking in that it yields a certain allocation of power by designating specific roles and attributes to a group of human and non-human actors (see Barad, 1998; Mol, 2002). The work of coordination is a moral intervention, a design move that involved making normative judgements about those practices that were salient to the mProject, and those that could be dismissed. As Fenwick and Edwards contend, this act of selection entails standards that seek to purify a sociomaterial assemblage:

Purification refers to the way in which the educated subject is assembled upon the basis of the denial of the play of multiplicity and difference and the mobilizing of specific practices as more valuable than others […] Standards are mobilized to select and purify the what and how […] and the people to be enrolled. (Fenwick & Edwards, 2010, p. 49)
The Academics were aware that coordinating the multiplicity of the HAT through the establishment of a hierarchy of realities would allocate power in certain directions; they were deliberate in their work to empower the disabled children and their families and conscious of their role as patient advocate (see Table 3-1, mProject document #35).

Drawing on an interpretation of liberation theology (Farmer, 2005) and its imperative to take a “preferential option with the poor” (Boff & Boff, 1987; Gutiérrez, 1988), the Academics’ publications and presentations made it explicit that the mProject was to be an “inherently political” intervention (Table 3-1, mProject document #35, p. 2). The intellectual currents of liberation theology and its entanglements into the mProject will be more fully explored in the next chapter, but this scholarship is presented here to illustrate how the work of coordination entails the application of standards. In the case of the mProject, privileging the HAT’s enactment as a patient advocacy tool was seen to align with a normative claim, drawn from Catholic theology and prominent health activists that ICTD projects should reach “beyond the mere analysis of social inequality towards a critique of the structures that perpetuate and produce social injustices” (Ibid., p. 6). The Academics relinquished their stance as the “fluid inventor” and intervened in the multiplicity of the HAT – they applied a moral standard to define how these contrasting realities should relate to one another: When enactments conflict, the HAT was to participate in the enactment of the material-discursive practices of a patient advocacy intervention. They were to, in such cases, suppress their material-discursive apparatus for pedagogically-rich learning. In asserting this singularity, the Academics stabilised the fluid space enacted by the mProject, making the assemblage of actors relatively “heavy with norms” (Callon, 1992, p. 91) so as to become a more fixed and sustainable entity – an immutable mobile that could be made to travel from site to site via the manipulations elaborated in Callon’s fourth moment of translation (cf. Fenwick & Edwards, 2010).

7.4 Intermediaries and displacements

The movements described so far involve the fluidity that was engendered by the multiplicity of the HAT – and the Academics’ subsequent attempts to moor this mobility through the normative work of coordination. This mooring allowed for the demarcation of new boundaries for the Academics’ problematisation, and an articulation of the spaces that were to be constructed within the network (Murdoch, 1998). Like the research in
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Callon’s foundational account of scallops, the fluidity of the mProject was stabilised as it proceeded into the fourth moment of translation:

The initial problematisation defined a series of negotiable hypotheses on identity, relationships and goals of the different actors. Now at the end of the four moments described, a constraining network of relations has been built. (Callon, 1984, p. 218)

With the network relations in the mProject sufficiently robust, movement could resume again during mobilisation. However, these movements relate not so much to the fluidity of the HAT, but to the more orchestrated displacements that were necessary to expand the newly consolidated mProject.

Having moored the fluidity of their project through the work of coordination, the Academics established the scale, or scope of their mobile learning intervention and could begin scaling the mProject through the interessement of a new set of network actors: policy leaders with the funding and authority to support the extension of their project. This expansion is consistent with discourses in ICTD related to the scalability of projects (see Avgerou, 2008; Walsham & Sahay, 2006). Sahay and Walsham draw the distinction between scale and scaling as follows:

Although in practical terms scale refers to the size or scope of something (for example, an information system or a process), scaling concerns the process through which that product or process is taken from one setting and expanded in size or scope within that same setting and/or also incorporated within other settings. (2006, p. 185)

Hosman contends, “the proof-of-concept provided by a promising or successful pilot project is helpful for convincing stakeholders to invest in larger projects” (2008, p. 423). Like other ICTD researchers, the Academics attempted to demonstrate “proof of concept” to promote the scalability of the mProject. The decision-makers had to be convinced that the mProject constituted an obligatory passage point in the attainment of their own policy-related work practices, and was therefore worthy of their financial and organizational endorsement.

By the fourth moment of translation, the Academics had formulated an answer to the research question:

How can the participatory development of a practice-based mobile learning intervention for CHWs and their supervisors improve the health care access of communities?
At this point, their adoption of a “preferential option for the poor” had resulted in the establishment of a hierarchy of HAT ontologies corresponding to the following proposition:

The participatory development of a practice-based mobile learning intervention leads to: a health assessment tool, a job aid, a training tool, and most importantly, a patient advocacy tool that improves the health care access of communities.

This statement was based on their collaboration with a sample of CHWs and mobile phones, along with one of the many NGOs with operations in Kibera and Makueni. Now, as the funding period for the mProject approached its end, the Academics attempted to secure the support of decision-makers by persuading them that their account of the mProject represented the interests of many more CHWs, smartphones, and NGOs.

The notion of a credible spokesperson is a key aspect of the fourth moment of translation:

Who speaks in the name of whom? Who represents whom? These crucial questions must be answered if the project led by the researchers is to succeed. (Callon, 1984, p. 214).

According to Callon, the credibility of a representative – of the spokesperson – is achieved through the specific movements of enrolled actors. The trajectory of these movements does not flow haphazardly with the emergent fluid spaces of the “HAT multiple”, but instead corresponds to concerted acts of representation and displacement which allow the Academics to “speak on behalf” of other network actors to greater or lesser degrees of success. There is a “center-outward focus” to such displacements, all involving “the question of how actors at the center of a networking entity mobilize the people and things they are enrolling” (Nespor, 1994, pp. 14–15). These radial trajectories are conceptualized in Figure 7-1 as three different streams of CHWs, mobile phones, and NGO workers travelling along separate cascades of intermediary representations, all funneling into the Academics’ obligatory passage point.

Up to this point, the Academics had worked directly with a defined group of CHWs, mobile phones, and NGO workers during interessement and enrolment. With research funding from the DFID-ESRC Joint Scheme, they applied the Participatory Action Research methodology to assemble a network of individuals – and this assemblage had incorporated the HAT into its practices, according to a specific hierarchy of HAT enactments. Would more CHWs, mobile phones, and NGOs in Kenya do the same? In order to obtain additional funding and support to maintain and expand the mProject – and
thereby *scale* the intervention – the Academics had to convey that this experience was representative of what could happen with more CHWs, mobile phones, and NGOs. The Academics would have to persuade policymakers that they were the credible spokespersons not just for their direct collaborators, but for larger populations of CHWs, mobile phones, and NGOs. Notwithstanding the persuasiveness of such presentations, it is possible to explore empirically the strengths and weaknesses of their mobilisation of actors, since becoming a spokesperson has “a definite physical reality which is materialized through a series of displacements” (Callon, 1984, p. 217). The displacements to mobilise the support of the CHWs would have these individuals “move” through a “cascade of intermediaries who little by little reduce the number of representative interlocutors” (Ibid., p. 216).

Beginning with the roughly thousands of CHWs working across Kenya, the interessement of the Kenyan NGO led to the designation of the hundreds of CHWs sponsored by the organisation who, according to Callon, might “speak in the name” of all CHWs (Ibid.). Those Kenyan CHWs were in turn represented by roughly 75 individuals in Kibera and Makueni who were selected by the NGO administrators to participate in the mProject. Among those selected, 25 “Pioneers” were interviewed by the Academics and out of those, one CHW would ultimately attend a stakeholder’s meeting (Table 3-1, mProject documents #47 & #48), as a representative of all CHWs. Earlier on, this CHW had expressed her reluctance to speak in front of the large audience, so the Academics prepared a video of her, seated outside the dispensary in Makueni as she enthusiastically described her involvement in the mProject. Projected onto the large screen during a stakeholder’s meeting, this testimony, along with photos of her colleagues, was presented to confirm the Academics’ proposition that “the CHWs want improved training and supervision for professional advancement” and that when interested by the HAT, they would ultimately enroll in the mProject.

An analogous succession of transformations can be traced to show how the Academics became the spokesperson for a group of mobile phones that, like Callon’s scallops, “do not possess an articulate language” (Ibid. p. 216). The classic account of mobilisation describes how such a *chain of intermediaries* – from counts, to numerical inscriptions, to graphs and charts, and then academic publications – enabled three scientists at an amphitheatre in Brest to speak on behalf of countless non-human actors inhabiting the depths of the ocean. “The scallops are transformed into larvae, the larvae into numbers, the numbers into tables and curves which represent easily transportable,
reproducible, and diffusible sheets of paper” (Callon, 1984, p. 217). A similar string of intermediary representations had been constructed by the Academics to displace the mobile phones across time and space, allowing these Bottom of the Pyramid consumer products to travel to the Academics’ presentation at an ICTD stakeholder’s meeting in a Nairobi office building.

Like the researchers who enumerated the larvae attached to towlines, the Academics could count how many mobile phones were successfully interested by the HAT. In intra-action with the CHWs, the Academics’ material-discursive apparatus had left behind permanent marks of its phenomena – the digital traces produced by the mobile phones when learning actions took place. Mobile phones were transformed into digital traces, the digital traces into data stored on a distant server, the data into counts, the counts into charts, and the charts into a Powerpoint file presented to decision-makers with money and authority in public health and international development. Through this sequence of displacements, the Academics became a spokesperson for the mobile phones and asserted their claim that “the mobile phones can host a pedagogically rich learning application to promote global health”.

Did the Academics succeed in persuading policy leaders that they were credible spokespersons for CHWs and mobile phones? If Callon’s analytic framework holds, then the Academics had to accomplish two inter-related tasks to establish their credibility vis-à-vis these decision-makers. First, they had to make the case that what was presented in their Powerpoint slides represented the interests of the individual actors actually enrolled in the mProject. Such an argument relates to what Campbell and Stanley have called the “internal validity” and “efficacy” of the intervention (1966). Secondly, the Academics had to show that in enacting the mProject actor-network as such, those particular individuals represented the interests of many additional CHWs and mobile phones – actors that would be interested by the HAT in the future, given adequate funding and support. This argument relates to the “external validity” and “effectiveness” of the intervention (Ibid.). With the first task, the Academics would demonstrate that the material-discursive apparatus that they assembled was durable. With the second task, they would show that this apparatus would continue to draw additional CHWs and mobile phones towards the obligatory passage point articulated in their problematisation. In asserting their credibility as the “sole and ultimate spokesman” this way (Callon, 1984, p. 216), the Academics would show that they had effectively mobilised participants in the
mProject and thereby demonstrate that this research intervention was *sustainable* enough for policymakers to begin investing in the work of *scaling*.

### 7.5 Open controversies and reconfigurations

At the stakeholders’ meetings, the Academics presented their two major claims on behalf of the actor-network: (1) CHWs want improved training and supervision for professional advancement; and (2) mobile phones can host a pedagogically rich learning application to promote global health. The policymakers had to be persuaded that the Academics were *credible spokespersons* – Had the Academics’ mobilised sufficient numbers of CHWs and mobile phones when making such claims? Did the *chains of intermediary representations* constitute a series of solid equivalences, beginning with CHWs and mobile phones at large and ending with the Academics’ presentation? The success of mobilisation, according to Callon, is to be “strictly measured by the solidity of the equivalencies that have been put into place and the fidelity of a few rare and dispersed intermediaries who negotiate their representativity and their identity” (Ibid p. 218).

“All the manifestations by which the representativity of the spokesperson is questioned, discussed, negotiated, rejected, etc” relate to the *controversies* of innovation in science and technology (Ibid., p. 219). These controversies can be further understood as debates over whether the intermediary representations could be considered “robust evidence” for claims made by a spokesperson. Techniques of displacement during the fourth moment of translation “range from mobilization in the flesh – assembling strikers for a mass rally, for example – […] to the representation of previously dispersed entities in stable, mobile, and combinable forms (textual or electronic)” (Nespor, 1994, p. 14). If such embodiments and inscriptions were to successfully interesse policymakers, they had to align with what “counted as evidence” within the material-discursive apparatus enacting the policy making process. As Sutcliffe and Court note, “the breadth of what is considered evidence is […] wide and dynamic [but] it would be a mistake to assume that in reality all forms of evidence share equal importance, relevance, or weighting” among policy makers (2005, p. 3).

The Academics’ adoption of the Participatory Action Research methodology (White, Suchowierska, & Campbell, 2004) and theory-driven evaluation (Chen, 1990) was aimed at “eliciting the experiences and views of poor people” so that these individuals could “lead in the development of the app” and define success and failure on their own terms rather than responding to externally-imposed targets (Table 3-1, mProject
Noting a gap in research to describe CHW participation in health policy activities, the Academics advocated “for the ‘voice’ of the CHWs to be a central component of programme design and implementation” (Table 3-1, mProject document #39, p. 2). During the stakeholder meetings in Nairobi, the “voice” of the CHWs was to be materialised through the photos and the CHW’s video-recorded testimony. These intermediary representations were presented to policymakers as evidence that “CHWs want improved training and supervision for professional advancement.” The Academics asserted that while the purposive sampling strategy in Kibera and Makueni could not “be treated as statistically representative of all CHWs’ working contexts,” the data collected would “provide compelling evidence from two contrasting situations from which lessons can be learnt” (Table 3-1, mProject document #5, p. 3).

The Academics’ evidence did not align neatly with the positivist, expert-oriented knowledge regimes which were seen to dominate government policymaking (cf. Sutcliffe & Court, 2005). Those material-discursive practices placed the results of randomised control trials (RCTs) “on a pedestal above all other forms of evidence” (Shelton, 2014, p. 253) and did not correspond with the Academics’ intermediary representations, which were to provide “an in-depth understanding of contexts and issues […] as a precursor to theory development, claims about prevalence or other generalizations” (Table 3-1, mProject document #39, pp. 3–4). While the video and photos of the CHWs may have supported the Academics’ aim to provide “credible and grounded accounts of ‘what works for whom in what circumstances’” (Table 3-1, mProject document #5, p. 3), these inscriptions did not furnish policymakers with handy estimates of “how many?” Would, as Callon asks, “the masses […] follow their representatives” (1984, p. 214)?

Policymakers might have been more readily interested by the intermediary representations typically generated from RCT studies. Those population-based assessments of programme efficacy and effectiveness offered statistical estimates of “how many” and such representations were highly compatible with dominant material-discursive practices in “evidence-based policy” (Sutcliffe & Court, 2005). But even in the absence of the highly-valued inscriptions from experimental trials, the policymakers in Nairobi could still be swayed by the photos and the video testimony, so long as these representations conveyed the viability of the mProject. As Chen argues, health programmes are not created solely for academic and scientific concerns, but must also meet the “political, organizational, and community requirements” of stakeholders (2010,
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p. 207). These considerations relate to what he calls the *viability* of interventions, rather than their efficacy or effectiveness, and address the following types of issues:

- Can the intervention program (1) recruit ordinary clients without paying them to participate, (2) does it have a clear rationale for its structure and linkages connecting an intervention to expected outcomes, and (3) do ordinary clients and other stakeholders regard the intervention as helpful in alleviating clients’ problems or in enhancing their well-being as defined by the program’s real world situations? (2010, p. 207)

To interesse the policymakers, the Academics’ representations had to show that the mobilisation of CHWs was viable – that the displacements leading into their obligatory passage point were “likely to last” (Callon, 1984, p. 219).

The policymakers were receptive to the Academics’ claim that the CHWs want improved training and supervision for professional advancement (my field recording, March 18, 2015, stakeholder’s meeting, AMREF Headquarters). They applauded the video testimony and praised the CHW for her dedication and successful efforts, with one Ministry representative proclaiming, “We feel the tool is very good” (Ibid.). While the stakeholders did not challenge the durability of the actor-network that had been assembled by the Academics, questions remained about how many additional CHWs could be mobilised. Could the CHW’s testimony be considered representative of many other CHWs in Kenya? Controversies about the representativity of the enrolled CHWs prompted an attendee from a multi-lateral aid agency to explain:

Understanding that this [the mProject] is a research project, we will take this as a reference point for different kind of initiatives later – health initiatives. So what would be interesting to understand is the criteria, the selection criteria for CHWs. How did you select them? If you could bring that out, it would really help us out. (Ibid.)

One attendee pointed out that the CHWs who enrolled in the mProject all worked in well-functioning Community Units, and he expressed doubt that similar results could be had in areas where the Community Health Strategy was less established. Another stakeholder observed that while the mProject may have generated results among CHWs in urban areas or rural villages, Kenyan CHWs from nomadic pastoralist communities were not represented. A Ministry officer further noted that since CHWs were not officially remunerated for their work, providing CHWs with smartphones phones and airtime for personal use was a “good thing” and could motivate the many others who typically did not receive such incentives.
The policymakers were similarly reserved in their reaction to the mobile phones’ performances in the mProject. Their admiration for the Academics’ actor-network did not lead to categorical support for the claim that mobile phones can host a pedagogically rich learning application to promote global health. The attendees of the stakeholder’s meeting accepted the Academics as credible spokespersons for the smartphones in their intervention, but they were not convinced that additional phones could be mobilised in the future, given the widespread use of less expensive feature phones. As one attendee stated:

Yes, it is a fantastic tool that you have […] however our [breakout discussion] group strongly felt like, how about, how can we make the same information available on a feature and regular mobiles? Basically if it’s possible, then that would be great for Kenya, especially in the rural areas where there is no, or less access to the smartphones. (my field recording, March 18, 2015, stakeholder’s meeting, AMREF Headquarters)

The stakeholders also expressed their uncertainty over how other mobile phones could be interested, given that there were already so many other m-health initiatives operating to address a wide range of pressing health issues articulated in the Community Health Strategy. Finally, an attendee shared her doubts about how many smartphones could continue hosting the mobile learning intervention going forward into the future:

One thing that came up in this group and in the presentation this morning is around the continuing operational costs [of the mProject]. Once you have implemented a project […] It has some costs that have taken place. And when you are thinking of “scaling” or you are “handing over”, these are the things that you have to think about […] Who is going to take over those costs? Is it the CHWs, the CHEWs, the government? How will it work? So I think it’s a really pragmatic question to ask […] Assuming that the project was not there anymore, would this solution continue to work? (Ibid.)

In the closing comments at the stakeholders’ meeting, a Ministry official stated, “We feel this is a very good success story that can be used as a baseline for the future use of mobile phone” (Ibid.). But the cost of procuring, maintaining, and operating a smartphone was controversial. Assessing the Academics’ impressive results in light of those financial implications, she asked the group, “Can we achieve more than this”?

The Academics convened a second stakeholders’ meeting in Nairobi four months later with charts and numbers aimed at addressing the policymakers’ prior concerns (see Table 3-1, mProject document #50), but these inscriptions did not succeed in convincing them that the mProject had mobilised sufficient numbers of CHWs and mobile phones. Neither the Ministry of Health nor the other aid agencies formally endorsed the
continuation and expansion of the mProject. Without additional funds to purchase airtime and data bundles, the mobile phones would no longer be interested by the HAT to host a mobile learning intervention. The CHWs had already begun to detach themselves from the HAT and had started using other, less constrained features of the mobile phones to address the immediate needs of the disabled children. And like the fishermen who “wait for the final verdict” on scallops and towlines (Callon, 1984, p. 213), the Kenyan NGO was never completely interested. It had withheld its complete support until it could be certain that the other actors would be successfully mobilised. As the prospect of future funding diminished, the Kenyan NGO was pulled towards an alternative mobile phone intervention, the highly visible Corporate Social Responsibility initiative of a global accounting firm which would conceptualise learning as the “acquisition of knowledge”, rather than “participation in knowledge”. With more and more human and non-human actors severing its linkages to the HAT, the device of interessement could no longer exert its agency in the enactment of a health assessment tool, a training guide, a job aid, a consumer choice, or an advocacy tool.

By the end of the fourth moment of translation, the Academics had not settled the controversies over the identities and interests of the CHWs, mobile phones, and the Kenyan NGO. Like the researchers in Callon’s paper, they were obliged “to transform the device of interessement […] and to undertake a vast campaign to educate and inform” so that more enlisted actors would accept the Academics as credible spokespersons (1984, pp. 220-221). The Academics re-articulated their problematisation in order to consolidate their claims that: the CHWs want improved training and supervision for professional advancement; and the mobile phones can host a pedagogically rich learning application to promote global health. New funding from one Academic’s academic institution was secured to support additional research. The HAT was no longer retained to act as a device of interessement – the soul of this reconfigured apparatus was to be materialised in other, yet to be determined ways. The Participatory Action Research approach, which had been adopted earlier to empower the CHWs as learners, would now be focused on empowering disabled children and their mothers in order to establish an additional claim: Disabled children and their mothers want improved access to health and education services.

7.6 Summary

This chapter on mobilisation drew from spatial theories to elaborate the forms of movement that took place during the fourth moment of translation. It described how the
Academics’ initial stance as “fluid designers” helped to enact a mobile learning intervention with boundaries that were vague and dynamic, rather than distinct and fixed. This fluidity was seen to be compatible with the complex working conditions of development projects, but it imposed conflicting identities on the CHWs as they were confronted with the responsibility of caring for the large numbers of disabled children in their communities. In order to resolve those tensions, the Academics worked to coordinate the varied enactments of the HAT, privileging the HAT’s enactment as a patient advocacy tool – and the CHW’s corresponding identity as a patient advocate. This hierarchy of ontologies was established based on the Academics normative claims for social justice, but failed to consolidate the support of the formal health system, leading to the demise of the HAT as a device of interessement and the gradual dissolution of the mProject actor-network.

My narrative of mobilisation illustrates how scaling up ICTD projects can be understood as a form of design practice – as situated action to close a gap between reality and an intended future (Heeks, 2002). As Suchman argues, technical systems such as the mProject, cannot simply be “stabilized and cut loose from their sites of production long enough to be exported en masse from their sites of use” (2002, p. 95). Scaling the mProject required continued local improvisations to enlist policymakers and funders. The mProject failed at the end of the fourth moment of translation because there were no “design improvisations” to the mProject, nor were there any “actuality improvisations” that would alter the reality of funders and donors (Heeks, 2002, p. 108). In the next chapter, I show how the controversies of designing educational technology in ICTD can be understood as a “matter of care” (Puig de la Bellacasa, 2011). Responding to the call for STS studies that “trouble the ways in which care is performed” (Murphy, 2015), I will critique the Academics’ enlistment of social justice scholarship and suggest how the work of “infrastructuring of publics” (Dantec & DiSalvo, 2013; Marres, 2007) can better attend to the complexities and the materialities of enacting social justice in mobile learning and ICTD.
“Tragic choices”, according to political philosopher Martha Nussbaum, are social situations that force individuals to choose between the basic entitlements necessary for “a dignified and minimally flourishing life” (2011, p. 33). Such entitlements are understood as “capabilities”, a concept developed by economist Amartya Sen (1999) and elaborated by Nussbaum (2000). Integrating Aristotelian moral philosophy into development economics, the idea of capabilities is considered a paradigm by international development policy-makers (Fukuda-Parr, 2003) as well as ICTD scholars (Zheng & Stahl, 2011; Klein, 2013). This notion is widely-regarded as an advancement over utility and income-based approaches to development policy and practice (Clark, 2009), emphasising instead:

choice, or freedom, holding that the crucial good societies should be providing for their people is a set of opportunities, or substantial freedoms, which people then may or may not exercise in action: the choice is theirs (Nussbaum, 2011, p. 18).
In her framework of social justice, Nussbaum contends that tragic choices oblige us to think about how to rank these basic capabilities and to discern “[h]ow might we possibly work toward a future in which the claims of all the capabilities can be filled” (2011, p. 38). What is “the best intervention point to create a future in which this sort of choice does not confront people?” she asks, and how might we “move people closer to the capability threshold right away, even if we can’t immediately get them above it” (Ibid., p. 39)?

How to intervene in the interest of social justice and the good life? In demonstrating the ontological multiplicity of atherosclerosis as the “politics of what?” Mol concludes:

All in all, “choice” may not be the best term to capture what needs to be done, and what is going on, in the politics of what that we as medical professionals, ethnographers, sociologists, philosophers, and, yes, as patients too engage or may engage in. We need other terms. We have some other terms: discord, tension, contrast, multiplicity, interdependence, coexistence, distribution, inclusion, enactment, practice, inquiry - but we could do with more. Which ones? (2002, p. 180 -181)

In this chapter, I argue that the concept of care (Puig de la Bellacasa, 2011) is an additional term that is necessary for understanding how design practice is entangled with these global aspirations to promote capabilities and advance human development. The last four chapters described how the Academics attempted to coordinate and tame the controversies of five different material discursive apparatuses enacting CHWs as public health researchers, consumers, learners, health system cadres, and community activists. I set out with “minimal theoretical rigging” to “cut the network” by following the HAT through the four moments of translation. I added conceptual work on the material-discursive apparatus (Barad, 1998) to further describe how the Academics’ problematisation was materialised during interessement. I then incorporated Mol’s work on multiplicity and ontological politics to better depict the trials of strength that unfolded during enrolment (1999, 2002). Spatial theories related to fluidity (Mol & Law, 1994) and coordination work (Mol, 2002) were finally incorporated into my “observing apparatus” to render a more textured account of mobilisation.

With this assemblage of theoretical concepts, I was able to describe in detail the sociomaterial effects of several different enactments of the HAT: as a health protocol, a consumer good, as content for e-learning, as a job aid, and as a patient advocacy tool. Yet this “observing instrument” does not capture how poverty, morality, and theories of social
justice related to design practice, and to the concomitant materialisation of the mProject. These factors were a crucial part of the empirical setting but have not been adequately accounted for in my analysis thus far. The apparatus that I have assembled up to now could have just as easily been built during a case study of a corporation in an industrialised nation. Assuming that each of the five material-discursive apparatuses enacting the HAT was gathered in the interest of promoting human capabilities, I contend that additional theoretical equipment related to care is necessary to bridge sociomaterial practices of design with aspirations of social justice and the advancement of human capabilities.

Earlier in the Chapter 2, I described how STS researchers use theoretical concepts to build apparatuses to observe and analyse the sociomaterial practices of science and technology. Like the instrumentation in Latour and Woolgar’s classic account of “laboratory life” (1979), the semiotic tools of STS require adjustments and tinkering in response to the contingencies of the empirical data and the aspects of the phenomenon of interest. Barad notes:

This is part of the creativity and difficulty of doing science: getting the instrumentation to work in a particular way for a particular purpose (which is always open to the possibility of being changed during the experiment as different insights are gained). (2007, p. 203)

To illustrate more precisely the entanglements of poverty, morality, and social justice theory in design practice for ICTD, I will therefore recalibrate my theoretical apparatus to examine the mProject not as an effect of numerous material-semiotic practices related to the HAT, but as a “thing” or actor in itself that relates to a wider constellation of humans and non-humans enacting the global development agenda.

Building on my empirical analysis in Chapters 4-7, this chapter incorporates feminist STS theory to analyse the mProject as a matter of care (Puig de la Bellacasa, 2011). In the first section, I introduce work by feminist STS scholars to suggest that the ontological politics of designing educational technology for CHWs are better understood as the politics of caring (Puig de la Bellacasa, 2011). Adding this notion of matters of care into the theoretical rigging for my research, I analyse how care was performed in the mProject, critiquing the Academics engagements with social justice scholarship as “moral values added to the thinking of things” (Puig de la Bellacasa, 2011). Following this “vexation of care”, I show how attending to exclusions might generate a different way to care – an intervention in the “politics of what” that is firmly attached to the material-
discursive practices of Academics, CHWs, mobile phones, NGOs, and patients, yet remains open to alternative and unforeseen enactments of social justice.

8.1 Matters of care in STS

During the account of translation provided in Chapters 4 through 7, the rhetoric of emancipation percolated through each of the material-discursive apparatuses enacting the HAT, but allocations of power differed in each performance. As content for e-learning, the HAT was the soul of an apparatus to empower the CHWs in their identities as learners, while its alternative enactments incorporated CHWs into an assortment of instruments to empower other individuals and identities. Empowerment was, therefore, a contested practice directed at various actors implicating overlapping but distinct sets of human and non-human identities. The articulation of these sociomaterial entanglements raised political questions for the Academics about the options available, the stakes of each option, and how to choose among options (Mol, 1999). Coordinating the multiplicity of the HAT stabilised the actor-network but, like any apparatus, inevitably enacted exclusions.

Star has argued for examining how exclusions are enacted throughout the formation of actor-networks, reiterating Callon’s explicit vision of translation as a set of concepts to articulate power dynamics in science and technology. She writes:

One of the features of the intermingling [of people and objects] that occurs may be that of exclusion (technology as barrier) or violence, as well as extension and empowerment. I think it is both more analytically interesting and more politically just to begin with the question, cui bono? than to begin with a celebration of the fact of the human/nonhuman mingling. (1990, p. 43)

This call to examine the politics of technoscience has been taken up by feminist STS scholars who “not only invite us to ask ‘For whom?’, but also ‘Who cares?’ ‘What for?’ ‘Why do ‘we’ care?’, and mostly ‘How to care?’” (Puig de la Bellacasa, 2011, p. 96). As discussed below, these engagements with STS signify an ethico-political obligation, an affective state, and a material vital doing (Puig de la Bellacasa, 2011).

8.1.1 Care as an ethico-political obligation

Care is considered an ethico-political obligation that “goes beyond a moral disposition or wishful thinking to transform how we experience and perceive the things we study” (Puig de la Bellacasa, 2011, p. 100). Treating the formation of actor-networks as matters of care extends Latour’s prior efforts to direct STS research towards the
gatherings that constitute *matters of concern* (2004, p. 232). Deploring the “corrosive critique” associated with the dismantling of scientific matters of fact, Latour called for a respectful critique directed at “cherished objects”, with the aim of strengthening their claims to reality rather than weakening them:

The critic is not the one who debunks, but the one who assembles. The critic is not the one who lifts the rugs from under the feet of the naïve believers, but the one who offers the participants arenas in which to gather. The critic is not the one who alternates haphazardly between antifetishism and positivism […] but the one for whom, if something is constructed, then it means it is fragile and thus in great need of care and caution. (Ibid., p. 246)

Moving away from the deconstruction of scientific facts, Latour’s matters of concern called for critical inquiry to address public issues entailing democratic processes and the interdependence of multiple actors. Pursuing this move, materials and devices would be treated as important actors in the democratic arena, and a respectful ethos would produce descriptions that refrained from reducing the construction of technoscience to facile pursuits of power and domination (Puig de la Bellacasa, 2011).

Feminist scholars in technoscience challenged Latour’s contention that respect and fairness pre-empted the need for radicalised voices from the margins. For example, Puig de la Bellacasa asks (Ibid., p. 89), “In the context of a troubled and strongly stratified world, do we not still need critical approaches to play a role in the assembling of concerns?” The addition of “care” to matters of concern signified a renewed call for the critical scrutiny of power relations in sociomaterial assemblages that constituted social issues. Murphy asserts that examining matters of care “[…] amplifies the affective entanglements through which things come to matter and injects commitments to attending to marginalized, invisibilized and neglected elements, experiences, and relations” (2015, p. 721). In this light, critique was not about laying easy blame on obscure oppressive powers as Latour might have feared, but about demonstrating how sociomaterial gatherings could reinforce inequitable relationships that devalued caring relations around matters of concern (Ibid., 2011).

Advocating care in STS is therefore a call to articulate the construction of ethically and politically demanding issues, and to bring the neglected, effaced, and devalued experiences of care to the foreground (Martin et al., 2015; McNeil & Roberts, 2011). These critiques of care are intended to lead to better care – deconstructing matters of care must “cut the network” in ways that do not simply lead to scepticism, doubt, or
indignation, but result instead in more attachments that open up possibilities for change. Thinking with care is a:

commitment to a collective of knowledge makers – however loose its boundaries and complex its shapes. It is [...] the embeddedness of thought in the worlds one cares for”. (Puig de la Bellacasa, 2012, p. 202)

Coupled to the resuscitation of critique in the gatherings of the actor-network is a “speculative commitment to think about how things would be different if they generated care” (Puig de la Bellacasa, 2011, p. 96). This is a “commitment” in the sense that the futures that are envisioned are firmly situated in the sociomateriality of gatherings. Yet, such extensions are to remain “speculative” so that they do not “[…] let a situation or position – nor even the acute awareness of pervasive dominations – define in advance what is or could be” (Puig de la Bellacasa, 2011, p. 96). If, as Barad asserts, power relations are continually shifting with the constant re-configurations of the material-discursive apparatus, then the strategies to redress the sedimentation of harm and injustice must also be lively, contingent, and adaptive (2007).

8.1.2 Care as an affective state

Matters of care affirm and extend Latour’s commitment to include affects as participants in the sociomaterial gatherings of concerns. Care is an affective state that is entangled in emergent gatherings that all leave behind their permanent marks in the world. Murphy describes care as being part of an affective economy where emotions act “not as a primal force in the individual or the psyche” (2015, p. 722), but as actors that can be analysed in same way that Marx analyses commodities. Cartographies that follow the formation of the actor-network – with all its attendant circulations of power – would therefore need to incorporate affects such as care, worry, and passion, in addition to the more conventionally utilitarian interests that had typically been applied to the deconstruction of matters of scientific facts.

As an affective state, care not only participates in the formation of the actor-network, but shapes the knowledge practices of feminist STS scholars who study such gatherings. To think with care is to reject the “bifurcation of nature” separating scientific reasoning from sensory and affective forms of rationality (Latour, 2004; Puig de la Bellacasa, 2011; Stengers, 2011). “From this affective perspective, transforming things into matters of care is a way of relating to them, of inevitably becoming affected by them,
and of modifying their potential to affect others” (Puig de la Bellacasa, 2011, p. 99). As philosopher of science Vinciane Despret argues:

To ‘de-passion’ knowledge does not give us a more objective world […] And as long as this world appears as a world ‘we don’t care for’, it also becomes an impoverished world, a world of minds without bodies, of bodies without minds, bodies without hearts, expectations, interests, a world of enthusiastic automata observing strange and mute creatures; in other words, a poorly articulated (and poorly articulating) world. (2004, p. 131)

This “care”, however, is not to be conflated with positive feelings or sentimental attachments, nor viewed as a moral value or an inherently “political good” – it may instead involve negative emotions such as anger, unease, and trouble that do not necessarily generate ready comforts or rewards (Murphy, 2015). To think with care is to “modify the affective charge of objectified things” – to reintroduce attachments, emotions, passions to the production of academic knowledge (Puig de la Bellacasa, 2011, p. 97).

8.1.3 Care as a material vital doing

Puig de la Bellacasa asserts that care involves “material engagement in labours to sustain interdependent worlds” (2012, p. 198). In this signification as a material vital doing, care is an ethically and politically charged sociomaterial practice. Cultivating relations with and between heterogeneous actors entails caring about something or somebody: the link between “to relate” and “to care” is an ontological claim rather than moral one (Ibid.). Drawing from the work of Haraway (1988), Puig de la Bellacasa argues that caring in STS research involves attending to the deployment and consequences of its own “semiotic technologies”, assuring that these academic practices not only acknowledge, but also foster multiplicity (2012, p. 199). In this context of knowledge production, care is enacted through the “mundane practices of research, teaching, and writing” and obliges STS scholars to “ask about how we can be more accountable for our participation in the technoscientific worlds we study and inhabit” (Kenney, 2015, p. 2).

Advocating for care in STS is also a call to bring neglected, invisible and devalued experiences of care to the foreground as objects of study (Martin et al., 2015; McNeil & Roberts, 2011). Feminist scholarship has long taken interest in the devalued labours associated with caring and “has underscored the absolute necessity – and therefore value – of relational care work to survival, to politics, and […] to knowledge” (Martin et al., 2015, p. 628). These “labours of care” are not tied to any single occupation, but typically
involves affect, communication, and community-building practices that are complex, not readily reduced to discrete tasks, escape easy valuation, and are difficult to schedule (Puig de la Bellacasa, 2011). These domestic and relational sociomaterial enactments are often considered superfluous and consequently erased by technology designs that favor industrial forms of working relations (Suchman, 1987). Matters of care directs the ‘semiotic technologies’ of STS research to articulate these marginalised and “technological lives in a philosophical manner which includes experience, suffering, or exclusion” (Star, 2007, p. 229).

Entangled in the sociomaterial constitution of divergent material-discursive practices, care and similarly charged affective elements – such as concern and empowerment – do not represent “a romantic endeavor, nor an exclusive affair of motherly love” (Puig de la Bellacasa, 2011, p. 95). Martin et al. elaborate on the contestations that emerge out of problematisations of care:

Who has the power to define what counts as care and how it should be administered? Care can render a receiver powerless or otherwise limit their power […] It can also sediment these asymmetries by putting recipients in situations where they cannot reciprocate. (2015, p. 627)

Asserting that both care and feminism are situated and political practices that can reinforce, rather than oppose oppression, Murphy advocates for a “vexation of care” in feminist STS that critically examines how the political work of affect operates “within and against development projects, public health practices, labor stratigraphies, family planning practices, humanitarian interventions, pedagogy, family formations, and so on” (2015, p. 722).

Drawing from its conceptualisation as an ethico-political obligation, an affective state, and a material vital doing, I will argue that care played a central role in the formation and dissolution of the mProject actor-network. I begin with the claim that the fluid actor-network enacted through the multiplicity of the HAT constituted a “cherished object” that was “fragile and thus in great need of care and caution” (Latour, 2004, p. 246). I suggest that the Academics enacted a matter of care that may have resonated with contemporary academic theories and practices in educational technology, but exacerbated the operational disconnect between CHWs and the formal health system. I then argue that attempts to stabilise the tenuous gathering of mProject actors through the application of social justice principles further alienated the CHWs, even if these design moves stemmed from affects related to sympathy and the moral outrage of the Academics and other
enlisted actors, and a desire to rescue disabled children from among the poorest of the poor.

8.2 The mProject as a matter of care

8.2.1 Mobile learning as a fragile and cherished object

The account of interessement in Chapter 5 recounts how the HAT instantiated the Academics’ desire to implement a “practice-based mobile learning intervention”. Aligned with contemporary approaches in professional education, this device of interessement assembled an actor-network with vague, shifting, and expanding boundaries; a fragile object that needed to be carefully cultivated if it was to enact the pedagogical innovation envisioned by the Academics. The fragility of the mProject stemmed from the exceptional mobilities of its early actors and their fluid sociomaterial practices. As described in Chapter 6, the phones that were enlisted for their portability and unobtrusiveness were not only mobile in this physical sense, but also vacillated in their identities as consumerist “facilitators of user choice” and “causal agents” for socio-economic development. At any moment, phones that had been enrolled in a workplace learning intervention could be diverted for recreational purposes, or to pursue alternative means of livelihood. The CHWs themselves also proved to be highly mobile actors, travelling from households to community centers and health facilities as they performed their dual functions as community leaders and health system cadres. Their work practices were carried out in places that were equally dynamic, where any given household could be a site of health care delivery or a neighborly encounter, or both.

The displacements and fluctuations of phones, CHWs, and places were extended and amplified when the HAT was installed a device of interessement. During enrollment, the HAT’s multiplicity as a health assessment instrument, as educational content, as a job aid, and as a patient advocacy tool implicated additional actors such as disabled children, caregivers, educators, NGOs, health officers, medical equipment, and educational materials – thereby generating new and tenuous associations that did not necessarily correspond to the initial scope of the Academics’ problematisation or the boundaries of Kenya’s Community Health Strategy. The fluid enactments of the HAT extended well beyond the confines of conventional training practices, challenging the dominant view that “the school and classroom signify the location of learning, the book signifies the content of learning, and the curriculum signifies how and when learning is to take place”
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(Usher & Edwards, 2007b, p. 107). Even the more progressive educational theories of Lave and Wenger (1991) do not adequately account for the mobilities observed in the mProject. Their well-cited narratives of situated learning also tend towards relatively stable sets of practices that are anchored to certain locales, albeit ones outside the classroom. As Leander et al. note, the notion of legitimate peripheral participation in communities of practice may have developed “an expanded version of mind and learning as distributed and mediated, [but the] theories of distribution within this tradition have been packed rather tightly within local containers” (2010, p. 335).

Such static and narrowly circumscribed conceptualisations of teaching and learning were considered theoretically incompatible with the preferences of mobile learners, who purportedly required educational experiences that were not only “situated” beyond the physical confines of schools, but also “personalised” to accommodate a diversity of “learning styles”, and “authentic” in the manner that they engaged students in “exploration and inquiry” on “real-world” topics of interest to those learners (Traxler, 2007, p. 7). Researchers in educational technology noted how mobile learning disrupted the illusion of the “stability of context” engendered by traditional learning practices, which seemed to operate within “a fixed location with common resources, a single teacher, and an agreed curriculum” (Kukulska-Hulme et al., 2009, p. 9). The more contemporary, technology-enhanced approaches to learning were seen to enable mobilities that were difficult to control, testing the “degree to which the subject matter can be bound or moored” in relation to “discipline, pedagogy and identity” – and raising questions about “what subjects – knowledge and individuals – are assembled in the new spatial (dis)orderings” (Edwards et al., 2011, p. 226). In short, the mProject actor-network was a fragile object due to the fluidity of its practice-based approach to workplace learning, as well as the mobilities of its phones, learners, and sites of learning.

This gathering of actors was not only fragile, but also entangled in the affective attachments of progressive educational scholarship. The Academics’ “pedagogically rich” learning intervention enacted a “cherished” actor-network that championed the CHWs as “producers of knowledge for the community” who were capable of complex tasks rather than passive “‘low-level’ users of codified knowledge” (Table 3-1, mProject document #35, p. 4). The Academics cited research papers by Scardamalia and Berieter (1994) advocating collaborative learning in “knowledge-building communities” that would “foster transformational thought” through “progressive problem solving and advancement beyond present limits of competence” (p. 266-269). The “practice-based
learning intervention” as initially problematised by the Academics’ aligned closely with Lave and Wengers’ conceptualisation of learning-as-participation (1991), whereby learners engaged in a process of becoming a member of a certain community. Learning in the mProject was problematised as a dialogic practice, whereby CHWs actively performed knowledge-making activities collaboratively, instead of receiving content in a “top-down” manner.

As discussed in prior chapters, the Academics’ grant application advanced a view of learning that drew upon the design principles of the Conversational Framework. Chapters 5 and 6 described how the HAT enacted learning-as-participation through “conversation-stimulating questions” that prompted the CHWs to engage in conversations with their mobile phones, with their supervisors, with caregivers of children in the community, and with themselves. These conversations became increasingly elaborate with the annexation of the WhatsApp forum. The installment of the HAT as a device of interessement and the subsequent enrolment of the WhatsApp forum were tied to the way the Academics cared for the CHWs as learners – to their values associated with the benefits of group learning and its potential for “togetherness, solidarity, and collaboration” (Sfard, p. 8), as opposed to individualistic pursuits of a “concept, conception, idea, notion, misconception, meaning, sense, schema, fact, representation, material, [or] contents” (Ibid. p. 5). In this way, communal aspirations underpinning the learning-as-participation metaphor constituted an affect of care that in turn participated as a lively actor in the sociomaterial gathering of the mProject.

In advancing this view of the learning as a process of participation, the Academics rejected the acquisition-based metaphor of learning which operationalised knowledge as a private possession to be accumulated, applied, and transferred – as a commodity that assigned identities, classified, and conferred power in ways that fostered “competition and solitary achievement” (Sfard, 1998, p. 8). Dismissing this acquisition-based approach to mobile education as ineffective, “information-centric”, “over-simplistic” and contrary to social justice principles (Table 3-1, mProject document 35, p. 5), the Academics envisioned a learning intervention with “smartphone technology [that] allows CHWs and their supervisors to mutually engage in learning, training and supervision that fit with their specific needs” (Table 3-1, mProject document #40, p. 4, italics mine). This problematisation promoted the participatory form of learning elaborated by Sfard (1998), one that embraced the ideals of democracy and encouraged reflection and dialogue to strengthen “evolving bonds between individuals and others […] the aspect of mutuality
characteristic of the part-whole relation [...] the dialectic nature of the learning interaction” (p. 6). The affective discourse corresponding to these collaborative and experiential pedagogies served as the “connection points” (Sørensen, 2010, p. 38) to install the HAT as a device for enlisting mobile phones and CHWs (refer to Section 5.5.2). These pedagogies were “cherished” values that shaped how the Academics problematised the goals of learning, the identities of learners, and the mechanisms by which the former was expected to empower the latter. As a cherished object, the mProject actor-network was an enactment of care that carried politics and ethical implications beyond those that could be discerned through classic ANT tracings of “interests”.

8.3 Caring for the mProject

Latour writes (2004), “we concentrate our passionate interest on only those things that are for us worthwhile matters of concern” (p. 241) and are understandably compelled to shield the fragile and cherished objects of our making from the “cruel treatment” of “critical barbarity” (p. 240). But as Puig de la Bellacasa argues, it is “by interrogating the way such issues are assembled – that caring “liveable relationalities” can be identified, sustained, extended, and enriched (2011, p. 93). This “vexation of care” requires disturbing the assumptions about the political work of our cherished objects, and situating “affection, attention, attachment, intimacy, feelings, healing, and responsibility as non-innocent orientations circulating within larger formations, instead of as attributes of individual scientists or feminists” (Murphy, 2015, p. 722). In this vein, understanding how the mProject actor-network might have generated more and better care entails a critique of the exclusions that were inevitably enacted by this fragile and cherished object. I assert that it requires a vexation of care that troubles the aspirations and premises of contemporary educational theories and practices and their relationship with health system strengthening and the global campaign to alleviate poverty.

Just as the HAT carved the network to shape my prior narrative of translation in the prior four chapters, so will it frame this critique of care. Continuing to use the HAT as a token of analysis here should not be read as an argument for preserving it as a device of interressement, nor is it a claim about this artefact’s inherent operational or ethical appeal. The HAT’s trajectory is revisited in this section as an analytic device to examine its exclusions in more detail, and these “cuts” will serve as the basis of my critique. Focusing and building on these particular exclusions is an effort to achieve my own form of care, in the manner advocated by Puig de le Bellacasa who writes (2011):
It is important to stay close to the material signification of caring [...] The commitment to show how forms of domination affect the construction of things and lead to exclusions is not necessarily directed to the disarticulation of the world, or to the negation of the reality of matters of fact and the materiality of technologies. Rather it adds an urge to further engage with the material-semiotic becoming of things [...] critical cuts shouldn’t merely expose or produce conflict but should also foster caring relations. (p. 95-97)

As Barad observes, cuts are inevitable in any material-discursive apparatus, but these exclusions also create openings for the articulation of new human and non-human reconfigurations that can generate promising change (2007). To establish a sociomaterial foundation on which to base my speculation of alternative futures, I critique the HAT’s enactment of care by examining three specific cuts that materialised during this narrative of translation: the exclusion of acquisition-based approaches to learning, the disconnect from the Kenyan Community Health Strategy, and the subsequent suppression of the mobile phone in the Academics’ pursuit of social justice.

8.3.1 Excluding acquisition-based approaches to learning

Installed by the Academics as a device of interessement, the HAT functioned as the soul in a material-discursive apparatus where CHWs were active producers of knowledge rather than passive recipients of information, and mobile phones were not simply vehicles for delivering content or multiple-choices quizzes, but lively actors that enabled more dialogic forms of supervisory and peer-to-peer learning (refer to Chapter 5). Excluding acquisition-based educational approaches was an enactment of care that was meant to liberate CHWs from the regime of the prescribed curriculum, emancipating those learners from the dictates of rigid educational objectives and hierarchical forms of learner assessment. The CHWs were not required to demonstrate mastery of concepts in childhood development but were instead enlisted to participate in the production of “transformational knowledge” that acknowledged the expertise they had “about building links between formal healthcare and the community, and about the successful implementation of new initiatives” (Table 3-1, mProject document #39, p. 3). Chapters 6 and 7 describe how the emancipatory valence of the HAT’s enactments did not take into account the power dynamics that were embedded into the alternative, acquisition-based approaches to formal training and traditional certification programs. The mProject aligned instead with discourse in mobile learning research which sought to “empower people to manage their own learning in a variety of contexts throughout their lifetimes” (Sharples, 2000, p. 178).
This rejection of acquisition-based approaches to education was consistent with contemporary theories and practices that assumed learners were “interested in participation in certain kinds of activities rather than in accumulating private possessions” (Sfard, 1998, p. 6), where knowledge was conceptualised as a process or performance, rather than an object conferring status and privilege. Yet while this proposition may have been advocated by scholarly proponents of “authentic” and “effective” professional learning (e.g., Webster-Wright, 2009), it was not one that was completely embraced by the CHWs. To the contrary, learning was viewed as a way of gaining credibility in the community, of improving their livelihoods, and securing employment (Table 3-2, mProject interviews #11, #23, #28).

As an NGO fieldworker pointed out, CHWs by definition “come from the communities they serve” and were not spared from the effects of the poverty in Kibera and Makueni:

You want CHWs to volunteer but they need food on the table, they have families, they need to feed their children and take them to school, they need to pay their house rent […] Kibera has only private schools so they have to pay school fees. It’s not like there is free primary education […] There is no public school here […] – So you find that community work is not a priority unless there is something you are giving them. (Table 3-2, mProject interview #2)

For CHWs, the pursuit of learning opportunities was linked at least in part to instrumental purposes – to a desire to acquire expertise and/or material resources, such as credentials, for personal gain. One CHW explained:

[Y]ou are not earning anything [as a CHW] apart from trainings and exposures [to visitors from development organisations] […] For sure it’s too good because I have been working with people who are poor academically, but since the inception of this pilot program of CHW, it has given me the momentum to focus and further our focus in terms of financial status, entrepreneurship; we have done a lot, we have achieved a lot and we are willing to achieve more. There is more room for visitors to come and work with us. (Table 3-2, mProject interview #1)

Furthermore, the alternative concept of learning to participate as “part of a whole” (rather than “acquiring” knowledge) was compromised because at that point, “the whole” was a nebulous entity. While the mobile phone might have helped to promote the emergence of a nascent “community of practice” as theorised by Wenger (1998), it remained unclear who and what was to constitute that community. Defining the knowledge practices that would enact a “learning community” was challenging given that CHWs were
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...geographically remote from one another, their identities as community leaders and health system cadres were overlapping and shifting, and their work remained isolated from the operations of the rest of the health system.

8.3.2 The disconnect from the Community Health Strategy

The mProject may have succeeded in drawing CHWs closer to their supervisors, but by excluding the priorities of Kenya’s Community Health Strategy, it widened the disconnect between CHWs and the formal health system, while pulling their supervisors away from nationally-defined priorities (refer to Section 6.3.3). The Community Health Strategy was part of another fragile and cherished object – it was a policy document that operated as the soul in a larger, entrenched material-discursive apparatus aimed at buttressing an over-burdened and failing health system. This national blueprint for health system strengthening was tightly coupled to the quantitative, health-related targets of the Millennium Development Goals (Ministry of Public Health and Sanitation, 2008) and the “growing preference for meeting such targets through sets of contractual relations, reporting upwards to central authorities, [so as to] give credence to a view of development as a set of deliverable actions” (Powell, 2006, p. 519). The pedagogically-rich forms of learning championed by the Academics remained marginal to the e-learning agenda embraced by the health ministry and the Kenyan NGO and did not improve the CHWs’ access to these powerful actors in global health arena. The formal health system, the Kenyan NGO, and the global telecommunication actors were all involved in e-learning programmes that valued and promoted acquisition-based approaches to health worker training that could be documented, measured, and replicated in ways not immediately possible with practice-based approaches to learning (refer to Section 4.3.3).

The policy discourse of the Community Health Strategy was responsive to the Millennium Development Goals and instantiated in official training modules, referral protocols, and health information systems derived from paper-based forms known as the MOH 513, the MOH 514, and the MOH 515 (see Ministry of Health, 2005, 2006, 2007). The CHWs had attempted to fulfill many of the duties that were allocated to them through this government plan, but they had experienced a wide array of challenges in doing so and looked to training programs as one avenue for enhancing their work practices (Table 3-1, mProject document #39). However, the mobile learning intervention that was enacted through the HAT focused on child development milestones and this topic was not directly addressed in this government document. Rather than enhancing the activities...
that were promulgated through the Community Health Strategy, the mProject supplanted them with a different, narrower set of practices associated with childhood milestones. The mobile learning intervention cut a different network that did not include the policy provisions of the Community Health Strategy, by-passing the on-going CHW practices related to HIV follow-up, hygiene and sanitation, malaria, maternal-child care, and malnutrition, as well as the skills related to health education and data collection and reporting. This exclusion resonated with the established body of educational research that positioned mobile phones as “disruptive devices” (Sharples, 2002) that could advance forms of life-long learning with “liberating possibilities, providing freedom from the dead hand of the collective, the bureaucratic management of state-funded and administered institutions” (Usher & Edwards, 2007a, p. 46).

Prioritising the assessment of childhood development milestones to the exclusion of the Community Health Strategy was also an enactment of the Academics scholarly attachments to participatory design and human-computer interaction, fields of technology design which privileged the input of users. It was a validation of the expertise of CHWs, an acknowledgement of their autonomy and of their ability to direct their own learning. Yet the exclusion meant that the new practices performed by the mProject participants would not be immediately recognised as part of national efforts to strengthen the health system. Emancipating CHWs from the policy dictates of the Community Health Strategy may have allowed them to develop alternative skills to identify the many unmet needs of disabled children in the community, but this did not give these volunteers the authority to redirect resources to meet those daunting requirements. Funding, programmes, facilities, providers, supplies, equipment and practices circulated through the policy provisions of the Community Health Strategy as part a highly visible, if tenuous, material-discursive apparatus that embodied standards of care from the compelling Millennium Development Goals. The ability to classify and refer children with delayed milestones was enacted through practices that did not overlap with the larger, more established apparatus – to the Health Ministry, it was considered “outsider knowledge” and further distanced the CHWs from the ongoing formal operations of the Kenyan health system.

8.3.3 Excluding mobile phones in pursuits of social justice

In Sorting Things Out: Classification and its Consequences, Bowker and Star have observed that “classification systems” are ubiquitous, necessary and usually
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mundane, but they often represent collective ethical choices that have considerable material, political and moral consequences:

The moral questions arise when the categories of the powerful become taken for granted; when policy decisions are layered into inaccessible technological structures; when one group’s visibility comes at the expense of another’s suffering. (1999, p. 320)

The authors’ account of how the “lives of individuals are broken, twisted, and torqued by their encounters with classifications systems” (Ibid., p. 26) resonates with the trajectories of “hidden children” in Kibera and Makueni. The HAT enacted a classification scheme that brought the exclusions of the formal health system into stark relief. Socially stigmatised children who were subsequently classified as “delayed” through the material-discursive practices of the mProject learning intervention found themselves confronted with an unresponsive health infrastructure (Ibid.), one that embodied standards of care that did not apply directly to this particular category of individuals. Disability, as discussed in Chapter 6 on enrolment, was not part of the discourse related the Millennium Development Goals and was not included in formal training curriculum for Kenyan health workers.

The material force of this clash in categories corresponded to what physician-anthropologist Paul Farmer describes as “structural violence”, a sociomaterial assemblage which:

[…] constricts the agency of its victims. It tightens a physical noose around their necks and this garroting determines the way in which resources – food, medicine, even affection – are allocated and experienced. (2004, p. 315)

The Academics asserted that the plight of the disabled children was a manifestation of such “structural violence” and they applied additional constructs from liberation theology (Boff & Boff, 1987; Gutiérrez, 1988) to shape the further emergence of the mProject actor-network. The call for “pragmatic solidarity” was invoked to argue that ICTD research interventions should “make common cause with those in need in a very practical and real manner” (Table 3-1, mProject document #35, p. 6). They write:

The pragmatic solidarity approach, applied to our project (which had initially been designed and conceptualised as a mobile learning intervention for CHWs) thus had wide ranging implications, not least with regard to engaging with wider community structures and power relations. Essentially, it could be argued that the project has worked toward tackling the structural violence encountered. (Ibid.)
The material force of structural violence demanded a material response. Shunning deterministic, techno-centric approaches to ICTD, the Academics were emphatic that the mProject’s pragmatic response to structural violence would not merely build on the functionalities of ICTs, but would instead form other associations to alter the local allocation of resources and power.

Social justice was therefore advanced through the mProject actor-network by cultivating new attachments that were not typically associated with ICTD research. Chapter 6 described how the Academics promoted new linkages to actors such as the awareness campaigns, and the delivery of services and supplies of direct benefit to disabled children – while the fluidity of the mobile phone was left relatively unchecked. Beyond the solar chargers and the WhatsApp learning forum, no additional attachments were made during enrolment that would extend, capture, or characterise the “learning actions” that were mediated through the mobile phones. As recounted in Chapter 6, pragmatic solidarity took its shape through new operational associations with supportive services for disabled children, rather than through innovations in ICT. Caring for the disabled children through the mProject actor-network involved securing the appropriate educational and health services as quickly as possible.

Confronted with what Bowker and Star describe as the excruciating “torque” of oppressive classification systems, the impulse to minister to the immediate sequelae of such structural violence is compelling, laudable, and arguably, what makes us fully human. This was a longing for an active, embodied form of compassion, a sociomaterial practice of “suffering-with” that:

[...] is not just about acknowledging the suffering of others. It is also about asking the question, “how much of this suffering is [...] unnecessary and what might we do collectively to lessen it?” (Farmer, n.d.).

The rationale behind the design moves during enrolment suggests that to advance social justice, ICTD research had to add attachments from alternative areas of activity to “make common cause with those in need in a very practical and real manner” (Table 3-1, mProject document #35, p. 6). In this formulation of social justice, caring in the mProject was no longer achievable through contemporary research on education and technology, but necessitated new, morally-endowed attachments; in a sense requiring a “moral value added to the thinking of things” (Puig de la Bellacasa, 2011, p. 86). Just as theories in educational technology provided “connection points” (Sørensen, 2010, p. 38) to assemble the mProject during interessement, Academics used theories of social justice to attach
sociomaterial attachments associated with rescue and relief. However, concepts such as “pragmatic solidarity”, “structural violence”, and “preferential options for the poor” did not create immediately obvious “connection points” for the sociomaterial practices of ICTD research on mobile phones.

8.4 Morality and the speculative commitment to care

Without lapsing into the euphoric discourse of techno-centric enthusiasts, this section suggests that ICTD researchers need not forsake the possibilities of the mobile phone in the name of social justice principles. I argue against essentialising certain practices as more or less ethical than others and explore the possibilities of incorporating the mobile phone into relations of caring for disabled children. I begin with the claim that rescue and relief are not the only possible pragmatic acts of solidarity with the poor. Other development practices – situated beyond those sites of direct humanitarian engagement – must also be directly incorporated into any formulation of social justice that seeks to address the causes of poverty, rather than just its effects. Reading Farmer’s *An anthropology of structural violence* (2004) through Bowker and Star’s work on classification and information infrastructures (1999), I establish the theoretical basis for my speculation on how the mProject actor-network might have tackled structural violence in a manner that advanced, rather than suppressed the practices of ICTD research in mobile learning. As an example of this alternative vision I am proposing, I will then present participatory design research on the materials and devices of democratic “publics” (Dantec & DiSalvo, 2013; Marres, 2007; Marres & Lezaun, 2011).

8.4.1 The material-discursive apparatus of structural violence

In *An anthropology of structural violence* (2004), Farmer advances the concept of structural violence to argue that poverty and misery are not isolated local tragedies, but the embodiments of a “social machinery of oppression” that exerts its domination globally and systematically through “a certain social order” (2004, p. 307). Structural violence is understood as a “socialization for scarcity” performed “by a complex web of events and processes stretching far back in time and across continents” (Ibid., p. 315). The social origins of this transnational architecture of systemic injustice are incrementally and subtly effaced, its dubious history dissolving into “structures that are both ‘sinful’ and ostensibly ‘nobody’s fault’” (Ibid. p. 307). Farmer’s analysis of structural violence here has commonalities with Barad’s theorisation of the material-discursive apparatus (2007), and
the idea that specific practices become “punctualised” (cf. Law, 2003) or “black-boxed” (cf. Latour, 1987) through standardisation, so that their effects are taken as given. Hunger, injury, disease, stigmatisation, sub-standard housing, and lack of water and sanitation services can therefore be viewed as sediments of a vast and entrenched social apparatus, its inner processes and linkages erased with time by those in power.

Farmer suggests that remediating such sediments in a sustained and comprehensive manner requires a better understanding how structural violence is constituted:

Without a historically deep and geographically broad analysis, one that takes into account political economy, we risk seeing only the residue of meaning. We see the puddles, perhaps, but not the rainstorms and certainly not the gathering thunderclouds. (Ibid., p. 309)

He advocates “a deeply materialist approach to whatever surfaces in the participant-observer’s field of vision – the ethnographically visible,” in order to generate “an honest account of who wins, who loses, and what weapons are used” (Ibid., p. 308). As a physician and anthropologist working for decades in a Haitian free clinic, Farmer’s “field of vision” has been homed on the human toll of an unjust social order. His graphic and poignant ethnographies of structural violence describe in painstaking detail “who loses”, but accounts of “who wins” and with “what weapons” remain less developed. This is to be expected, given Farmer’s positionality as a health care provider delivering health care to the poor.

Rejecting the “undue romanticism” of cultural ethnographies that sentimentalise poverty, Farmer has drawn from epidemiology, forensic and clinical medicine, demography, and biology to recount the grinding materiality of human suffering. But the materiality of the larger apparatus of structural violence is rendered with the broader brush strokes of history and political economy – the inner workings of this apparatus remain black-boxed, as does its relation to the everyday lives of the poor (Bourgois & Scheper-Hughes, 2004). In the absence of more fine-grained considerations of what is “structural” and how up-stream development practices play into those arrangements, it would be difficult to halt the sediments of the unjust social order that Farmer so rightfully deplores. “Laying bare the fretwork of entrenched structures that promise more misery” as Farmer advocates (p. 308) should not only serve to denounce such arrangements, but be incisive enough to help intervene in the production of their devastating “permanent marks”. Collapsing a vast global continuum of development
actors into a crude binary comprised of the oppressed, and a highly undifferentiated array of oppressors masks the sociomaterial arrangements that constitute structural violence. Intervening in inequitable power arrangements becomes even more challenging if the cascades of development practices extending beyond the local clinic – these alternative “ways to care” – are dismissed as inferior expressions of pragmatic solidarity or indiscriminately attributed to the “winners” in a transnational struggle for domination.

8.4.2 Social justice and the “built moral environment”

Resonating with the discussions of performativity in ANT in Chapter 2, structural violence is understood as an effect, rather than a causal factor. As Bourgois and Scheper-Hughes observe:

Farmer’s model of structural violence is a vivid reminder that most violent acts are not deviant. They are defined as moral in the service of conventional norms and material interests. (2004, p. 318)

In the prior chapters, I describe how the suffering of the “hidden children” children was sedimented out of the disconnect between a fledgling classification system to diagnose developmental delays, and a larger infrastructure constituted through the material-discursive practices of Kenya’s Community Health Strategy and ultimately, the Millennium Development Goals. This was a conflict between two enactments of care, one brought forth by the mProject actor-network to train CHWs, and the other deployed by the Ministry of Health to strengthen a struggling national health system.

I assert that the Academics’ attachments to contemporary theories and practices on technology-enhanced learning need not have been ancillary to the remediation of structural violence, but could have been key sites to engage in acts of pragmatic solidarity with the poor. How might social justice have been specifically pursued through the practices of research on mobile learning, rather through separate acts of rescue and relief? Asserting that “it is politically and ethically crucial to recognize the vital role of infrastructure in the ‘built moral environment’” (1999, p. 326), Bowker and Star offer a way of conceptualising the relationship between design practice, mobile learning, and social justice in the mProject actor-network:

[…] there are ways of scaling up from the local to the social, via the concept of boundary infrastructures […]. The value of this approach is that it allows us to intervene in the construction of infrastructures – which surely exist and are powerful – not only as critics but also as designers. (Ibid., 317)
Drawing from Farmer (2004) and Bowker and Star (1999), I propose that when the “built moral environment” exerted structural violence on disabled children though the apparatus of the Community Health Strategy, designers might have directly intervened in those structures by linking the local practices of classification enacted by the HAT to the prevailing standardised practices of the formal health system.

What were the “design improvisations” that could have moved the mProject closer to the reality of the formal health system? How might the permanent marks left behind during encounters with disabled children have enhanced standard data collection practices? What co-morbidities did disabled children commonly experience and did those align with other institutionally-sanctioned, and therefore funded, health priorities? What needs of disabled children fall outside the remit of the health system? Design moves that address these questions might lead to acts of pragmatic solidarity with the poor that resist the idea of an “imperialist über-social world” (Bowker & Star, 1999, p.303) and strive instead for “coherence without unconscious assumption of privilege” (Ibid.). They correspond to an explicitly feminist undertaking aspiring to “a kind of double vision” and the “nurturing” of the marginality that is inherent in being a member of more than one community (Ibid.).

Cultivating such linkages involves categorical work that dynamically negotiates the inherent tensions in borderlands where humans enact more than one identity in concert with objects that embody multiple meanings (Ibid., p.310). When categorical work successfully accommodates this multi-membership and reconciles the activity of different communities for sustained periods, its material-discursive practices are said to have been standardised and as such, reified in a built environment that Bowker and Star call boundary infrastructure. ICTs are entwined in their conceptualisation of this boundary infrastructure and serve as a material gateway through which designers might work for justice – supplementing acute, stop-gap methods of poverty alleviation with more systemic modifications of the social structures that generate sedimentations of violence and poverty.

8.4.3 Mobile learning and the materiality of democratic publics

In the prior section, I have demonstrated how theories of social justice can be “attached” to the sociomaterial practices of ICTD interventions. Specifying the pragmatics of implementation are beyond the scope of this thesis. But as part of my own “speculative commitment to care” (Puig de la Bellacasa, 2011, p. 96), I will point to ways
I think that categorical work might lead to a boundary infrastructure that links the mProject actor-network to the Community Health Strategy. This work would begin with a “many-to-many relational mapping” (Bowker & Star, 1999, p. 309) between the multiple identities of CHWs, disabled children, and mobile phones, along with the several enactments of the HAT described in earlier chapters. The mapping must also incorporate the “permanent marks” of phenomenon from a host of other “caring” material-discursive apparatuses – including but not limited to the digital traces of learning actions, MOH reporting sheets, referral forms, and descriptors of disabled children captured with ball point pen on paper. Every object is a potential mediator that might travel across multiple communities and acquire new forms and meanings as it threads disparate groups together.

From an information systems standpoint, the challenge for designers is to discern “who needs to know what?” and make the necessary modifications and allowances for the way objects are used differently from moment to moment, in group to group. Citing Suchman and Trigg (1993), Bowker and Star describe this activity as “the ‘artful integration’ of local constraints, received standardized applications, and the re-representation of information” (1999, p. 292).

Categorical work entails juggling identities and meanings, rather than resolving these tensions once and for all. It is not about mooring mobility, nor does it leave it completely unchecked. Bowker and Star suggest that this is a learning enterprise, in so much as classification systems used by different groups “are historically situated artifacts and, like all artifacts, are learned as part of membership in communities of practice” (p. 287). They continue, “the illegitimate stranger is a source of learning. Someone’s illegitimacy appears as a series of interruptions to experience” (p. 295). In the case of the mProject, the newly identified disabled children are a source of learning for both the formal health system and the mProject actor-network. Building on to the Conversational Framework (Laurillard, 2002) that was enlisted the during problematisation, a first step would clearly be to establish new learning conversations that incorporate the experience of disabled children. But Bowker and Star introduce an additional dimension to this design challenge when they discuss Morton’s feminist notion of “hearing to speech” (1985). They suggest that categorical work requires “stretching to affiliate with multiplicity” through a form of active listening that empowers those who speak (p. 309). This suggests that in giving the poor a “voice” in the production of knowledge, it is equally important to develop forms of representation that will help ensure that what they say is *heard* in pragmatic and generative ways.
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The boundary infrastructure proposed to address the marginalisation of disabled children draws from empirical work by Le Dantec and DiSalvo (2013) who demonstrate how participatory design methods could be directed towards the practice of “infrastructuring” (Star & Bowker, 2010). In one site, these authors examined how a range of ICTs, including mobile phones, laptops, and internet platforms could be integrated into a digital clearinghouse on community resources for homeless individuals, caseworkers, local organisations, and government agencies. In a second site, participatory design methods were used with a group comprised of university researchers, community agencies, church groups, business leaders, neighbors, and local youths to develop a community-based platform with robotics and sensing capabilities. These “infrastructuring” initiatives were seen to support the formation of publics, which are defined as emergent, heterogeneous collectives of humans and non-humans that gather around “issues that have insufficient institutional support, while also requiring political settlement” (Marres, 2007, p. 771). These designers conclude that “through PD [participatory design], objects were created to which attachments could form” and further suggest that “design provided structures to which emotions, beliefs, and desires might adhere and thus be sustained” (Dantec & DiSalvo, 2013, p. 260).

8.5 Summary

In this chapter, I incorporated feminist theory on matters of care into my “observing apparatus” for my doctoral research. These concepts were more sensitive to the relations between poverty, morality, and theories of social justice in the enactment design practice in an ICTD project. I illustrated how the mProject actor-network enacted a matter of care – a fragile and cherished object with attachments to contemporary theories and practices in educational technology. Like any material-discursive apparatus, this matter of care marked boundaries that excluded certain actors, identities, and practices. I critiqued some of those exclusions: its rejection of acquisition-based approaches to learning, its dismissal of the Kenyan Community Health Strategy, and the suppression of the mobile phone in pursuits of social justice. I have shown that by reading social justice theory on structural violence through scholarship on boundary infrastructure, it is possible to trace how design practice might enact a form of pragmatic solidarity with the poor that includes the sociomaterial practices of ICTs and their designers. I suggest that by engaging in categorical work that negotiates and nurtures
multiplicity, designers of ICT artefacts might channel their technical expertise towards a “built moral environment” that advances the full set of human capabilities, mitigating the tragic choices that confront the poor in their day-to-day lives.
9 Success and Failure in the Matters of Care

July 2011 –

The narrative in Chapters 4 through 8 has traced the sociomaterial relations of “design practice” in a globally-distributed, multi-stakeholder, and technologically-mediated ICTD project for poverty alleviation. In this “ethnography of development practice” (Mosse, 2005), I have recounted how multiple problematisations circulated through transnational sets of concepts, artefacts, donors, policymakers, implementing bodies and local communities to iteratively constitute the mProject. In the prior chapter, I suggested that these various problematisations could be understood as matters of care – as distinct, but inter-related material-discursive apparatuses that were gathered around the compelling aspiration to alleviate global poverty. Each matter of care assigned a different set of roles to the CHWs, the mobile phones, and the HAT – and each apparatus operationalised “design” and “use” (and therefore “success” and “failure”) in conflicting ways. This chapter will now (re)present my empirical narrative in the form of a visual description, building upon the conceptual model of design-reality gaps (Heeks, 2002) that was described in the first two chapters.

Image 9–1 Stakeholders’ meeting: recommendations from multi-laterals and NGOs (photo: J. Henry)
In Section 9.1, I reintroduce the conceptual work on design-reality gaps (Heeks, 2002) which operationalises project success and failure as parameters in a contingent, socio-technical system. Next, I demonstrate how the four moments of translation were incorporated with this model, so as to locate the Academics’ designerly practices during the life cycle of their international development project. This is followed by illustrating how concepts related to the material-discursive apparatus and to multiplicity helped to elaborate the trials of strength that challenged the Academics’ efforts to implement their pedagogically rich mobile learning intervention. Section 9.4 continues by showing how it was necessary to incorporate the concept of care to address an empirical situation involving poverty and morality, and I then suggest that infrastructuring and boundary infrastructure were concepts that could have engaged generatively with empirical concerns about social justice in ICTD. This chapter then concludes with an analysis of the “success” and “failure” of the mProject in relation to the broader socio-technical system, in light of my updated specification of the design-reality gap.

9.1 Success and failure in a socio-technical system for ICTD

Heeks theory of design-reality gaps (2002) serves as a useful starting point for problematising the sociotechnical system of a wicked problem. Re-introduced below in Figure 9-1 this model conceptualises design as “a representation of an intentional future” made up of “components from the designers’ own context” and “conceived assumptions about the situation of the user” (Ibid., p. 105). The model illustrates how a design is
constituted by actors such as information, technology, processes, objectives and values, staffing and skills, management systems and structures, and other resources. Reality is in turn defined as “the current ‘actuality’ in a location” (Ibid., p. 104). The size of the gap between design and reality is directly correlated with the likelihood of project failure. The success rate of ICTD projects can be increased through local improvisations that reduce the distance between design and reality.

As discussed in Chapter 2, the theory of design-reality gaps was formulated early in the ICTD movement. It drew from the prevailing experience with large-scale, Ministry-endorsed implementations of information systems in developing countries. In such settings, enactments of technology design were seen to be “distant in physical, cultural, economic, and many other ways” from technology use, generating design-reality gaps that were “more extreme and more explicit and, as a result, […] easier to identify and to understand” (Ibid. p. 106). However, in the case of participatory ICTD projects such as the mProject, such clear-cut distinctions between users and designers, as well as between technology production and deployment, were blurred, making it more challenging to specify how design-reality gaps lead to project failure.

9.2 Translation and the design-reality gap

Callon’s four moments of translation provided additional theoretical equipment to open the “black box” of project failure in an empirical case of ICTD where designers and users were not so readily isolated. Figure 9-2 shows how the first moment of translation led to what Heeks calls a “design”. A design is, in effect, a problematisation that enlists heterogeneous actors corresponding to the seven different dimensions specified in Heeks’ model. Callon’s theorisation on the inter-definition of actors and the obligatory passage point lends additional insight into the inner workings of a design. Applying these classic ANT concepts to the mProject data helped to demonstrate that when formulating solutions, a designer does not specify the seven dimensions in parallel, to act independently of one another. Rather, a design extends the cherished “objectives and values” of designers into a tentative system of alliances that enlists actors from the remaining six dimensions into a distinctive, inter-connected, sociomaterial configuration. Based on this analysis, I reverse the direction of the arrows in Heeks' original model to indicate that the more successful the translation, the smaller the design-reality gap.
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The progression from the first to second moments of translation is therefore shown in Figure 9-2 as an early and emergent materialisation of a designer’s intervention to change an existing reality. The order in which Heeks’ seven dimensions were incorporated into the design was salient in a local, participatory intervention such as the mProject. Objectives and values associated with progressive digital learning set the course for a “practice-based” intervention that would focus first and foremost on local actors linked to processes, as well as staffing and skills. Such situated participatory priorities gave way to the enlistment of specific data flows and stores that promoted the dialogic exchange of information and the adoption of smartphone technology to support such digital “learning conversations”. Other resources included the devices of interessement, such as the HAT, that established the material conditions for drawing enlisted actors closer to the Academics’ intended future. And finally, management systems and structures would be incorporated as the final dimension in the Academics’ design, in accordance with the “bottom-up” fashion championed in scholarship on progressive digital learning.
9.3 Multiplicity and the design-reality gap

Figure 9-3 then illustrates how the subsequent transition from the second to third moments entailed overcoming trials of strength to manage the gap between the Academics’ design and the reality encountered during deployment. Neither Callon (1984) nor Heeks (2002) provide additional conceptual details about how such trials of strength emerge during enrolment. I therefore integrated Barad’s notion of the material-discursive apparatus (2007) and Mol’s work on multiplicity to show how trials of strength can be understood as the ontological politics that enact the design-reality gap. As seen in Figure 9-3, design was problematised by the Academics during the first moment of translation, and then materialised during interessement, to constitute a material-discursive apparatus. The HAT was enlisted as device of interessement and functioned as the “soul of the apparatus” for material-discursive practices related to progressive research in learning and digital technology. Installed by “heterogeneous engineers” early on during interessement, this “soul” is a material artefact that materialises the “objectives and values” articulated during problematisation.

The gap in Heeks’ model of ICTD failure corresponds to the space separating the researchers’ design from the reality (or rather, realities) enacted through the multiplicity
of the HAT (Mol, 2002). In this participatory project for grassroots mobile learning, the design-reality gap was not so much a matter of geographic or socio-cultural divides, but was instead constituted as fluid space separating the educational researchers’ designerly practices from the multiplicity of ways in which health workers, mobile phones, and other actors lived in relation to one another. Local improvisations to reduce or manage the design-reality gap involved the work of distribution and coordination (Mol, 2002) that drew together the enactments of the HAT as health assessment instrument, educational resource, job aid, a consumer choice and patient advocacy tool. This active manipulation of the HAT’s various network effects required the creation of new sociomaterial relations implicating the seven dimensions of design articulated by Heeks. These associations would enable the multiple realities of the HAT to “hang together” (Mol, 2002) and thereby address the design-reality gap.

9.4 The design-reality gap and the matters of care

Post-ANT concepts related to multiplicity and the material-discursive apparatus provided a systematic approach to illustrate how design-reality gaps are formed. But, they did not sufficiently capture the material and affective aspects that are specific to working in the challenging conditions of poverty, nor did they help describe how those factors played into the gathering of the actor-network. I demonstrated that conditions of resource scarcity and human suffering were important actors in the production of participatory technologies. Figure 9-4 illustrates how feminist STS scholarship on matters of care (Murphy, 2015; Puig de la Bellacasa, 2011; Star, 2007) furnished the necessary “sensitising terms, ways of asking questions and techniques for turning issues inside out or upside down” (Mol, 2010, p. 261). This theoretical work offered methods to demonstrate empirically how the materiality of poverty, and the “care” it evoked, were key “actors” in the mProject.

Redfield has observed that “humanitarian design offers a direct and material conduit for expressing care” (2016, p. 175). This design practice intervenes “at the micro-level of daily needs” and advances solutions that “seek to do good, not simply expand power or reap profit” (Ibid., p. 160, author’s emphasis). Figure 9-4 makes this notion of care explicit in Heeks’ model for ICTD, illustrating how the Academics’ ethical aspirations participated as lively actors from the first moment of translation onward. Multiplicity generated numerous alternative ways of caring that conflicted with the Academics’ design. Each of those ways of caring corresponds to a distinct material-
discursive apparatus that assigned different roles and attributes to CHWs, their supervisors, mobile phones, the Kenyan NGO, and the HAT. As described in Section 8.4 of the previous chapter, the trials of strength generated by these assignments resonate with Star and Bowker’s description of classification systems and their consequences:

when all [classification systems] are aligned, there is no sense of torque or stress; when they pull against each other over a long period, a nightmare texture emerges. (1999, p. 27)

Accordingly, reducing the design-reality gap during the third and fourth moments of translation required local improvisations to alleviate what Bowker and Star characterise as the torque of “interacting trajectories of bodies and multiple identities” (Ibid., p. 190). Local improvisations (Heeks, 2002) at this juncture involved the morally-charged work of distribution and coordination to manage multiplicity (Mol, 2002), as well as concerted acts of representation and displacement to mobilise additional human and non-human actors (Callon, 1984). Distribution, coordination, representation, and displacement are therefore concerted acts undertaken by researcher-designers to manage the design-realty gap. Figure 9-4 shows that such local improvisations are closely related to Star and Bowker’s notion of infrastructuring, designerly work to cultivate “one of a
number of possible distributions of tasks and properties between hardware, software and people” (2010, p. 232).

During enrolment, the Academics of the mProject modified the configuration of their original design, as part of the distribution and coordination of the HAT’s multiple enactments. Chapter 7 described how the Academics launched into mobilisation to bring reality closer to their modified design. They enlisted additional actors to enact a cascade of intermediaries to draw policy-makers into the mProject actor-network. For mobilisation to succeed, what then needed to unfold was a series of negotiations to reconcile the identities of enlisted actors. These negotiations would continue until the Academics’ problematisation was “deemed to be beyond question” and controversy thus closed (Callon, 1984, p. 220). These negotiations correspond with Heeks’ description of the:

[… ] continuous reciprocating improvisation between design and actuality that, if success is to be achieved, will seek accommodation and adaptation between design and actuality sufficient to achieve workable closure. (2002, p. 108)

To elaborate a conceptual understanding of these alternating local improvisations on design and reality, Figure 9-4 illustrates how Star and Bowker’s work on infrastructuring (2010) is integrated into the fourth moment of translation. Closure of controversy in matters of care at the end of mobilisation is ultimately manifested by establishment of a boundary infrastructure, a sociomaterial “scaling up from the local to the social” (Bowker & Star, 1999, p. 317). As with the earlier materialisation of the Academics’ problematisation, the order in which actors are enlisted into a boundary infrastructure is a pertinent feature in my elaboration of the design-reality gap. Moving from the third to fourth moment of translation, the first step is to engage with complementary management systems and structures to assure the institutionalisation, and therefore sustainability, of what was conceived originally as a highly personalised and participatory ICTD intervention. Enlisting actors from this dimension is necessary to secure important other resources, such as the time and money necessary to maintain and extend the project.

The next set of local improvisations involves the alignment of hardware and software standards, as well as the establishment of communication protocols to close the design-reality gap as it pertained to technology and information. With those material conditions in place, the work of infrastructuring could then focus on the organisational arrangements and training necessary to align proposed changes with the existing staffing
and skills. The successful management of the design-reality gap is achieved at the end of mobilisation, when relevant work practices or processes are coordinated to accommodate all objectives and values of enlisted actors. Figure 9-4 finally shows how a “boundary infrastructure” is sedimented out matters of care to enact the “built moral environment” (Bowker & Star, 1999, p. 326) which I contend is a materialisation of social justice.

Social justice “matters” in the model presented in Figure 9-4 it is conceptualised not only in terms of a naturalised standard or provocative actor in the design of ICTD. Here, social justice is also theorised as a sociomaterial enactment, “a material and processual justice which rather than being focussed on normative issues is concerned with fusing justice and matter: thick justice” (Papadopoulos, 2014, p. 76). As described in section 8.4, social justice as boundary infrastructure is a structural remedy, a sociomaterial response to the “structural violence” which is sedimented as an “infrastructural expression of the process of oppression” (Boff & Boff, 1987, p. 29). As Martin et al. assert, “care organizes, classifies, and disciplines bodies. It is in this sense that care makes palpable how justice for some can easily become injustice for others” (2015, p. 627). Like all sociomaterial performances, enactments of social justice are not bedrock; their matter and meanings are always subject to reconfiguration and re-articulation, marking different boundaries that exclude different actors (Barad, 2007).

The empirically-derived elaboration of Heeks’ model in Figure 9-4 illustrates that during the life cycle of a ICTD project, there are many points at which the design-reality gap may be exacerbated or attenuated, thereby decreasing or increasing the likelihood of project success and failure. In the case of the mProject, the researchers did not appear to undertake the necessary “reciprocating improvisations between design and actuality” (Heeks, 2002, p. 108) that would mobilise stakeholders over the course of the fourth moment of translation. Instead, the Academics’ design remained static from the end of enrolment onward; the multiple enactments of the HAT remained fixed according to a single hierarchy that privileged its performance as an advocacy tool for marginalised disabled children and there were no further “design improvisations” or “actuality improvisations” (Ibid.) to enlist new actors and eliminate others.

To substantiate this “ordering of goodnesses” (Mol, 2002), the Academics cited the principles of social justice as advocated in Farmer’s call for “pragmatic solidarity with the poor” (1999). Coordinating the HAT’s multiplicity into this singularity at the start of the fourth moment of translation made the actor-network “heavy with norms” (Callon, 1992). It was a move to “purify” the mProject with standards (Fenwick & Edwards,
2010), to stabilise the fluidity of the intervention so that it would be more readily taken up by decision-makers with the authority and resources to sustain and scale an intervention geared towards caring for marginalised disabled children. The series of negotiations to reconcile the multiple identities of enlisted actors did not occur during the mobilisation. Once the enactments of the HAT were coordinated, there was no further pivoting between the Academics’ design and the alternate realities enacted through the multiplicity of HAT. Star has suggested that such “tacking back-and-forth” between “well-structured and ill-structured components” is essential to the design and maintenance of boundary infrastructures (2010, p. 613). Goodman reported similar findings in her empirical study of design practice in San Francisco technology firms (2013). She evokes the metaphor of textiles, knotwork, and the “ontological twists of [...] design performances [that] produce and bind together users, clients, and systems into stable proposals” (2013, p. 202).

At the end of the funding period, the mProject was not financially, institutionally, or socially sustainable because there had been no further adaptations or accommodations for “multiplicity”. In excluding acquisition-based approaches to learning and the Community Health Strategy, the Academics failed to enrol the material-discursive apparatus of the formal health system and did not build the necessary alternative sociomaterial alliances to oppose, subvert, or resist the more dominant matters of care in international development successfully. Appeals to universal standards of social justice were insufficient to mobilise the necessary actors that could scale and sustain the mProject. By the end of the fourth moment of translation, no boundary infrastructure was enacted to narrow the design-reality gap and thereby transform an individualised, emancipatory mobile learning intervention into a collective and therefore sustainable materialisation of social justice.

9.5 Summary

The empirical narrative in Chapters 4 through 8 described how the attributes of “designer” and “user” shifted continually across a given set of actors, depending on which material-discursive apparatus – or “matter of care” – was at play. The conceptual model assembled here in this chapter attempts to graphically capture that complexity while also bringing out the intricate relational work performed by the Academics in their role as designers. It illustrates the kinds of local improvisations that they could undertake throughout the life cycle of the mProject. These improvisations could be implemented to
form alliances that would stabilise their participatory intervention for pedagogically rich mobile learning, either by bringing reality closer to their design, or by moving their design closer to reality.

Latour has suggested that a project is “innovative” to the extent there is initial uncertainty about the types and numbers of actors that must be enrolled (1996). He contends that the work of an “innovator” is complicated because the enrollment of actors does not progress in a hierarchical, orderly fashion:

Not only do the [implicated] actors vary in size, so that they may represent fewer allies than they claim to stand for, but they may also bring into play far more actors than anticipated. If there are fewer of them, the project loses reality, since its reality stems from the set of robust ties that can be established among its actors: if there are too many of them, the project may well be swamped by the erratic intentions of multiple actors who are pursuing their own goals. (Ibid., p. 71)

The extended model of design-reality gaps highlights the discerning work of the “innovator” as it relates to the wider and complex sociotechnical system of an ICTD project. It attempts to illustrate Mosse’s assertion that success and failure “is not just about what a project does, but also how and to whom it speaks, who can be made to believe in it” (2005, p. 158).

In answering my research question: What are the sociomaterial relations of “design practice” in a globally-distributed, multi-stakeholder and technologically-mediated ICTD project for poverty alleviation? I have described the rise and fall of the mProject as an international development project. My thesis analyses its failure to form alliances to link its Participatory Action Research activities to the global policy agenda. Such linkages would have supported the sustainability and scalability of the Academics’ mobile learning intervention by facilitating Ministry endorsements and access to global funding. However, as indicated in Figure 9-4, the management systems and structures that are implicated in achieving scalability and sustainability need not be limited to those of the global development regime.

Indeed, the Academics problematised the mProject as both a development project and a research project, funded jointly by a development agency (DFID) and a research council (ESRC). The tensions created by this duality will be discussed in the concluding chapter, as part of the implications of my thesis. My empirical narrative has described how research projects in technology are, by Latour’s definition, “innovative” undertakings in that they never follow an “elegant order” - the innovator can never anticipate at the outset the number and types of actors that will need to be enrolled (1996,
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p. 72). The graphic representation of design-reality gaps in Figure 9-4 attempts to convey this complexity. It illustrates how the design challenge of ICTD projects involves assembling the necessary heterogeneous actors, in the manner described by Latour (2008) – humbly, deliberately and with careful attention to materiality, meaning and morality.
10 Conclusion

This thesis has examined the role of designers in relation to the broader socio-technical ecosystem of a wicked problem in ICTD design. In doing so, I answer the research question: What are the sociomaterial relations of “design practice” in a globally-distributed, multi-stakeholder and technologically-mediated ICTD project for poverty alleviation? Answering this question entailed three empirical tasks. First, I demonstrated how design practice in ICTD can be understood as a heterogeneous sociomaterial enactment that implicated a globally-distributed, diverse array of human stakeholders and material artefacts. I then show how in this assemblage, there were blurred and shifting boundaries between “design” and “use” corresponding to power struggles in the ontological politics of care (Puig de la Bellacasa, 2011). Finally, I incorporated this sociomaterial analysis of design practice with the theory of design-reality gaps (Heeks, 2002) to illustrate how the Academics’ actions to coordinate the contested notions of “design” and “use” not only increased or decreased the likelihood of project failure, but had moral implications as well. In answering my research question, I have demonstrated how human-machine interaction extends beyond conversations or other transactions between users and technologies, and is better understood as a sociomaterial assemblage working through and inhabiting the interface (Suchman, 2006).

In this concluding chapter, I will discuss how my findings contribute to the fields of ICTD, feminist STS scholarship, and the academic tradition of ANT. I then present the challenges of conducting my research and explore some of the limitations of this thesis. Avenues for further investigation are then examined, followed by an overview of the implications for the policymaking, design, and research. Finally, I close with a reflection on my positionality in relation to the object of my research – the transnational and heterogeneous actor-network that has enacted design practice in the mProject.

10.1 Contributions of the research

In the prior chapter, I have presented an updated conceptual model that describes the rise and fall of participatory ICTD projects for poverty alleviation. In doing so, my work aims to contribute to three areas of research activity: the field of ICTD, feminist
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STS scholarship, and the academic tradition of ANT. In the following sections I discuss the contributions of my work. In the domain of ICTD, my thesis addresses the need for well-developed social theory that explores the relationship between technology and development (Burrell, 2016; Walsham, 2013; Heeks, 2006). My work also draws upon and contributes to feminist STS investigations on matters of care (Murphy, 2015; Puig de la Bellacasa, 2011). Finally, this empirical study contributes to the body of ANT research by generating new methods that integrate post-ANT with classic ANT concepts. These contributions are further discussed in the remainder of this section.

10.1.1 Contribution to social theory in ICTD

This thesis is the first attempt to apply and elaborate the theory of design-reality gaps to study a participatory ICTD project for poverty alleviation. Masiero has also recently extended this theory of ICTD failure (2016, p. 488). However, her conceptual work is specific to deployments of government information systems rather than interventions where the poor are envisaged as both primary users and designers. Although widely-recognised in the ICTD community, the theory of design-reality gaps has not been taken up by researchers in studies of participatory ICTD projects for poverty alleviation. This is perhaps because users are the putative designers in such undertakings, and Heeks himself has observed that when the contexts of design and use are similar and/or co-located, “design-actuality differences can be subtle, implicit, and hard to identify. It can therefore be hard to think beyond the black box.” (2002, p. 106).

In updating Heeks' theory of ICTD failure, my work is also the first effort to adopt the “material ecosystemic” approach proposed by Burrell to theorise “the role played by technology as material artifact, system, or technique in realizing the many and diverse goals of [global] development” (2016, p. 1). Whereas prior ANT-inspired accounts of ICTD focus on barriers to deploying large-scale e-government initiatives, Burrell offers two vignettes describing how local villagers integrate ICTs into existing material assemblages to enact social change. My thesis extends this attention to “material forms and relational materialities” (p. 6) in two ways. First, it theorised the dynamics of the “ecosystem” more comprehensively through the theory of design-reality gaps and the concepts of translation, the material-discursive apparatus, multiplicity, and matters of care. Secondly, it re-inserted professional designers and engineers as participants (but not primary drivers) in that material ecosystem and traced the materiality of the emergent ICT over the longer course of an entire project funding cycle. These ANT-informed
analyses lend insight into the performance and politics of international development projects, which remain the central mechanism by which socio-economic change is implemented in low income nations (Heeks & Stanforth, 2014).

This thesis further contributes to theory in ICTD by better conceptualising the “nexus of theory and practice” where the ‘D’ might be brought to bear on the design and deployment of ICTs (Donner, Grinter, & Marsden, 2013). Burrell contends that few studies theorise how ICTs relate to global development, and those that do fail to problematise the role of the designers and researchers pursuing those interventions (2016). Observing that the field of development studies has been primarily concerned with “policy, institutions, and macroeconomic forces”, she asks: “What does it mean to act or to intervene in other ways, not through policy making, but through the material design of technological artifacts and systems?” (Ibid., p. 1) The material ecosystem shown in Figure 9-4 illustrates how concepts of “care” and “social justice” served as conceptual points of attachment to connect the Academics’ material-discursive apparatus for mobile learning with other related problematisations of care that spanned an array of national and international development institutions. However, that conceptual connection between informatics and development theory proved to be fragile, offering little guidance on how ethical design practice associated with “care” might be enlisted to enact “social justice”. What was missing specifically was theoretical work on the possibilities of intervening through the mundane practices of technology design – that is, through work involving coding, software, prototypes, visualisations, data, hardware, mobiles, computers, and servers. Figure 9-4 demonstrates how scholarship on infrastructuring and boundary infrastructures by Bowker and Star (1999) offers a basis for theorising more systematically about how the practices of technologists might participate directly in sustained, material enactments of social justice.

10.1.2 Contribution to feminist STS studies of care

In deconstructing the multiple enactments of care in a participatory ICTD project for poverty alleviation, this thesis advances Puig de la Bellacasa’s call for “an ethos of care within the study of science and technology” (2011, p. 85). My study joins a small but developing body of scholarly work linking the design, production, and use of digital technology with feminist STS perspectives on matters of care. Within the wider HCI research community, scholars have begun to reference this feminist concept of care as objects of critical research in empirical studies of hacker communities (Irani, 2015;
Toombs, Bardzell, & Bardzell, 2015; Toombs, 2016), labour movements for online workers (Salehi, Irani, Al Khatib, and Bernstein 2014), coding practices for computer visualisations (Webmoor, 2014), and repair work on mobile handsets (Houston & Jackson, 2017). Others have highlighted the role of care in their own research practices in participatory design (Light & Akama, 2014; Lindström & Ståhl, 2014), consistent with a “research through design” approach that engages in theory-building while designing and producing specific artefacts (Bardzell, Bardzell, Irani, Lindtner, Williams, & Zimmerman, 2016; Saludo, 2015; Zimmerman & Forlizzi, 2014). HCI scholars Irani and Silberman have argued that in addition to analysing care through design, gathering “stories about design” is also necessary to address asymmetries of power in informatics research. The authors write:

[...] designers committed to advancing justice and other non-market values must attend not only to the design of objects, processes, and situations, but also to the wider economic and cultural imaginaries of design as a social role. (2016, p. 4573)

In this respect, my sociomaterial account of the globally-distributed, heterogeneous laboratory life of the mProject is a story about design. By illustrating – in ANT terms – the interplay between the affective attachments of the Academics, the modernisation of the Kenyan health system, and the dual and conflicted sociomaterial heritage of the mobile phone as both system for social change and enabler of consumer choice, this thesis offers a novel analysis of the transnational ontological politics in ICTD. This is a domain not yet examined as a matter of care in feminist STS research.

Redfield observes that relatively few STS studies (feminist or otherwise) have addressed technology outside of highly industrialised settings, “particularly at the micro-level of modest miracles and mundane practice”, and then further notes that “postcolonial critique favors sweeping rhetoric and the vast geohistorical tableaus of a global North and South” (2016, p. 160). Reiterating the importance of critique of the sociomaterial matters of care for global humanitarianism, Murphy argues that “when affect is constructed as the pivot of a political or recuperative project, and when technoscience is invited to choreograph belonging and pleasure, or to assemble intimacy and rescue, this is a moment to remember critical tools and entangled pasts” (2015, p. 732). By troubling the assumptions of participatory, practice-based approaches in informal technology-supported learning and illustrating how the application of social justice principles led to
the demise of the mProject, my thesis is a first effort to critique ICTD explicitly as a matter of care in feminist technoscience.

In its attention to social theory and its revival of generative critique in the depiction of matters of care, this thesis is part of the “21st-century trajectory in STS” (Martin et al., 2015, p. 629) corresponding to Sismondo’s (2008) vision of the “engaged program”. In this move, the aim is for STS research “to contribute both to some version of activist projects and to general theoretical perspectives” (Ibid., p. 21), to form a space for “theoretically sophisticated analyses of science and technology in explicitly political contexts” (Ibid., p. 13). This thesis is positioned as an interventionist STS that seeks to promote science and technology in the public interest, and also be “more accountable for our participation in the technoscientific worlds we study and inhabit” (Kenney, 2015, p. 2). My research embraced this activist project in STS, not only by directly engaging with the emancipatory politics of the mProject as an object of study, but through the reflexive research practices described in Chapter 3 that demarcate my positionality. In the closing section of my thesis, I further discuss how the politics of my methods inevitably “participate in the collective activity of making and unmaking technoscientific worlds” (Kenney, 2015, p. 2)

10.1.3 Contribution to ANT

My research contributes to the ANT tradition by providing practical guidance to researchers who are interested in studying the formation and dissolution of heterogeneous assemblages. Heeks contends that “methodologically, ANT can be difficult to put into practice” and that scholars in development studies and ICTD have been deterred by the complexity and diversity of the approach, and by the lack of detailed accounts on how to apply such concepts to their research (2013, p. 7). To address this shortage of methodological guidance, I have “exposed the seams” (Kenney, 2015) of my own knowledge-making practices in Chapter 3. These methodological insights are descriptive rather than prescriptive. They do not offer a template or toolkit, but instead describe “how ANT influences the questions asked, the way you explore your phenomena, what is attended to, how you understand and think with your data, and how it might be represented” (Thompson & Rimpiläinen, 2012, Introduction, para. 2).

“A contribution to ANT gently shifts the existing theoretical repertoire” observes Mol (2010, p. 261); it adds conceptual “terms and modes of engaging with the world” that helps scholars “[...] to attune to the world, to see and hear and feel and taste it” (Ibid.
p. 262). Enriching the ANT tradition is not about conducting case studies to validate or reject a theoretical concept, or to refine it until it can be reliably replicated across a range of settings. Instead, Mol explains how case studies are occasions to adapt ANT, to expose the theoretical repertoire to different scenarios that can generate additional methods to trace the formation of sociomaterial relations:

Every time a new case is considered it suggests different lessons about what an “actor” may be […] The point is not to purify the repertoire, but to enrich it. To add layers and possibilities. In this tradition, then, terms are not stripped clean until clarity is maximized. Rather than consistency, sensitivity is appreciated as a strength. (Ibid., 257)

In Chapters 4 - 9, I demonstrated how empirical data from an ICTD project “shifted” the theoretical repertoire of ANT, how it served as an occasion to devise more sensitive methods that would attune more closely to the ways in which poverty, politics, and morality participated in the sociomaterial enactment of design practice. With these methods, I engaged in my own “tacking back-and-forth” between the stability of classic ANT and the more fluid post-structural concepts, working to move the narrative along the linear trajectory of a project funding cycle while at the same time conveying the complexity of design practice.

10.2 Challenges and limitations of the thesis

All semiotic technologies are partial and situated. The boundaries of my knowledge-making practices were marked iteratively as my analysis moved from one site of knowledge production to the next (cf. Marcus, 1995). I described in section 3.7.1 how I attempted to make my “mobile positioning” (Haraway, 1988, p. 585) visible by explicating the theoretical concepts that I applied through the four moments of translation, and by using descriptive and vivid language. Being reflexive about the boundaries of my knowledge-making practices was a way of remaining accountable for the exclusions that were enacted through the methodology described in Chapter 3 (Haraway, 1988). Having now finished cutting the network for this narrative, I extend this discussion of reflexivity by presenting some of the challenges and limitations of my overall analysis.

One of the challenges of this study was managing the large amounts of data related to the mProject. The time and resource constraints of writing a doctoral thesis made it possible to analyse only a subset of what was made available to me. My thesis draws primarily from written text in the form of research publications, project documents, interview transcripts, e-mail and social media correspondence and does not incorporate
the video and photos that were collected by the mProject research team. Due to this high volume of project data and my personal travel constraints, I did not attempt to engage in additional primary data collection beyond what was performed during the site visit to Kenya and the meetings in Paris, London and Oxford.

Figure 3-2 shows how an extensive and complex web of sociomaterial relations presented numerous possibilities for “following the actors” at the outset of the study. In Chapter 3, I described the practical and analytic considerations that went into devising my methods to “cut” that network. Following the HAT through four moments of translation was a way to carve out the emergent network of actors that constituted the scope of my study. This “minimal methodology” delimited the object of observation within my own material-discursive apparatus to examine design practice, but inevitably truncated the analysis of the actor-network, both in temporal and spatial terms. Cutting the network was, in effect, a boundary-making practice that enacted its own exclusions, some of which are presented here as limitations of my thesis.

One limitation of my study relates to the way my narrative was framed to coincide temporally with the life of a development project. For the reasons discussed in Chapter 3, this account was anchored to four sequential moments of translation that occurred during the funding period of the mProject: I did not follow the formation of this actor-network beyond the end date of the project grant. However, the termination of external funds does not necessarily result in the complete dissolution of a sociomaterial gathering. No conclusions can be made about the state of alliances after the funding ceased. Without the freely provided data bundles and calling cards, the connections between CHWs, their mobile phones, and the other actors might have withered away completely, or they might have been sustained. Alternatively, new sociomaterial practices might have been formed that did not reflect the initial aims described in the Academics’ grant application. The Academics’ work on the development of “connection points” (Sørensen, 2010, p. 38) between social justice theory and ICT became part of a follow-on project that is also outside of the scope of my thesis. Additional research to trace the formation of the actor-network beyond the time frame of the development project would have generated valuable insight into the kinds of sociomaterial practices that persisted (or not) once the project funding had ceased.

Another limitation of the thesis is its relatively brief analysis of how the local NGO participated in design practice. Following the trajectory of the HAT brought the roles of the Academics, CHWs, and mobile phones to the foreground, but left the
practices of the Kenyan NGO largely out of the narrative. Yet these community-based organisations are widely-considered to be pivotal actors in the international development arena, and Gitau, Diga, Bidwell, & Mardsen argue that “processes to support co-operation between researchers and NGOs, within design processes, are imperative to ICT4D projects” (2010, p. 1). Watkins, Swidler, and Hannan observe that while much of the development studies literature has viewed NGOs as “capable of liberating communities and individuals from incompetent or oppressive states on the one hand and the grip of the market on the other,” these “local organisations confront a profound contradiction between the global visions of transformation that animate them and the complex, obdurate material and social realities they encounter on the ground” (2012, p. 286). The practices of these actors are seen to be embedded within vast and complex accountability regimes that involve both the performance standards of global donors and organisational responsibilities to local communities (Ebrahim, 2005; Newcomer, Baradei, & Garcia, 2013). These relationships were not captured by following my analytic token during its travels through translation and were therefore not included my narrative of participation in design practice.

Finally, one of the enduring critiques of ANT has been its amorality – that is, its “failure to illuminate the processes of technology design in ways that might serve the ends of freedom and justice” (Winner, 1993, p. 376). In this narrative, the Academics’ explicit attachments to both liberation theology and to the emancipatory currents of contemporary educational research made it possible to include justice as an object of study. Theoretical work on matters of care provided the conceptual terms to critique how the Academics invoked social justice principles to coordinate the multiplicity of the HAT; and to propose infrastructuring as an alternative form of coordination work that would enable Academics to enact more situated forms of justice. However, it was not within the scope of this thesis to go further and consider, in Mol’s words, “What might it be good to do? What might the good be, here and now, in this case [...]?” (2002, p. 169). Answering these questions will require additional theoretical equipment that can problematise how the enactments of the HAT should be ordered in the name of “fairness, equity, and freedom” (Mamo & Fishman, 2013, p. 8).

10.3 Future studies

I have elaborated Heeks’ theory of design-reality gaps to describe the rise and fall of a participatory mobile learning project for Kenyan CHWs. Further empirical studies
would help to determine whether this updated model is helpful for understanding mobile phone interventions for poverty alleviation in different sectors such as health, microfinance or agriculture. Alternatively, the model might by applied in studies of educational interventions that involve different devices, such as radios or portable lab top computers instead of mobile phones. Such additional work would have two potential benefits. First, if the proposed model proves to be sensitive enough to describe a wide range of ICTD interventions for poverty reduction, it can serve as a design resource to increase the likelihood of project success. Second, in cases where this model requires modifications or is otherwise unhelpful, those empirical findings would contribute to theory by identifying new concepts to help describe project outcomes in ICTD.

Another avenue for future research is to explore the model in Figure 9-4 might support “speculative design practice” for new “boundary infrastructure”. Bardzell and Bardzell have pointed to an emerging body of research involving “design futuring and emancipatory design,” which integrates the “use of critique as speculation with design activities” (2016, p. 26). Auger suggests that “careful management of the speculation” is key to soliciting design input from participants, requiring “a bridge to exist between the audience’s perception of their world and the fictional element of the concept” (2013, p. 11-12). He contends that if a proposed design is too familiar, it is easily incorporated into the status quo and passes unnoticed, yet if it presents concepts and sociotechnical environments that are too implausible, participants are likely to disengage from the collective process of envisioning new futures. The “material ecosystemic” model proposed in this thesis can make speculative design workshops more effective by bridging the sociomaterial practices of heterogeneous participants – and not simply their individual perceptions – so that sustainable collective futures are enacted, rather than simply envisioned.

Finally, additional research is needed to extend a sociomaterial theory of social justice in ICTD. This elaborated theory about justice in ICTD would be distinct from the relatively well-established tradition of work on ethics in HCI in general and ICTD in particular (Friedman, 1996; Dearden, 2012; Steen, 2011; Sterling & Rangaswamy, 2010). Whereas theoretical work on ethics in technoscience focuses on individuals and the “rational and methodical application of values or principles for creating rules of conduct and moral courses of action,” Mamo and Fishman call for a framework of justice that addresses the heterogeneous gathering of actors around matters of care (2013, p. 3); this
framework is needed to assess the “politics of what” and the “enactments of goodness or goodneces” (Mol, 2002). As Reardon contends, contemporary calls for justice in science and technology:

[...] invite us to move outside of the space of thinking about the self, and the conduct of the self, in this age of the self (Rose 1996). In a moment when institutions – even public ones – encourage us to focus inwardly, these increasingly prominent calls for justice offer a space for thinking about others. They orient us around the collective – around what can come together and what cannot and why. (2013, p. 179, my emphasis)

Demonstrating how justice “matters” shifts the analysis away from questions of “individual autonomy, control, privacy, and liberty (classic ethics issues) toward identifying and addressing group-based and community-level constraints and possibilities produced through structural power” (Mamo & Fishman, 2013, p. 11).

In this thesis, I illustrated how the Academics were obliged to intervene in a multiplicity of identities spanning the domains of research, policy, and practice. Professional designers, like physicians in a health system, require social theory that helps them engage with normative questions about “what to do”, not through codified response but through the discernment of the distributed and practice-based sedimentations of knowledge production. Future research is needed to determine whether widely-applied development theories which stress individual agency, freedom, and choice—such as the Capability Approach (Sen, 2001; Nussbaum, 2011) – can adequately address the collectivist imperatives of social justice that are raised here. Answering these questions would require additional theoretical equipment that can problematise how the enactments of the HAT should be ordered in the name of “fairness, equity, and freedom” (Mamo & Fishman, 2013, p. 8). Bowker and Star (1999) and Verran (1999) suggest that through the collectivist moral theory developed by Addelson (1994), empirical and relational modes of ANT inquiry can help generate an embodied, group-based response to the ethical question: “How should we live”?

10.4 Implications of the thesis

The ESRC-DFID Joint Scheme provided a valuable opportunity to analyse empirically the tensions between implementing a successful development project, as defined by the global development regime – and conducting a successful social research project, as defined by the academy and its disciplinary traditions. This thesis has illustrated how the Academics’ socially-embedded research practices were valuable in
the sense of bringing unmet local needs to the foreground and prompting community advocacy for disabled children. Yet these same activities “failed” in the sense of neglecting the aims of the Millennium Development Goals and were not integrated into the Community Health Strategy. Mosse cautions that when notions of success and failure are anchored too tightly to global development targets, other practices with the potential to improve local livelihoods are obscured and stifled (2005). He argues that public policy indicators of success and failure can inhibit the emergence of alternative project logics that may be more suitable for certain socio-economic contexts (Ibid.). Moreover, policy indicators of “success” also discount the positive but unintended livelihood effects that are generated by local actors and beneficiaries (e.g., Kanungo, 2003). In depicting these controversies over the definitions of success, my narrative of the mProject joins other studies in highlighting the challenges of assessing the impact of academic research interventions (e.g., Chubb & Watermeyer, 2017; Laing, Mazzoli & Todd, 2018), especially when study teams are interdisciplinary, multi-sector, and globally-distributed (e.g., Jeanes, Loacker & Sliwa, 2018; Gooch, Vasalou & Benton, 2017).

Consistent with the theoretical tenets of ANT (refer to Section 1.7), the success of the mProject was analysed strictly in terms of the number and the strength of its alliances with concepts, objects, devices, humans, and organisations. While this narrative has described how the mProject failed to create linkages that would have strengthened its sustainability and scalability as a development project, my analysis did not ascertain the extent to which other types of alliances were cultivated (refer to Section 10.2); it leaves open the possibility that the mProject succeeded as a research project, as a social mobilisation project or as a yet-to-be imagined assemblage of alternative sociomaterial relations. In keeping with these ANT principles, the updated model of design-reality gaps presented in Figure 9-4 remains agnostic about what types of linkages are possible and desirable when attempting to address the gap that separates reality from an always emergent and ever contested design.

As Yarrow asserts, an ethnographic analysis of practices offers a way of surmounting the “post-colonial predicament” – it can help to decouple “the pessimism from the insight” and bypass “entrenched ideological oppositions” in order to understand how development works (or not) in the present, and how it might be made to work better in the future (2011, p. 2-3). Mosse notes that while the “development encounter of power” should not be sanitised (2013, p. 231), it is important to recognise that:
the operational control which bureaucracies or NGOs have over events and practices in development is always constrained and often quite limited; regardless of whether they are disciplining or empowering in intent. (Ibid., p. 8)

Confronted with the fragility of the public health system, troubling health indicators, and the expectations of its suffering beneficiaries, the adherents of the Community Health Strategy were not in a position to claim success either, irrespective of that programme’s political legitimacy and privileged access to global development resources. In analysing notions of success and failure in the ontological politics of the mProject, I argue that there were numerous, competing material-discursive apparatuses of care all seeking to empower, emancipate, and include in the name of human solidarity, equity and fairness. This suggests the collective need for reflexivity about how our different material-discursive practices exclude, attribute success, intra-act, generate torque, and perpetuate sedimentations of structural violence – even as they embody aspirations to promote human capabilities and improve livelihoods. In the subsections below, I offer further implications of these findings for policy, design, and research in ICTD.

10.4.1 Implications for policy practice in ICTD

This thesis invites policymakers to consider how their own care practices constitute and maintain the gap separating design from reality. As the Millennium Development Goals are supplanted by the post-2015 Sustainable Development agenda, three core themes have emerged in the global policy discourse: (1) inclusion (2) transformation, and (3) sustainability (Heeks, 2016). This discourse suggests that policymakers seek to address the growing disparities between rich and poor, that they are no longer satisfied with incremental approaches to socio-economic change, and that they are concerned with meeting the extended needs of both present and future generations. These current policy imperatives can be understood as entangled actors circulating within a multi-sectoral, public-private, transnational matter of care. For these well-funded, institutionally-sanctioned activities to become obligatory passage points for sustainable social inclusion, decision-makers will need to consider the ways in which their “policy levers” (Grace, Meurk, Head, Hall, Carstensen, Harris, & Whiteford, 2015; Howlett & Howlett, 2010) risk creating classification systems that exclude the participation of intended beneficiaries. They need to be more vigilant to the ways that such instruments of policy practice – administration, regulation, community education, finance, and
subsidies – can generate *torque* in relation to less dominant ways of enacting care by their grassroots constituents.

In the case of training initiatives for CHWs, my research findings resonate with the ethnographic research conducted by Maes, Closser, and Kalofonos (2014), who argues that improving “CHW policy and practice – in multiple political contexts around the world – requires treating CHWs like global health actors and not as resources to be better exploited through technical quick fixes” (2014, p. e8). Promoting sustainable social inclusion through ICTD therefore requires policymakers to acknowledge *multiplicity* – to recognise how human and non-human actors negotiate multiple roles and accountabilities as part of concurrent, alternative material-discursive apparatuses. *Caring* policies are those that incorporate flexible standards that foster the work of *distribution, coordination,* and *infrastructuring* to accommodate this *multi-membership* and its attendant marginalisation (Bowker & Star, 1999). Sites of *multiplicity* should be treated not only as sites of local resistance, revolution, or subversion, but also as sociomaterial points of attachment for potentially innovative configurations of devices, beneficiaries, and other implicated actors. Supporting the coordination work described in Section 8.4.3 will require policies and funding for platforms that better integrate government information systems with stand-alone personal devices and applications.

10.4.2 Implications for the design practice in ICTD

This research also has implications on the work of trained designers participating in ICT projects with and for the poor. The findings show how it is through the mundane attentive practices of distribution, coordination, and *infrastructuring* that such professionals transform aspirations of care into sociomaterial assemblages of social justice. Accordingly, Latour suggests that the professional designer is charged with the humble task of “drawing things together,” of attending closely to details and meaning, so as to carefully extend the heterogeneous actor-networks that gather around matters of concern (2008). This drawing together of heterogeneous actors implies a humility that is:

[…] a clear substitute for revolution and modernization […] Designing is the antidote to founding, colonizing, establishing, or breaking with the past. It is an antidote to hubris and to the search for absolute certainty, absolute beginnings, and radical departures” (Ibid., p. 5).

This modest depiction of design practice is at odds with the sweeping transformational discourse in ICTD and mobile learning, which aligns more readily with the “humanitarian neophilia” described by Scott-Smith (2016). Scott-Smith critiques the humanitarian
sector’s widespread adoption of the “Californian Ideology” (Barbrook & Cameron, 2001), showing how the logic of the market, along with “individual rebellion, radical individualism and a utopian technological determinism” combine to materialise technologies that “under-state the state” and “over-state the object” (2016, p. 2232).

Devices such as mobile phones are often championed as “nomadic” revolutionary innovations – personalised, portable objects that seek to engage with needs at the micro-level to enable survival without modernist, state-led infrastructures, such as electricity grids and health systems (Redfield, 2016). In the “urgent desire ‘to make a difference’ in an often intractable world”, designers frame technological objects narrowly to achieve the modest, but tangible “fix” (Ibid., p. 175). What then often ensues, argues Scott-Smith, are novel gadgets that may be celebrated for their demonstrated effectiveness and efficiency within very limited scopes of action, but fail to improve lives in sustained and significant ways (2016). As a material-discursive apparatus of the Californian Ideology, humanitarian innovations such as mobile phones have therefore advanced forms of design that address isolated individual users, rather than collectives of heterogeneous actors interested by matters of care. This thesis argues that rather than simply expanding individual choice and autonomy, technologists seeking to enact more comprehensive and durable manifestations of social justice must also incorporate management systems and structures, as well as the notion of boundary infrastructure more extensively into their problematisations of care. Again, this would entail more design work on platforms that reconcile the digitally-supported knowledge practices of the poor with existing IS systems that are endorsed by government and development agencies.

10.4.3 Implications for research practice in ICTD

The model proposed in this thesis makes no normative claims about the specific kinds of management systems and structures that lead to successful participatory projects for poverty alleviation. This is an empirical question. In my research, the “academic affections” of the Academics were aimed at subverting power away from both the market and the state to benefit the CHWs. Such efforts to liberate the CHWs follow what Scott-Smith lauds as the “succession of inspirational humanitarians [that] has managed to find that autonomous space to assist suffering people in a way that is separate from both states and markets – yet is still firmly political” (2016, p. 2242). Yet, I have shown that disentangling ICTD from the market and state was difficult and could work to the detriment of users/beneficiaries. The enlisted humans and non-humans assumed their
roles within the Academics’ mProject, but their sociomaterial ties with alternative, market-oriented and state-based material-discursive apparatuses were never completely severed: translations were always partial. As Redfield (2016) observes, scholars who are engaged with humanitarian technologies and have critiqued the failures of both market and state must now confront the provocative political question raised by development scholar James Ferguson (2010): *What do we want?*

Redfield suggests that academics, while rejecting both neoliberalism and the bureaucracies of the nation state, offer little social theory on the ideal social arrangements. Drawing from Ferguson, he writes:

> […] critical reflections of the contemporary moment routinely conclude by expressing indignation. They rightly denounce injustice and inequality, and rightly assign blame. They rarely, however, offer much in the way of a positive alternative vision, particularly at a level of technical detail or material artifacts. (2016, pp. 173-174)

In the material ecosystemic model proposed in this thesis, the affective entanglements of researchers have material consequences that either help or hinder the realisation of poverty alleviation. If the aim of ICTD projects is to realise comprehensive and sustained social justice in the form of *boundary infrastructure*, my model suggests that academic researchers must challenge their assumptions about the political work of cherished values related to “openness”, “emancipation”, “fluidity”, as well as “rescue”; and also reconsider the role of “markets”, “authority”, “bureaucracy”, and “infrastructure” in drawing together collectives of care.

Humanitarian technologies, asserts Redfield, “embody, convey, and manipulate moral affect” (2016, p. 160). Yet such sensibilities are omitted from most scholarly accounts of technology design, in conformance with the politics of an academy that favors methodological clarity and tangible outcomes (Akama, 2015). The narrative form of this thesis strays from the dominant mode of communication in HCI, the scientific report, to illustrate how design practice in ICTD is a matter of care. In my analysis, affective states are treated as lively participants in the materialisation of actor-networks for ICTDs, making it possible to analyse the political assumptions of academic research and to also explore how some innovations evoke anger, despair, or ambivalence among academics – while other technologies remain, in the words of Mol and De Laet (2000), “moving” and “easy to love”.

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10.5 Researcher positionality revisited

How should one write, what words should one select, what forms and structures and organization, if one is pursuing understanding? (Which is to say, if one is, in that sense, a philosopher?) [...] Style makes its claims, expresses its own sense of what matters [...] There may be some views of the world and how one should live in it [...] that cannot be fully and adequately stated in the language of conventional philosophical prose, a style remarkably flat and lacking in wonder — but only in a form that itself implies that life contains significant surprises, that our task, as agents, is to live as good characters in a good story do, caring about what happens, resourcefully confronting each new thing [...] And what if it is love one is trying to understand, that strange unmanageable phenomenon or form of life, source at once of illumination and confusion, agony and beauty? Love, in its many varieties, and their tangled relations to the good human life, to aspiration, to general social concern? What parts of oneself, what method, what writing, should one choose then? What is, in short, love’s knowledge — and what writing does it dictate in the heart?

Martha Nussbaum, 1990, p. 3-4

Methodology and methods are central concerns in this narrative of design practice. Attending to my own methodology and methods (and not just to those of ICTD designers) responds to the call for STS scholars to care about how their forms of knowledge production strengthen and undermine the technoscientific worlds that they study. I have shown how praxiography – the ethnography of practice – can be adopted to analyse the methodology and methods of ICTD. As discussed earlier, an ethnography by definition 1) draws on data from “real world” contexts; 2) values the perspectives of both the research subject and the analyst; and 3) analyses meanings that emerge through the enactments of “language, bodily movements, artefacts, images and technologies” (Flewitt, 2011, p. 296). At this point, it is evident how the first and third criteria have been addressed: I drew from the empirical data of the mProject and applied methods from the ANT tradition to describe how heterogeneous participation in design enacted the politics of care. Less apparent is how the second criterion of ethnographic research was addressed in my work – how my participation relates to the performances of other actors in the mProject actor-network. I therefore close this doctoral thesis with a more explicit discussion of my positionality in the mProject actor-network, and how my research practices mediate my relations with those actors.

Praxiography is a form of ethnography. Chiseri-Strater has noted that “in ethnography a major goal of the research process is self-reflexivity – what we learn about the self as a result of the study of the ‘other’”(1996, p. 119). She contends that this “turning in upon ourselves” involves locating the role of the self not only in relation to study informants, but in relation to theory, to methods, and to the transformation of data
into written text (Ibid.). Kenney amplifies the relational dimensions of this positionality when suggesting that the concept of accountability, which emphasizes “[…] the self in relation to a collective,” is a more generative concept than “reflexivity”, which may be more widely adopted, but “foregrounds the self as the key player” (2015, p. 2, author's emphasis). Whereas forms of self-disclosure associated with “reflexivity” might be dismissed as “confessional tales” or as perfunctory moves to qualify the findings of academic research, Kenney argues that understanding positionality as “accountability” – as the relationship between the self and others – can refine the scholarly practices of STS researchers so that they “generate knowledge not only about, but also for the life worlds we study” (Ibid., author’s emphasis).

As discussed in Chapter 2, my study is situated as part of a “materialist, naturalist, and posthumanist elaboration” of the performative turn in social theory (Barad, 2003, p. 803). With this theoretical stance, knowledge practices are considered interventions on, rather than representations of reality. My empirical narrative illustrated how different sets of knowledge practices enacted the HAT’s multiple realities as a health assessment tool, a device of interessement, an educational resource, a job aid, a consumer choice and a community advocacy tool. These enactments constituted the formation of the extended, but fragile mProject actor-network, demonstrating how the reality of the HAT is “more than one, but less than many” (Mol, 2002). There was yet another performance enacted by the HAT – that of an analytic token drawing my material-discursive practices as doctoral student into the mProject actor-network. In this respect, my participation in this gathering of heterogeneous actors was that of a “participant-storyteller” (Kenney, 2015; Verran, 1999) deconstructing design practice into its sociomaterial bits and pieces and re-assembling it in the text of the pages in a thesis.

In this material-discursive apparatus for doctoral research, the ANT tradition acted as a repertoire of theoretical concepts that guided me through the empirical data from the mProject. Latour playfully describes “methodology” and “method” as “pompous Greek names” for describing the approaches that help scholars discern “where to travel” and “what is worth seeing there” (2005, p. 17). In this regard, ANT served a vast “repository of terms and modes of engaging with the world […]”, ways of aiding me “in getting a sense of what is going on, what deserves concern or care, anger or love, or simply attention” (Mol, 2010, p. 262). The gathering of theoretical “props, equipment, knowledge and skills” assembled over the course of thirty years of ANT scholarship presented a host of methods to craft a story. In dialogue with the mProject data, classic
ANT concepts were first selected to structure the plot, and then elements from other domains of scholarship were iteratively added both to enrich and advance the story along its linear time trajectory. These post-ANT theoretical insights were deployed to convey the affective and material challenges of laboratory life in ICTD better, and to allude to the trials of strength that tested the fixity of my own identity as a “doctoral student” during interactions with a research colleague, a health practitioner, a fellow parent, or a child in need.

When advocating that positionality be framed in terms of “accountability” rather than “reflexivity”, Kenney is not arguing for the bureaucratic practices linked to monitoring and evaluation:

Accounting, in this sense, refers not only to “rendering a reckoning” but also to the creative practice of “narration and relation” (Oxford English Dictionary (OED)). Giving an account does not have to look like performing an audit; it can also look like telling a story. (2015, p. 10)

As such, writing a story about participation in ICTD design was not about representing reality, but about relating to it. In the way Kenney describes, story-telling was a practice that involved forging relations between words and the mProject actors, and assembling connections with the individuals who would eventually read and adapt those words (or not). Words constitute the “permanent marks” in the material-discursive apparatus that enlisted me as a doctoral student. Assembled together in this thesis as a matter of care, these words are meant to be read not as realist ethnography, but as “fables of attention” – that is, “social stories that orient their readers around moral questions,” and “do not just illustrate social theory”, but embody and enact it (Kenney, 2015, p. 11).

Being accountable as a STS researcher is therefore about being responsible for the sociomaterial relations that are formed through my story-telling practices about the mProject actor-network. In this context, care is constituted as a literary form akin to the novel that strives for moral relevance by weaving fine-tuned perceptions of situated particulars with incisive articulations of abstract principles (Nussbaum, 1990). Accordingly, to care is to attend closely to how words are chosen and composed into phrases, sentences, and sections of chapters. It is also about recognising the inevitable exclusions that arise from this text, and acknowledging the difficult questions that emerge from such “cuts”. Care for the mProject actor-network is reified here – with the 94,594 permanent marks assembled in 337 A4 pages, hard-bound in medium blue cloth (or perhaps compiled in 35 megabytes of a digital file). How will this object perform as a
doctoral thesis, as a methodological provocation for design, or as a technology for
empowering the poor? Those trajectories remain to be followed into the near and distant
futures. This text may yet extend itself in the ways that Law and Singleton have described
– as a network object, a fluid object, or “fire object” that “jumps, creatively, destructively
and more or less unpredictably, from location to location” (2005, p. 347). Or alternatively,
it may not move at all. Like the other micro-gadgets embodying desires to alleviate
poverty and enact social justice, my reification of care remains, in the words of Redfield,
an “ambivalent achievement” (2016, p. 176). Offering neither accusatory critique nor
triumphant redemption, what is presented now is not so much a network, fluid, or fire
object, but bears more resemblance to one of Auden’s ironic points of light – a small but
steadfast flame that burns, a trace sedimentation of love’s knowledge.


265


271


Law, J. (2010). The Materials of STS. In D. Hicks, & M.C. Beaudry (Eds.), The Oxford handbook of material culture studies (pp. 1-18) Oxford: Oxford University Press.


Shelton, J. D. (2014). Evidence-based public health: Not only whether it works, but how it can be made to work practicably at scale. *Global Health: Science and Practice, 2*(3), 253–258. doi:10.9745/GHSP-D-14-00066


Appendices
## MOBILE COMMUNITY HEALTH WORKER STAKEHOLDERS MEETING

**AMREF HEALTH AFRICA INTERNATIONAL TRAINING CENTRE**

**WEDNESDAY MARCH 18, 2015**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Person Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900-0930</td>
<td>Arrivals and Registration</td>
<td></td>
</tr>
<tr>
<td>0930-0945</td>
<td>Welcoming of participants and Introductions</td>
<td></td>
</tr>
</tbody>
</table>
| 0945-1030| Key take Away Points
  - Project background- Main “take-away” points-
  - Images and video (CHVs'/CHEWs' take)                                 |                    |
| 10.30-11.00| Coffee Break                                                             |                    |
| 11.00-11.20| Project background and motivation (Goals)                               |                    |
|           |  - Links to the CHV curriculum                                           |                    |
|           |  - Why smartphones?                                                      |                    |
|           |  - Forms of training                                                     |                    |
| 11.20-11.45| Methodological approach (Processes)                                     |                    |
|           |  - PAR                                                                   |                    |
|           |  - Iterative design                                                      |                    |
|           |  - Theory-driven evaluation                                              |                    |
| 11.45-1.00| Dissemination and discussion of findings in detail                       |                    |
| 1:00-2:00 | Lunch Break Break                                                        |                    |
| 2.00-4.30 | Discussion on the way forward for project                               |                    |
## Appendix B - Attempts to obtaining study access to ICTD projects

<table>
<thead>
<tr>
<th>Name of Organization</th>
<th>Point of Contact</th>
<th>Referred by</th>
<th>Dates of Interaction</th>
<th>Method of Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya-based NGO I</td>
<td>eHealth Programme Manager</td>
<td>Doctoral Supervisor</td>
<td>5/20/11 - 7/7/11</td>
<td>e-mail</td>
</tr>
<tr>
<td>French private telecom firm</td>
<td>International Project Manager</td>
<td>UNESCO Mobile Learning Conference</td>
<td>12/21/11 - 1/10/12</td>
<td>e-mail</td>
</tr>
<tr>
<td>UN organisation II</td>
<td>Mobile Learning Specialist</td>
<td>Doctoral Supervisor</td>
<td>1/12/12 - 1/20/12</td>
<td>e-mail</td>
</tr>
<tr>
<td>UN organisation II</td>
<td>Programme Specialist in Mobile Learning</td>
<td>UNESCO Mobile Learning Conference</td>
<td>1/20/12 - 1/30/12</td>
<td>e-mail</td>
</tr>
<tr>
<td>Senegal-based NGO</td>
<td>Director of Monitoring &amp; Evaluation</td>
<td>Internet search</td>
<td>1/30/12 - 2/6/12</td>
<td>e-mail</td>
</tr>
<tr>
<td>Swiss-based NGO</td>
<td>Director of Geneva Office</td>
<td>Personal Acquaintance</td>
<td>3/7/12 - 3/8/12</td>
<td>e-mail</td>
</tr>
<tr>
<td>Asia-based multilateral</td>
<td>Vice President of Operations</td>
<td>Personal Acquaintance</td>
<td>4/29/12</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>US-based NGO I</td>
<td>Vice President for Programs</td>
<td>VP of Asia-based multilateral</td>
<td>5/21/12 - 7/2/12</td>
<td>e-mail</td>
</tr>
<tr>
<td>US government agency</td>
<td>President</td>
<td>Personal Acquaintance</td>
<td>7/2/12 - 5/23/12</td>
<td>e-mail</td>
</tr>
</tbody>
</table>
# Ethics Application Form:
**Student Research**

All research activity conducted under the auspices of the Institute by staff, students or visitors, where the research involves human participants or the use of data collected from human participants are required to gain ethical approval before starting. This includes preliminary and pilot studies. Please answer all relevant questions responses in terms that can be understood by a lay person and note your form may be returned if incomplete.

For further support and guidance please see accompanying guidelines and the Ethics Review Procedures for Student Research [http://www.ioe.ac.uk/studentethics/](http://www.ioe.ac.uk/studentethics/) or contact your supervisor or researchethics@ioe.ac.uk.

Before completing this form you will need to discuss your proposal fully with your Supervisor/s. Please attach all supporting documents and letters.

For all Psychology students, this form should be completed with reference to the British Psychological Society (BPS) Code of Human Research Ethics and Code of Ethics and Conduct.

## Section 1 Project details

<table>
<thead>
<tr>
<th>a. Project title</th>
<th>An ethnography of design practice in ICTD—How does mutual learning emerge during a participatory design project for mobile learning in Kenya?</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Student name and ID number (e.g. ABC12345678)</td>
<td>Jade Vu Henry HEN10081215</td>
</tr>
<tr>
<td>c. Supervisor/Personal Tutor</td>
<td>Niall Winters, Martin Oliver</td>
</tr>
<tr>
<td>d. Department</td>
<td>Culture, Communication &amp; Media</td>
</tr>
<tr>
<td>e. Course category (Tick one)</td>
<td>PhD/MPhil  ☒  EdD  ☐  MRes  ☐  DEdPsy  ☐  MTeach  ☐  MA/MSc  ☐  ITE  ☐  Diploma (state which)  ☐  Other (state which)  ☐</td>
</tr>
<tr>
<td>f. Course/module title</td>
<td>Education</td>
</tr>
<tr>
<td>g. If applicable, state who the funder is and if funding has been confirmed.</td>
<td></td>
</tr>
<tr>
<td>h. Intended research start date</td>
<td>January 1, 2015</td>
</tr>
<tr>
<td>i. Intended research end date</td>
<td>December 31, 2015</td>
</tr>
<tr>
<td>j. Country fieldwork will be conducted in</td>
<td>Kenya</td>
</tr>
</tbody>
</table>

If research to be conducted abroad please check [www.fco.gov.uk](http://www.fco.gov.uk) and submit a completed travel risk assessment form (see guidelines). If the
FCO advice is against travel this will be required before ethical approval can be granted: http://ioe.net.inst.ioe.ac.uk/about/profservices/international/Pages/default.aspx

k. Has this project been considered by another (external) Research Ethics Committee?

Yes ☐ External Committee Name:
No ☐ go to Section 2 Date of Approval:

If yes:
− Submit a copy of the approval letter with this application.
− Proceed to Section 10 Attachments.

Note: Ensure that you check the guidelines carefully as research with some participants will require ethical approval from a different ethics committee such as the National Research Ethics Service (NRES) or Social Care Research Ethics Committee (SCREC). In addition, if your research is based in another institution then you may be required to apply to their research ethics committee.

Section 2 Project summary

Research methods (tick all that apply)

Please attach questionnaires, visual methods and schedules for interviews (even in draft form).

☐ Interviews ☐ Controlled trial/other intervention study
☐ Focus groups ☐ Use of personal records
☐ Questionnaires ☐ Systematic review ⇒ if only method used go to Section 5.
☐ Action research ☐ Secondary data analysis ⇒ if secondary analysis used go to Section 6.
☒ Observation ☐ Advisory/consultation/collaborative groups
☒ Literature review ☐ Other, give details:

Please provide an overview of your research. This should include some or all of the following: purpose of the research, aims, main research questions, research design, participants, sampling, your method of data collection (e.g., observations, interviews, questionnaires, etc.) and kind of questions that will be asked, reporting and dissemination (typically 300-500 words).

Mutual learning is often cited as a key component in the participatory design of successful new technologies, yet the construct remains under-theorised. By drawing from the concept of boundary objects (Star & Griesemer, 1989) and from perspectives in Actor-Network Theory (Latour, 2008), this ethnography of an m-learning project for Kenyan health workers aims to provide a systematic and practice-oriented account of how mutual learning emerges within a globally-distributed assemblage of diverse human and non-human design actors. The research will address the following questions:

(1) How does the process of mutual learning among design actors unfold during the participatory design of an educational technology?
(2) How does the process of mutual learning relate to the substantiation of this educational technology?
(3) What “assistances and resistances” (Thompson & Rimpiläinen, 2012) can Actor-Network Theory and boundary objects offer to the study of mutual learning and participatory technology design?
## Section 3 Participants

Please answer the following questions giving full details where necessary. Text boxes will expand for your responses.

a. Will your research involve human participants?  
   - Yes [ ]  
   - No [ ] go to Section 4

b. Who are the participants (i.e. what sorts of people will be involved)? Tick all that apply.

- Early years/pre-school
- Ages 5-11
- Ages 12-16
- Young people aged 17-18
- Unknown – specify below
- Adults please specify below
- Other – specify below

NB: Ensure that you check the guidelines (Section 1) carefully as research with some participants will require ethical approval from a different ethics committee such as the National Research Ethics Service (NRES).

Health workers and programme administrators engaged with the mCHW research project in Nairobi and Makueni.

c. If participants are under the responsibility of others (such as parents, teachers or medical staff) how do you intend to obtain permission to approach the participants to take part in the study?
   
   All contact with participants will be subject to approval by the Principal Investigator of the mCHW project.
   (Please attach approach letters or details of permission procedures – see Section 9 Attachments.)

d. How will participants be recruited (identified and approached)?

   I will submit a list of potential participants for my research to the Principal Investigator of the mCHW project for his review and approval. The Principal Investigator may remove or add the names of individuals that may be recruited. Upon finalizing this list and receiving the authorization from the Principal Investigator to proceed, I will send each potential candidate an invitation to participate in my research (See Appendix 1-Invitation Letter).

e. Describe the process you will use to inform participants about what you are doing.

   When sending the Invitation Letter to all potential interviewees, I will attach a Research Information Sheet (See Appendix 2-Research Information Sheet). I will also deliver a face-to-face presentation to mCHW team members describing my project.

f. How will you obtain the consent of participants? Will this be written? How will it be made clear to participants that they may withdraw consent to participate at any time?

   See the guidelines for information on opt-in and opt-out procedures. Please note that the method of consent should be appropriate to the research and fully explained.

   When sending the Invitation Letter to participate in my study, I will also attach an Interview Consent Form which makes it clear that participants may withdraw consent to participate at any time (See Appendix 3-Interview Consent Form). Prior to beginning any interviews, I will also review the Interview Consent Form with the participant and answer any questions. I will request that the participant sign the Interview Consent Form to indicate that they have understood the purpose of the project and agree to participate in my research.

g. Studies involving questionnaires: Will participants be given the option of omitting questions they do not
The site and unit of analysis for my ethnographic investigation is a globally-distributed ICTD research and development project known as mCHW, an ongoing two-year project funded by the UK ESRC-DFID Joint Scheme for Research on International Development (grant reference: ES/J018619/1). The participating institutions are the IoE, Oxford University and the African Medical Research Foundation (AMREF) in Nairobi, Kenya. The mCHW project has adopted a Participatory Action Research (White, Suchowierska, & Campbell, 2004) approach to design, develop, implement and evaluate a mobile phone based learning intervention that will help train and supervise 70-75 community health volunteers (CHVs) in Kenya. The Principal Investigator, Niall Winters, and the Co-Investigator, Martin Oliver, are also the supervisors for my dissertation research. It is envisioned that my research will support an existing evaluation component that has been built into the larger mCHW project.

For my ethnography of the mCHW project, there will be five overlapping streams of data collection and analysis:

**Phase I: Gathering and Analysis of Secondary Data** - Throughout the study period, I will analyse transcribed interviews and other project documentation from the mCHW project, as well as relevant institutional material and research publications. This secondary data will first be used to generate a “situational map” that lays out the actors and relations in the mCHW project that will help me define and develop the ethnographic focus of my research—the set of specific objects and people that I will follow in my account of mutual learning in design. The map will also point to areas where additional data collection is required. Secondary data analysis will also be performed to gain additional understanding of how practices evolve during the life of the mCHW project.

**Phase II: Participant Observation of mCHW Project Meetings** - From January 21-February 4, 2014, I will attend a series of mCHW Project Meetings scheduled to take place in London and Oxford. The focus of the observations during Phase II will be on deepening my understanding of the evolving practices of different design actors and their interactions with one another.

**Phase III: Interviews of mCHW researchers and AMREF administrators** - During the mCHW Project Meetings, I will conduct a total of 5-6 interviews with mCHW researchers and AMREF staff. Each semi-structured interview will range from 30-45 minutes and will be based on an interview guide. The purpose of the interviews is to ascertain informants’ views on their evolving work practices in relation to the initial design and roll-out of the mCHW intervention.

**Phase IV: Participant Observation of mCHW Site Visit to Kenya** - During March 2015, I will accompany the UK research team during their Site Visit to Kenya. The focus of observations in Phase IV will be on deepening my understanding of the evolving practices of different design actors and their interactions with one another.

**Phase V: Interviews of CHWs, CHEWs, and AMREF Staff** - During the Site Visit to Kenya, I will conduct a series of interviews with CHWs, CHEWs, and AMREF Staff. There will be a total of 5-10 interviews. Each semi-structured interview will range from 30-45 minutes and will be based on an interview guide. The purpose of the interviews is to ascertain informants’ views on their evolving practices in relation to the final stages of design and roll-out of the mCHW intervention.

A prior request for ethics approval for Phases I-III was submitted in December 2014. This document is an application for ethics review of Phases IV and V, which is planned for mid-March 2015.
<table>
<thead>
<tr>
<th>wish to answer?</th>
<th>Yes ☒ No ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>h. Studies involving observation:</strong> Confirm whether participants will be asked for their informed consent to be observed.</td>
<td>Yes ☒ No ☐</td>
</tr>
<tr>
<td>If NO please explain why below and ensure that you cover any ethical issues arising from this in section 8.</td>
<td></td>
</tr>
<tr>
<td><strong>i. Might participants experience anxiety, discomfort or embarrassment as a result of your study?</strong></td>
<td>Yes ☒ No ☐</td>
</tr>
<tr>
<td>If yes what steps will you take to explain and minimise this?</td>
<td>Prior to conducting any interview or observation, I will review the confidentiality and anonymity provisions of the Informed Consent Form with the participant. During the interview, should the participant show visible signs of emotional or physical distress, I will stop the interview and allow the participant to decide whether to resume a later stage. After the interview, I will remove passages of the transcripts that may be linked back to individual respondents.</td>
</tr>
<tr>
<td>If not, explain how you can be sure that no discomfort or embarrassment will arise?</td>
<td></td>
</tr>
<tr>
<td><strong>j. Will your project involve deliberately misleading participants (deception) in any way?</strong></td>
<td>Yes ☒ No ☐</td>
</tr>
<tr>
<td>If YES please provide further details below and ensure that you cover any ethical issues arising from this in section 8.</td>
<td></td>
</tr>
<tr>
<td><strong>k. Will you debrief participants at the end of their participation (i.e. give them a brief explanation of the study)?</strong></td>
<td>Yes ☒ No ☐</td>
</tr>
<tr>
<td>If NO please explain why below and ensure that you cover any ethical issues arising from this in section 8.</td>
<td></td>
</tr>
<tr>
<td><strong>l. Will participants be given information about the findings of your study?</strong> (This could be a brief summary of your findings in general; it is not the same as an individual debriefing.)</td>
<td>Yes ☒ No ☐</td>
</tr>
<tr>
<td>If no, why not?</td>
<td></td>
</tr>
</tbody>
</table>

### Section 4 Security-sensitive material

Only complete if applicable

Security sensitive research includes: commissioned by the military; commissioned under an EU security call;
involves the acquisition of security clearances; concerns terrorist or extreme groups.

| a. Will your project consider or encounter security-sensitive material? | Yes* | No |
| b. Will you be visiting websites associated with extreme or terrorist organisations? | Yes* | No |
| c. Will you be storing or transmitting any materials that could be interpreted as promoting or endorsing terrorist acts? | Yes* | No |

* Give further details in Section 8 Ethical Issues

---

Section 5 Systematic review of research
Only complete if applicable

| a. Will you be collecting any new data from participants? | Yes* | No |
| b. Will you be analysing any secondary data? | Yes* | No |

* Give further details in Section 8 Ethical Issues

If your methods do not involve engagement with participants (e.g. systematic review, literature review) and if you have answered No to both questions, please go to Section 10 Attachments.

---

Section 6 Secondary data analysis  Complete for all secondary analysis

| a. Name of dataset/s | mCHW project interviews and documentation |
| b. Owner of dataset/s | Niall Winters |
| c. Are the data in the public domain? | Yes | No |
| **If no, do you have the owner’s permission/license?** | Yes* | No* |
| d. Are the data anonymised? | Yes | No |
| **Do you plan to anonymise the data?** | Yes | No* |
| **Do you plan to use individual level data?** | Yes* | No |
| **Will you be linking data to individuals?** | Yes* | No |
| e. Are the data sensitive (DPA 1998 definition)? | Yes* | No |
| f. Will you be conducting analysis within the remit it was originally collected for? | Yes | No* |
| g. **If no, was consent gained from participants for subsequent/future analysis?** | Yes | No* |
| h. **If no, was data collected prior to ethics approval process?** | Yes | No* |

* Give further details in Section 8 Ethical Issues

If secondary analysis is only method used and no answers with asterisks are ticked, go to Section 9 Attachments.

---

Section 7 Data Storage and Security
Please ensure that you include all hard and electronic data when completing this section.

Student Ethics Form: 2014/15  Page 6 of 14
### Section 8 Ethical Issues

Are there particular features of the proposed work which may raise ethical concerns or add to the complexity of ethical decision making? If so, please outline how you will deal with these.

It is important that you demonstrate your awareness of potential risks or harm that may arise as a result of your research. You should then demonstrate that you have considered ways to minimise the likelihood and impact of each potential harm that you have identified. Please be as specific as possible in describing the ethical issues you will have to address. Please consider / address ALL issues that may apply. Ethical concerns may include, but not be limited to, the following areas:

| - Methods                  | - International research |
| - Sampling                | - Risks to participants and/or researchers |
| - Recruitment             | - Confidentiality/Anonymity |
| - Gatekeepers             | - Disclosures/limits to confidentiality |
| - Informed consent        | - Data storage and security both during and after the research (including transfer, sharing, encryption, protection) |
| - Potentially vulnerable participants | - Reporting |
| - Safeguarding/child protection | - Dissemination and use of findings |
| - Sensitive topics        |                        |

---

<table>
<thead>
<tr>
<th>a. Confirm that all personal data will be stored and processed in compliance with the Data Protection Act 1998 (DPA 1998). <em>(See the Guidelines and the Institute’s Data Protection &amp; Records Management Policy for more detail.)</em></th>
<th>Yes ☒</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Will personal data be processed or be sent outside the European Economic Area?</td>
<td>Yes ☐ * No ☒</td>
</tr>
<tr>
<td>* If yes, please confirm that there are adequate levels of protections in compliance with the DPA 1998 and state what these arrangements are below.</td>
<td></td>
</tr>
<tr>
<td>c. Who will have access to the data and personal information, including advisory/consultation groups and during transcription? Only myself</td>
<td></td>
</tr>
<tr>
<td>During the research</td>
<td></td>
</tr>
<tr>
<td>d. Where will the data be stored? <em>my password-protected lab top and a secure password protected server</em></td>
<td></td>
</tr>
</tbody>
</table>
| e. * If yes, state what mobile devices: *researcher lap top*  
* If yes, will they be encrypted?: *no* | |
| After the research | |
| f. Where will the data be stored? *mCHW project server* | |
| g. How long will the data and records by kept for and in what format? The data and records will be kept for X years in audio and Word document format. | |
| h. * If yes, please provide details.  
*Consistent with all the other data collected as part of the mCHW project, the data from my dissertation will be made available for reuse through the UK Data Archive.* | |

---

Student Ethics Form: 2014/15  Page 7 of 14
**Gatekeepers**- The gatekeepers to the mCHW project are also the co-supervisors of my dissertation research. It is possible that other mCHW project members may feel embarrassed or anxious to give feedback or share insights that compromise their relationship with my co-supervisors. To allay this risk, until all individually-identifiable data is removed from the transcripts, I will be the only individual with access to interview data.

**Research bias and integrity**- Because my co-supervisors are the gatekeepers to the mCHW project, I will enjoy privileged access to the study site. With this level of access, I become a quasi-member of the project group and as such, my ethnography can be viewed as a form of reflexive evaluative inquiry of design practice that supplements and supports the theory-driven evaluation component that has already been built into the larger mCHW project. This dual role of project member-doctoral student constitutes a rare opportunity to conduct qualitative research on ICTD design actors, but may introduce equally important tensions if my personal research objectives should find themselves at cross-purpose with project priorities. Therefore, as with all collaborative research projects, I expect that my dissertation work will be subject to an additional layer of dialogue and negotiations on top of the formal provisions laid out in this ethics application. Because I worked as an in-house programme evaluator in a health care system for over ten years, I feel reasonably confident that through open and continual dialogue, I can navigate the power dynamics of my dissertation while generating a rigorous “self-study” of design practices.

**Research Methods**- I assert that interviews and participant observation are the most effective approaches to generating thick descriptions of work practice and mutual learning among design actors. Previously conducted ethnographies in interaction design (Goodman, 2013), research and development for educational technology (Fleischmann, 2006; Rimpiläinen, 2012), and health informatics (Bruni, 2005) have all effectively employed these qualitative methods to describe the practices of heterogeneous work groups from the perspective of ANT and boundary objects. My semi-structured interview guides will be based on the analysis of secondary data that takes place in Phase I and will revolve around mutual learning and work practices. As described in the Research Information Sheet (Appendix 2) and Informed Consent process (Appendix 3), I will be asking participants for permission to audio-record and take photos during the interviews and observations. In the event that participants do not authorize me to audio-record them, I will request their permission them to take written notes. If participants decline to give this authorization, I will remind them that participation in my research is completely voluntary and their involvement in other mCHW activities will not be affected if they refuse to participate in my research.

**Anonymity/Confidentiality**- As indicated above, any information supplied by respondents will be treated confidentially in accordance with the 1998 Data Protection Act. I will review the provisions outlined in the Research Information Sheet (Appendix 2) and the Informed Consent Form (Appendix 3) which provide assurances that: (1) Pseudonyms will be assigned to all individuals, (2) the interview transcripts will be edited to remove passages that may be linked to specific respondents, (3) My study solely aims to describe how different respondents view and judge their own work practices in relation to mCHW. It does not seek to evaluate these practices against any other externally-imposed standard. (4) I will use discretion and care to ensure that my research write-ups do not create embarrassment and anxiety for respondents;

**Data Management**- All audio recordings, interview transcripts, and research notes will be stored on personal password protected laptop computer and files will be stored on a personal password protected back-up server. Once measures have been taken to protect the Anonymity and Confidentiality of research participants as discussed above, the files will be uploaded to the mCHW project server, where it will be available to the larger project team and then eventually stored in the UK Data Archive, as specified in the mCHW grant application to the DFID-ESRC Joint Scheme.

**Risks**- Because this research does not involve human testing or other forms of direct interventions, the risk of personal harm to participants is minimal. Nevertheless, it is possible that the interviews will create anxiety or
embarrassment for the interviewees. To allay any anxiety or embarrassment, all participants will be assured of the confidentiality of their input, their right to review the transcripts, and their right to refuse any questions or withdraw from the study at any time.

**Benefit** - There are no direct benefits to participants, however, it is expected that the benefit will be an improvement in participatory design methods for technology enhanced learning, and a better understanding of how mutual learning relates to the work practices of design stakeholders.

### Section 9 Further information
Outline any other information you feel relevant to this submission, using a separate sheet or attachments if necessary.

### Section 10 Attachments
Please attach the following items to this form, or explain if not attached

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Information sheets and other materials to be used to inform potential participants about the research, including approach letters</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>b. Consent form</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>If applicable:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. The proposal for the project</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>d. Approval letter from external Research Ethics Committee</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>e. Full risk assessment</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

### Section 11 Declaration

<table>
<thead>
<tr>
<th>I have read, understood and will abide by the following set of guidelines.</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPS [ ] BERA [x] BSA [ ] Other (please state) [ ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have discussed the ethical issues relating to my research with my supervisor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have attended the appropriate ethics training provided by my course.</td>
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</table>

**I confirm that to the best of my knowledge:**
The above information is correct and that this is a full description of the ethics issues that may arise in the course of this project.

Name

Date

Please submit your completed ethics forms to your supervisor.
Notes and references

Professional code of ethics
You should read and understand relevant ethics guidelines, for example:
or
or
British Sociological Association (2002) Statement of Ethical Practice
Please see the respective websites for these or later versions; direct links to the latest versions are available on the Institute of Education http://www.ioe.ac.uk/ethics/.

Disclosure and Barring Service checks
If you are planning to carry out research in regulated Education environments such as Schools, or if your research will bring you into contact with children and young people (under the age of 18), you will need to have a Disclosure and Barring Service (DBS) CHECK, before you start. The DBS was previously known as the Criminal Records Bureau (CRB). If you do not already hold a current DBS check, and have not registered with the DBS update service, you will need to obtain one through at IOE. Further information can be found at http://www.ioe.ac.uk/studentInformation/documents/DBS_Guidance_1415.pdf

Ensure that you apply for the DBS check in plenty of time as will take around 4 weeks, though can take longer depending on the circumstances.

Further references
The www.ethicsguidebook.ac.uk website is very useful for assisting you to think through the ethical issues arising from your project.

This text has a helpful section on ethical considerations.

This text has useful suggestions if you are conducting research with children and young people.

A useful and short text covering areas including informed consent, approaches to research ethics including examples of ethical dilemmas.
Departmental use

If a project raises particularly challenging ethics issues, or a more detailed review would be appropriate, you must refer the application to the Research Ethics and Governance Coordinator (via researchethics@ioe.ac.uk) so that it can be submitted to the Research Ethics Committee for consideration. A Research Ethics Committee Chair, ethics department representative and the Research Ethics and Governance Coordinator can advise you, either to support your review process, or help decide whether an application should be referred to the REC. Also see ‘when to pass a student ethics review up to the Research Ethics Committee’: http://www.ioe.ac.uk/about/policiesProcedures/42253.html

<table>
<thead>
<tr>
<th>Student name</th>
<th>Jade Vu Henry</th>
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<tbody>
<tr>
<td>Student department</td>
<td>Culture, Communication and Media</td>
</tr>
<tr>
<td>Course</td>
<td>PhD in Education</td>
</tr>
<tr>
<td>Project title</td>
<td>An ethnography of design practice in ICTD—How does mutual learning emerge during a participatory design project for mobile learning in Kenya?</td>
</tr>
</tbody>
</table>

**Reviewer 1**

| Supervisor/first reviewer name | Martin Oliver |
| Do you foresee any ethical difficulties with this research? | The work operates within majority world settings, and does so as part of a funded research project, raising questions about influence, resources and power. All these aspects have been discussed and, we believe, sensible ways forward agreed – specifically, the maintenance of clear protocols to delineate participation in the funded project from participation in this doctoral work; and the ongoing involvement of supervisor scrutiny to ensure ethical issues are raised and resolved in a timely manner. I believe that the protocol proposed here is a good way to recognise this complexity and respect the rights of participants, whilst also allowing the work to proceed. |
| Supervisor/first reviewer signature | |
| Date | 10/3/15 |

**Reviewer 2**

| Second reviewer name | John Potter |
| Do you foresee any ethical difficulties with this research? | The ethical questions raised in the project have been addressed in the very thorough review presented here. Consideration has been given to the rights of participants throughout and sensitivity to potential issues arising in the data collection have been outlined. I am happy that this project should go ahead. |
| Supervisor/second reviewer signature | |
| Date | 12/3/15 |

**Decision on behalf of reviews**

| Decision | Approved subject to the following additional measures |
| Decision | Yes |
Appendix 1 - Invitation Letter

Dear [Participant],

I am a doctoral student at the UCL Institute of Education. This work is intended to support the evaluation component of the mCHW project. My doctoral supervisors are Dr. Martin Oliver from UCL Institute of Education and Dr. Niall Winters from Oxford University. I am conducting an ethnographic investigation of how mutual learning emerges during the participatory design of new technologies.

I am writing to you to request your help with my doctoral research. I would like to conduct an interview with you to learn about your perspectives on the design and use of the REFER app. The interview would last between 30-45 minutes and would focus on how you view your own work practices in relation the mCHW project.

I have attached a Research Information Sheet and Research Consent Form to give you more details about my doctoral work. I would be grateful for your cooperation. Please let me know if you would be willing to participate so that we can schedule a meeting for an interview.

I remain at your disposition should you have any additional questions related to my research objectives or my background and qualifications.

Kindest regards,

Jade Vu Henry
An ethnography of design practice in ICTD - How does mutual learning emerge during a participatory design project for mobile learning in Kenya?

Research Information Sheet

Jade Vu Henry

- This PhD dissertation is an ethnographic investigation of how mutual learning emerges during the participatory design of new technologies. It is intended to support the evaluation component of the mCHW project and focuses on how work practices change as the result of designing and using the REFER app. My study solely aims to describe how different respondents view and judge their own work practices in relation to mCHW. It does not seek to evaluate these practices against any other externally-imposed standard.

This is my main research question:
- How does the process of mutual learning among design actors unfold during the design of an educational technology?

I will be collecting the following data:
- Semi-structured interviews with mCHW stakeholders including the CHVs, CHEWs, AMREF administrators, as well as the researchers themselves.
- Participant observation of mCHW project activity
- Photographs of mCHW project activity
- Documentation from mCHW project activity

How the data will be used and stored:
- In compliance with the legal requirements of the UK Data Protection Act (1998), data will be stored on a secure password-protected lab top computer and a secure password-protected online server.
- At the end of the study, data and analysis will be presented to mCHW team participants. It will also be used in a PhD dissertation and other forms of academic communication, including papers and presentations.
- Consistent with the mCHW project, this data will also be made available for reuse through the UK Data Archive after the project ends, taking all the legally-mandated measures to protect personal privacy.

For further questions or concerns about the study, please contact either Jade or her supervisors through the email addresses provided.

Doctoral Supervisors:
Dr. Niall Winters
Department of Education
University of Oxford

Dr. Martin Oliver
Institute of Education
University College London

Confidentiality:
- All measures will be taken to preserve the confidentiality of participants. I will provide these participants with the following assurances:
  - All individuals will be assigned a pseudonym.
  - Transcripts will be edited to remove any passages that can be linked back to individual respondents.
  - Participants have the right to refuse to respond to any question I ask and may withdraw from my study for any (and no) reason.
  - Due diligence and care will be taken to ensure that my research write-ups do not create embarrassment and anxiety for any respondent.
Appendix 3 – Research Consent Form – Kenya Site Visit

An ethnography of design practice in ICTD—How does mutual learning emerge during a participatory design project for mobile learning in Kenya?

Research Consent Form

☐ I confirm that I have read and understood the Research information Sheet about the project.
☐ I agree to take part in the research project.
☐ I agree that if asked to do so, the researcher can record the interview.
☐ I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.
☐ I understand that due diligence and care will be taken to ensure that my research outputs do not create embarrassment and anxiety for any respondent;
☐ I understand that pseudonyms will be used in research outputs instead of real names.
☐ I understand that transcripts will be edited to remove any passage that can be linked back to me as a respondent.

Participant Name (Block Caps):
Date:
Signature:

Researcher Name (Block Caps):
Date:
Signature:
Appendix D - Research questions of the mProject

**primary research question:** “How can the participatory development of a practice-based mobile learning intervention for CHWs and their supervisors improve the health care access of communities in Makueni County and the Kibera informal settlement in Kenya?”

**sub-questions:**

1) What are CHWs’ learning needs and level of access to existing supervisory provision in order to deliver health services effectively?

2) What are CHWs’ views about how existing supervisory structures support them in setting and pursuing their own goals?

3) What are the processes and mechanisms by which CHWs and their supervisors engage in the participatory design and implementation of a mobile intervention to enable CHWs to deliver health services effectively?

4) How can mobile-based supervision and training be embedded within existing structures of the local primary healthcare system so as they can be most effective in supporting the poverty-relevant practices of CHWs in a sustainable and equitable way?

5) How can Sen’s CA be effectively operationalised to study the use of a mobile learning intervention in support of addressing the informational and health access dimensions of poverty alleviation?

6) What are the main implications and lessons learnt for health policy development on the implementation of mobile interventions for the supervision and training of CHWs in Kenya?

**primary research question:** “How can the participatory development of a practice-based mobile learning intervention for CHWs and their supervisors improve the health care access of communities in Makueni County and the Kibera informal settlement in Kenya?”
### Appendix E: The "HAT": The Malawi Development Assessment Tool

Source: "Final MDAT questionnaire in four sections: (B) Fine motor" by Gladstone et al. [https://doi.org/10.1371/journal.pmed.1000273.s003](https://doi.org/10.1371/journal.pmed.1000273.s003) is licensed under CC BY 4.0

<table>
<thead>
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<tbody>
<tr>
<td>1. Anterior midline deviation</td>
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<tr>
<td>2. Anterior lateral deviation</td>
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<td>4. Anterior superior deviation</td>
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<td>5. Anterior inferior deviation</td>
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<td>6. Anterior superior-inferior deviation</td>
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<td>10. Anterior posterior-inferior deviation</td>
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*Note: The table and diagram are not visible in the text. Please refer to the source for the visual content.*
<table>
<thead>
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<th>Question</th>
<th>Language</th>
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<td><em>Final MDAT questionnaire in four sections: (C) Language</em></td>
<td>by Gladstone et al.</td>
<td><a href="https://doi.org/10.1371/journal.pmed.1000273.s004">https://doi.org/10.1371/journal.pmed.1000273.s004</a> is licensed under CC BY 4.0</td>
</tr>
</tbody>
</table>
Source: "Final MDAT questionnaire in four sections: (A) Gross motor" by Gladstone et al. https://doi.org/10.1371/journal.pmed.1000273.s002 is licensed under CC BY 4.0.
Source: “Final MDAT questionnaire in four sections: (D) Social” by Gladstone et al. https://doi.org/10.1371/journal.pmed.1000273.s005 is licensed under CC BY 4.0
Appendix F - Users guide to the Malawi Development Assessment Tool

MALAWI
DEVELOPMENTAL
ASSESSMENT
TOOL
CONTENTS:

ITINERARY OF ITEMS IN KIT....................... Page 3
GROSS MOTOR questions......................... Page 4 - 6
FINE MOTOR questions............................ Page 7 - 10.
LANGUAGE questions.............................. Page 11 - 14
SOCIAL questions................................. Page 15 - 17
Developmental kit (Itinerary)

1. 5 Balls (tennis ball size)
2. Naming objects (10 of them)
   i. Broom (copy of larger one)
   ii. Matchbox
   iii. Plastic bottle e.g. for oil
   iv. Plate (plastic from market)
   v. Cup (plastic from market)
   vi. Spoon (plastic from market)
   vii. Soap
   viii. Pencil or ball point pen
   ix. Coin (any type)
   x. Bicycle made out of wire
3. Blocks – 12 (square one inch size)
4. Chiponde (peanut butter) bottle or other plastic bottle with easy screw top
5. Maize pieces (dried)
6. Sound tin/rattle
7. Plain paper or other such thing to write on with chalk/charcoal
8. Wooden containers looking the same but of different weights (one hollow and one with sand)
9. Sticks of two different lengths
10. Red woollen ball (pom-pom – can be hand-made)
11. Board with eight pegs to put in.
12. Chalk
13. Basket (for putting items in and for throwing balls into)
14. Chitenje material (cloth)
15. Car (made of wood or plastic one from local market)
16. Beads (found in market as used to put in hair)
17. String 1 metre long

**GROSS MOTOR:**

1. **Lifts chin up off the floor for a few seconds:** (Amadzutsa chibwano kwa kamphindi) Put the child on their stomach on a flat surface or mat. See if the child can at least lift his/her head so that the chin is off the surface for a short period of time.

2. **Prone (on his or her tummy), can lift head up to 90 degrees:** (Amadzutsa mutu koti amatha kuyang’ana kutsogolo) Put child on his/her stomach on a flat mat. See if the child is able to lift head and chest up so that his or her face makes a 90 degree angle with the mat for at least several seconds. The child may support themselves on their forearms.

3. **Holds head upright for a few seconds:** (Amalimbitsa khosi kwa kamphindi pang’ono. Akamunyamula pa phewa kapena kumbuyo.) Hold the child in the sitting position or on mum’s shoulders. See if child is able to hold his or her head upright and steady for at least several seconds without the head moving around too much at all the time.

4. **Pulls to sit with no head lag:** (Amadzikoka kuti akhale pansi) Put the child on his or her back on the mat. Hold the child’s hands and pull the baby up to a sitting position. See if the child’s head comes with the body and does not lag or fall behind at any time while the body is being pulled up. If it does from early on, do not keep on trying.

5. **Lifts head, shoulders and chest when prone.** (Amaimbita mutu, mapewa ndi chidali ndipo amawongola manja ake, amadzutsa chidali kuchokera pansi ndi manja omwe ndi kwaongo) Put the child on their stomach on a flat surface. See if the child is able to lift their head and chest off the surface using their arms for support so that he or she is looking ahead of themselves or even upwards.

6. **Bears weight on legs (holds legs strongly when put in standing position):** (Amalimbitsa miyendo yake mukamunyamula kuti ayime) Hold the child up as if they were standing position with their standing on the table. See whether the child supports his or her weight on the legs for a few seconds if you let your support go a little bit.

7. **Sits with help.** (amakhala pansi mothandizidwa) Put the child in the sitting position either on mum’s lap or on the floor in between mum’s legs. See if the child will sit with the help of mum with a nice straight back.

8. **Rolls over from back to front:** (Amatembeni ka ndikuchotsa manja ake kuti akhale chafufu mimba) See if the child rolls over any time during the examination, otherwise ask them mother whether she has observed this. Can put child in prone position and can show
the baby a toy and then pull it upwards beyond child’s sight. The child may roll over to try and grab the toy or just because it wants to continue to look at it.

9. **Sits without help for a period of time but unable to be left for a long length of time.** (Amakhala opanda kungwiririra kwa kamphindi/simungamukhazike kwa nthawi yaitali) The mother can not yet leave the child sitting alone for any length of time, but he or she is able to sit for a short time unsupported with pillows etc (a matter of seconds).

10. **Sits by self well:** (Amakhala pansi bwinobwino) Can be left sitting on the floor with toys to play with and can maintain balance in this position by self for a long period of time.

11. **Crawls (in any way):** (Amakwawa maluni monse ngakhalenidzi matako) Is able to get about by either shuffling on bottom or on all four limbs.

12. **Pulls self to stand/ trying to get to standing:** (Amayesera kudzutsa thupi lake kuti aime) Will grasp hold of furniture or other objects and pull self to standing position. Does not need to stay there for any length of time and may fall back down quite quickly.

13. **Able to stand well if holding on to things:** “Uses an object with the purpose of getting to standing” (Amagwira chinthu kuti ayime bwino osagwa) See if the child can stand and hold on to a solid object such as the side of a khonde or a chair for a few seconds. May pass this without having got themselves to the standing position.

14. **Walks using both hands of somebody:** (Amatha kuyenda mukamgwira manja onse) If you hold both hands to balance the baby, can they take several steps without tripping or falling?

15. **Walks with help (using somebody’s hand as if led or a piece of furniture):** (Amatha kuyenda atagwira mkono umodzi wa munthu wina) See if child can walk with the help of the mother holding out one hand to the child. See if the child will take a few steps with help or on the furniture, but not alone.

16. **Walks, but falls over at times:** Amayenda bwino koma amathu kugwa nthawi zina) Is able to walk but not that confidently yet and falls over at times quite often still.

17. **Stoops over and gets back up e.g.** Picks up object off the floor without falling (Amathama kuyenda kapena kugwa nthawi zina) See if child is able to bend over and pick up a toy and return to a standing position without holding on to things around them or sitting down.

18. **Walks well.** (Amathu kuyenda yekha bwino) See if child walks well without falling over often with good balance.

19. **Runs, but basic running – may fall over at times.** (Amathamanga mwapang’ono pang’ono kugwa nthawi zochepa) Able to get about quickly but not completely confident and falls over occasionally. Children often run with their legs side to side in an unstable fashion.
20. **Kicks a ball in any way/tries to kick a ball:** (Amatha kumenya mpira ngakhale ndi pang’ono) Can kick a ball by trying to move leg forward to meet it or by walking into it. Not necessarily kicking well with a really good swing of the leg.

21. **Runs well (confidently), and can stop and start without falling over:** (Amathamanga bwino osagwa) Runs with confidence with feet lifted up behind him or her as legs go forward.

22. **Kneels (as in a respectful way) and gets up without using hands:** (Akhonza kugwada ndikuthanso kuima opanda kugwirira chinthu) Able to get down on to his knees staying in an upright position and then get up without using hands.

23. **Throws a ball into a basket (at least one of 3 times) 1 metre away:** (Amaponya mpira ndikugwetsera mubasiketi kamodzi maulendo atatu pamtunda wa metre imodzi) Stands one metre away from examiner’s basket and is able to throw the ball in on at least one of three occasions when it is tried. Demonstrated by examiner first. Can use the metre long string to measure this.

24. **Runs, stops and is able to kick a ball some distance:** (Amathamanga, kudzaima ndikumenya mpira bwino bwino kwa kaulendo ndithu) Able to run up to the ball and kick it well a good distance with a good swing forward of the leg and balancing on one foot.

25. **Jumps with feet together off the ground:** (Amalumpha ndi miyendo yonse iwiri pamodzi) Able to jump with both feet leaving the floor together. Needs to get both feet off the ground.

26. **Jumps over line/string on the ground:** (Amalumpha chingwe kapena mzere ojambuliwa pansi) Able to jump well lifting both feet off the ground together over a string/line painted on the ground. Not a hop or skip. Feet should remain together and both feet reaching the floor at the same moment.

27. **Stands on one foot for less than 5 seconds:** (Amaima ndi mwendo umodzi kwa kampindi) Ask child to raise one foot usually by bending his knee and maintain a good balance on his other foot for at least a second – up to 5 seconds

28. **Walks on heels for 6 + steps:** Can walk 6 steps on heels easily. (Amatha kuyenda ndi chidendene ma sitepe osachepera asanu ndi imodzi.

29. **Jumps over a piece of paper (widthways):** Amalumpha pepala lomwe laikidwa kutso (Amalumpha pepala lomwe laikidwa kutso) Put a piece of the examination paper (A4 size) on the ground. Ask the child to stand close to the side of the paper with both feet together and to jump over the less wide part of the paper and landing with both feet together. Can be demonstrated. Both feet need to come off the ground.

30. **Walks on tip toes for six or more steps:** (Amayenda ndi zala za kumiyendo sitepe zokwana zisanu ndi imodzi) Able to balance on tip toes and walk 6 steps keeping up on the toes well with good balance.

31. **Hops on one foot without support, has to go four steps:** (Amalumpha ndi mwendo umodzi kokwana mastepe anayi) Makes three consecutive hops with the same leg raised throughout. Can be demonstrated by the examiner first.
32. Stands on one foot for a longer time – (at least 5 seconds and up to a minute)  
(Amairina ndi mwendo umodzi kwa kanthawi monga.) Ask child to raise one foot usually by bending his knee and maintain a good balance on his other foot for more than 5-10 seconds, up to a minute or two counts.

33. Can throw a ball up in the air and catch it with 2 hands. (Amatha kuponya mpire mmmwamba ndi kwuuwakha.) Can throw the ball up a good distance and catch it with two hands together.

34. Heel/toe walk with one foot behind the other along the string with good balance: (Amayenda mogundaniza mapazi potsatira mzere wolembedwa pansi) Can walk along the same line but this time heel to toe with his feet touching with good balance.

FINE MOTOR & PERFORMANCE:

1. Follows mother’s or guardian’s face/object to the midline: (Amatsatira ndi maso nkhole ya munthu kapena chinthu chowala, ngakhale chitasuntha pang’ono) Put the child on his/her back and hold the red yarn above the child’s face at about 15 cms. Move the yarn in an arc from one side to the other. See if the child follows the yarn with eyes to the midline/ a short distance.

2. Follows object or fixes and follows on face or bright object (red pompom) with eyes through 180 degrees. (Amatsatira ndi maso chinthu chowala kapena chimene akuchiona kwambiri kuchokera ku manja mpaka kumanzere) See if the child will follow the face or bright red object through a complete arc from left to right e.g. through 180 degrees.

3. Puts hands together/awareness of hands/puts in front of eyes/mouth: (Amabweretsa manja konkhope ndipo amatha kuwazindikira ka pena kuwaika mkamwa) While the child is lying on his or her back, see if the hands are brought together at the midline of the body and put them in front of his eyes to look at them. Do not cradle the baby in the parent’s arms during this,

4. Reaches out for a large thing eg. Rattle or red yarn : (Amafunika kufikira chinthu) If child is sitting in parent’s lap, see if the child will try and grasp an object such as the red yarn or the rattle. Examiner to bring the rattle or red yarn near the child and observe whether child could reach object. Use bright object that child can see well.

5. When holding objects, tends to put them in mouth: (Kawiri akagwira chinthu amafuna kuchiyika mkamwa) Often when the baby has picked up toys, they like to explore them by putting them in their mouth.

6. Grasps hold of a large thing e.g. Handle of the rattle or plastic spoon: (Amatha kufumbata chinthu ndi dzanja lake) See if the child is then able to pick up/grasp the object that he/she has been reaching for. The examiner gives the child a spoon, rattle or a pen in his hands and saw whether the child could grasp the object in his hands without letting it fall off.
7. **Can pick up a larger object from the ground** e.g. The spoon or the rattle or a block (Amatha kunyanamula chinthu chokulilapo pansi monga miyala olo supuni.) When sitting on mum’s lap or on the floor, likes to try and reach out and pick up objects off the ground or table that are interesting. Keep objects slightly out of reach, so that they have to reach for them.

8. **Can see a small object such as a piece of maize or a bean** – can see it and reach for it (Amazindikira zinthu zazing’ono monga chimanga, nyemba, amaziona olo amafuna kuzifikira) When the child is sitting on mum’s lap, place a small object like a piece of maize or a bean in your hand and show it to the child. See if they notice it by pointing, looking at it, or if they want to touch it or pick it up. They don’t have to pick it up – can just look at it.

9. **Transfers objects from one hand to another hand.** (Amatha kuchotsa chinthu dzanja lina ndikuika dzanja lina) Give the child a block and then try and give them another to the same hand. The child will often pass the first block to the other hand so that he or she can take the second one. Always use blocks, not other objects.

10. **Picks up small things with all four fingers in a RAKING fashion:** (Amatola zinthu zazing’ono ndi zala zonse zinayi)

11. **Strikes on object with another in imitation with the examiner.** (Amamenyetsa zinthu ziwiri zomwe wazigwira mmanja) If the child holds one block in each hand and hits the blocks together or if he strikes any two objects together. Usually done with one block in each hand. Not with pots and pans and lids which are larger. Needs to be SEEN not just asked…. Examiner takes a block in each hand and strikes them while the child is watching. The child was given a block in each hand and was told to do the same. The examiner repeated the procedure till the child could imitate properly.

12. **Finds object under the chitenje (piece of cloth):** (Amapera choseweretsa pansi pa chitenje) Put an interesting object eg. Car or rattle, under a piece of cloth while the child is watching and see if they then realise where it has been hidden and look for it.

13. **Neat pincer grasp, picks up maize or bean with thumb and one finger:** (Amatha kugwira mbewu ya chimanga kapena nyemba pakati pa chala choyamba ndi chuchiriwiri) If child is able to pick up maize with thumb and one of small fingers only.

14. **Puts blocks in and out of cup in imitation** (Amatsanzira kuponya zinthu monga miyala mu kapu) The child puts at least one cube in and out of a cup when shown by an examiner.

15. **Pushes a little car along** (Amatha kukankha galimoto yaing’ono (yoseweretsa)) Pushes the little car along playing with it and showing that he or she knows it should be moving.

16. **Puts blocks into chiponde bottle (short plastic bottle with screw on lid) in imitation** (Amatsanzira kuponya miyala mu botolo la chiponde) Puts at least one block into the chiponde bottle when shown by the examiner.
17. **Dumps blocks out of Chiponde bottle (short plastic bottle with lid) purposefully**
(Amakutula miyala kuchokera mu botolo la chiponde mozindikira) Show child on a couple of occasions how to dump the blocks out of the bottle. Then ask the child to get it out. Does not pass if child pulls blocks out with fingers or hands.

18. **Scribbles on paper (straight scribble)**: (Amakhwatchakhwatcha mizere papepala pogwiritsa nthito choko kapena makala) The child must make marks on the paper, more than just a slight mark on the paper and this is usually in a back and forwards manner.

19. **Scribbles on paper (circular scribble)** Amazungulizazunguliza papepala pogwiritsa nthito choko kapena makala) Scribbles but in a circular way not just back and forth.

20. **Tower of 2 blocks** (Amapanga chipirara cha miyala iwiri) Build a tower of two bricks, preferably of the same colour and see if the child will copy you. Count how many you get up to answer next items.

21. **Puts pegs into board in up to 2 minutes** (Amaika mapegi asanu ndi atatu mu mabowo a bolodi mwanathawi yosapyola mphindi ziwiri) Using the pegboards, take out all the pegs and see if the child can put them back in and see how many seconds it takes. They are allowed up to 2 minutes.

22. **Tower of 4 blocks** (Amapanga chipirara cha miyala inyai) Build a tower of four bricks, preferably of the same colour and see if the child will copy you. Count how many you get up to answer next items.

23. **Tower of 6 blocks** (Amapanga chipirara cha miyala imodzi) Build a tower of six bricks, preferably of the same colour and see if the child will copy you. Count how many you get up to answer next items.

24. **Puts pegs into board in up to 30 secs.** (Amaika mapegi asanu ndi atatu mu mabowo a bolodi mwanathawi yosapyola theka la mphindi……. Using the pegboards, take out all the pegs and see if the child can put them back in under 30 secs.

25. **Unscrews and screws back on the cap of the Chiponde bottle** (Amatha kutseka chitsekerero cha botolo la chiponde mozindikira ndi kutegula) Is able to actually screw and unscrew the lid off and on the chiponde bottle, not just pulling it off.

26. **Can put 6 hair beads on to a shoe lace (thread them on)** (Amatenga mikanda isanu ndi ndi kuika mu chingwe kapena ulusi) See if the child is able to thread 6 hair beads on to a thread.

27. **Copies a vertical line (as drawn by the examiner) with charcoal/chalk within 30 degrees** (Amatha kujambula mzere wowongoka) Is able to draw a line on the paper or on the khonde with chalk that is similar to your vertical line by at least 30 degrees.

28. **Picks longest stick 3 of 3** (Amasankha mtengo wautali pa unzake pamaulendo atatu) “Wautali ndi uti?” Put down 2 sticks of different length on the ground and ask the child “which one is longest?” Do not indicate whether the child has done the correct response, but put them down again and ask the same question. See if the child can do it 3 times.
29. **Picks heaviest box 3 of 3 – is the child able to tell you which box is the heaviest?**

(Amatha kuzindikira bokosi lomwe liri lolemera kuposa linzake?) “Lolemera kопosa ndi liti?” Put the two weights in the child’s hands and ask “which one is heavier?” Without indicating that that was the correct response, get the child to do it again two more times.

30. **Can make a bridge with bricks:** (Amapanga mlotho) Make a bridge for the child out of three bricks and see if the child can do the same. Keep yours up while the child is doing it and see if the child will copy you.

31. **Makes a doll or complicated car out of clay** (Amatha kuumba munthu olo galimoto ndi dongo) Can make a doll out of clay by themselves or another complicated toy such as a car.

32. **Copies a circle (needs to be complete) with chalk or in the sand with a stick** (Amatha kukopela lozungulira lopanda mpata) Show the child a circle and see if she can copy you. Can give up to 3 trials. Can do anything that is near to a circle that is complete or nearly complete. Continuous spiral motions as in scribbling do not count.

33. **Copies a cross with chalk** (Amatha kukopela mtanda) Draw a cross with chalk and see if the child can do the same. Anything where the two lines intersect counts. The two lines do not need to be the same size and can be at any angle. Can be in the sand with a stick or with a chalk or charcoal on paper or other surface. Can use back of questionnaire.

34. **Can draw a square:** (Amatha kukopela “square”) Must have four sides and be a similar shape to a square but does not need to be perfect. Can be in the sand with a stick or with a chalk or charcoal on paper or other surface. Can use back of questionnaire.
LANGUAGE/HEARING:

1. **Startles or jumps/responds to sounds**: (Amadzidzimuka akamva phokoso) If child responds or jumps when a loud sound is made. Can be a response in any way e.g. Change in activity or expression or eye movement. Can ask mum whether the child starts at sudden noises in the house.

2. **Happy vocalising or making sounds – not crying**: (Amapanga phokoso osati kulira monga “uh”, “eh”, “a”) Makes sounds other than crying eg. Throaty sounds or sounds such as “uh” or “eh” or “a, a, a” or gurgling sounds. Any vocal sound rather than crying.

3. **Laughs/chuckles**: (Amaseka) See if the child laughs out loud or whether the mum or guardian says they do.

4. **Turns to voice – if you are out of sight, does she/he look in the direction of your voice or sound?**: (Amatembenukira komwe kukumveka mau – ngati munthu sakuoneka kodi amayang’anya komwe kukuchokera mau kapena phokoso?) In response to the rattle or to mum’s voice, does the child turn his or her head towards the sound? Best to test both sides

5. **Uses single syllables or sounds, for example Ma, Pa, Da, Ba**: (Amapanga phokoso ndi liu limodzi monga ma/da/pa/ba) Makes any kinds of single syllable sounds as described.

6. **Responds to his or her name, turns and looks at you**: (Amazindikira dzina lake ndipo amasonyeza kuzindikira kuti waitanidwa) Is able to look up when asked for example “Chikondi?”. Be careful to distinguish between a response just to being called in a certain tone of voice and knowing his name. Does not need to say his or her name.

7. **Uses 2/4 syllable babble such as dada, mama, mimi, tata, but not specifically at anything or any person**: (Amapanga phokoso dada, mama, mimi, tata, mau awiri kufikira anayi opanda tanthauzo) The baby is able to make sounds that could be copied and sound almost like words. Needs to be clear or distinct sounds, not just vocalisations.

8. **Understands when being cautioned about danger, for example when saying “no” to child, they stop even briefly**: (Amazindikira pamene achenjezedwa pa choopsya monga
ponena kuti “ayi”amasiya kwakanthawi pang’ono) ‘Understands to stop doing something if the mother or guardian has said “no”’. eg. Going too close to the fire.

9. **Indicates by gesture to say “No”:** (Amakana pogwedeza mutu kapenanso mapewa) Definate shaking of head or shrugging of shoulders in showing refusal. Not just turning away from the situation or withdrawing. Can ask mother if he does it at home if not seen.

10. **Follows simple commands (1 stage)** eg. “give me the cup”: (Amapanga chomwe wauzidwa, monga “ndi patse kapu”) Is able to understand when asked to give the examiner something. The examiner must be careful not to indicate by pointing that they want the object, they must only say it.

11. **Unclear talk/jabber in sentences - pretends to talk but does not actually make sense.** (Amayankhula mau osamveka bwino, amayesera kuyankhula koma zimakhala zopanda pake): May sit and talk to themselves e.g. When playing with things, but may not make sense. Sounds like proper words and sentences but does not make sense.

12. **Says 2 words, but words other than mama/dada:** (Amanena mawu angati?) Ask the parent how many words the child says. See if you can find out what they are. Can include names of people as long as they are directed. Mama or Dada said not at anyone in particular does not count. Words need to be directed at some particular thing. Answer yes here if two words or more.

13. **Says 2 words together:** (Amanena mau awiri ophatiki zana monga mama-nsima, mama-pita, madziakumwa, dadi bwera): Note that the child is putting two words together in a meaningful phrase that indicates something. Examples are things like “mummy cup” or “water cup”.

14. **Says 6 words (words other than mama/dada):** (Amanena mawu angati?) Ask the parent how many words the child says. See if you can find out what they are. Can include names of people as long as they are directed. Mama or Dada said not at anyone in particular does not count. Words need to be directed at some particular thing. Answer “yes” here if more than six (6) words.

15. **Follows 2 stage commands e.g. “Go and take the cup and put some water in it”, “go and get the cup and put it in the basket”**: (Amatha kupanga zinthu zimene wauzidwa monga “tenga kapu ndipo iike mu basiketi”) Is able to do a command where they have to understand and then do a succession of two things.

16. **Identifies objects in the basket – at least 5.** Bicycle, spoon, cup, ball, car, bottle, chitenje, little broom, plate, pencil.) Amazindikira zinthu monga …njinga, sipuni, kapu, mpira, galimoto, mbale. Kumuuza kuti…..) “Ndi patse……………….” Count how many out of 10 the child has done. Make sure all 10 objects are put out. Answer YES if child can identify at least 5 of the ten objects. Doesn’t matter which ones.

17. **Speaks clearly in sentences. Child’s speech is fully understandable:** (Amatha kuyankhula bwino mwachidule zinthu zimene zachitika) Is the child able to narrate a story? Explain to mother “if you have sent your child somewhere can they recount just a little something of what happened e.g. Someone came looking for you”.

18. **Points to body parts:** > 1 part. (Amaloza ziwalu za mthupi lake. Kumufunsa:}
“kodi……..ili pati?”) Knows where the own child’s body parts are eg. “Where is your nose? Where are your eyes? Where are your ears? Where is your mouth?” Answer YES if knows TWO or more body parts.

19. Names 5 objects in the basket: (Amatchula maina a zinthu zimene zili m’bokosi. Kumfunsa mwana kuti ichi ndichani?) Can name at least five objects in the box of items eg. Bicycle, spoon, cup, ball, pencil, car, bottle, chitenje, plate, beans. Say to the child “What is this?” Give the child all 10 items and see how many he or she can do. Answer YES if the child can do at least FIVE (5) items. Doesn’t matter which ones.

20. Knows his or her first name - can say it: (Mwana amadziwa dzina lake (amatha kutchula dzina lake)) Ask the child for their name. Passes if can say their first name.

21. Knows actions of objects e.g. “which one do you use for sweeping?” Which one is for drinking? (Amazindikira nthito ya zinthu monga……. “Chodyera phala ndi chiti?”). “Chosesera ndi chiti?” “Chomwera madzi ndi chiti?” Put out a few different objects from the basket and ask questions above or similar ones and see if the child can point to the right objects.

22. Identifies objects (can give you objects you have named) in the basket – at least 10. Bicycle, spoon, cup, ball, car, bottle, chitenje, little broom, plate, pencil.) Amazindikira zinthu monga…njinga, sipuni, kapu, mpira, galimoto, mbale. Kumuuza kuti…..) “Ndi patse……………” Say to the child “Give me the spoon, cup….etc”. Count how many out of 10 the child has done. Make sure at least 10 objects are put out. Answer YES if child can identify at least 10 of the ten objects. Doesn’t matter which ones.

23. Names (can say it) 10 objects in the basket: (Amatchula maina a zinthu zimene zili m’bokosi.  Kumfunsa mwana kuti ichi ndichani?) Can name at least five objects in the box of items eg. Bicycle, spoon, cup, ball, pencil, car, bottle, chitenje, plate, beans. Say to the child “What is this?” Give the child all 10 items and see how many he or she can do. Answer YES if the child can do at least TEN (10) items. Doesn’t matter which ones.

24. Is able to categorise things. For example, ask the child – “Tell me some things that you eat, Tell me some animals that you know…….” Kumufunsa mwana…”Ndiuze zinthu zimene umadya…”or “Ndiuze nyama zimene umadziwa…….” (Need to be able to do one of these).

25. Is able to follow a three stage command. For example, “stand up, clap your hands and go over there” or “go over there and collect that cup on the ground and give it to your mum” Amatha kupanga zinthu zitatu zimene wauzidwa, monga “imilira, womba mmanja ndi pita uko…….”

26. Is able to tell you the use of objects: Knows “What do you do with a spoon, a bicycle, a brush?” (Funsani Umatani ndi njinga? Umatani ndi pensulo? Pamafunika mayankho monga, timakwera njinga, timajambulira zizunu, timamwera madzi. Need to have action word included in the answer.

27. Can do remember back 2 syllables when said to the child (Akhonza kukumbukira zilembo, chilembo, chimodzi, ziwiri, zitatu, zinayi) Say to the child. “When I say this, copy me….Pa, Chi, Tu, Go”. Say to the child, say “pa”, then say to the child “say pa, chi”, then say to the child “say pa, chi, tu”, then say to the child “say pa, chi, tu, go”. See how
far the child can get eg. How many they can do. Answer YES to this if they can at least do the first TWO eg. Pa and Pa, Chi... They get a YES here if they can do more.

28. Knows 2 of 3 questions relating to the understanding certain concepts e.g. What do you do when you are hungry? What do you do when you are tired? What do you do when you are cold? (Funsani...umatani ukamva njala? Umatani ukatopa? Umatani ukiziriza?)

29. Understands the adjectives such as “faster” by answering “Which goes faster, a car or a bicycle?” Amadziwa yankno la funso monga “kodi galimoto ndi njinga chimathamanga kwambiri ndi chiani?

30. Can do remember back 4 syllables when said to the child (Afkonza kukumbukira zilembo, chilembo, chimodzi, ziwiri, zinayi) Say to the child. “When I say this, copy me... Pa, Chi, Tu, Go”. Say to the child, say “pa”, then say to the child “say pa, chi”, then say to the child “say pa, chi, tu”, then say to the child “say pa, chi, tu, go”. See how far the child can get eg. How many they can do. Answer YES to this if they can do all FOUR (4) eg. up to Pa, Chi, Tu, Go.

31. Can understands prepositions and follow tasks related to this e.g. Put the bean under the cup, put it on the cup, put it next to the cup, put it behind the cup. (Mufunse mwana aike-pansi, pamwamba, kuseli, pakati. Angathe kuchita zinthu zitatu mwa zinthu zimene zili pamwambapa. Needs to be able to do at least 3 of the 4 of these.

32. Understands the concept of opposites e.g. A boy is big, a baby is ....... If the sun comes up in the day, the moon comes up ...... (Amadziwa mawu otsutsana a zinthu monga, abambo ndi anankula, mwana ndi ....... “Ngati dzawu limatuluka masana, mwefi, umatuluka .......” (must do 2 of these)

33. Knows quantities – up to 3 – “how many are these?” (Amadziwa kuchuluka kwa zinthu zokwana zisanu. Mwachitsanizo ukafunsa kuti izi ndi zinga?) Put bricks on the table and ask the child. Can you count these? How many are there? Write down the maximum the child could do. Answer YES to this if they can count 3 or more.

34. Knows quantities – up to 5 – “how many are these?” (Amadziwa kuchuluka kwa zinthu zokwana zisanu. Mwachitsanizo ukafunsa kuti izi ndi zinga?) Put bricks on the table and ask the child. Can you count these? How many are there? Write down the maximum the child could do. Answer YES to this if they can count 5 or more.
SOCIAL:

1. **Smiles, but not at a particular person** (Amamwetulira payekha popanda munthu kapena popanda kanthu). Smiles, but not always sure whether it is in response to someone else or not. Can ask “How does your baby smile?”

2. **Smiles in response to a person** (Amamwetulira anthu) With the child in mum’s arms or on his or her back, see if the baby will smile in response to the mum’s or your smile and vocalisations.

3. **Frolics with mother or caregiver (moves body in response to another person)**: (Amagwedeza thupi kusonyeza kukondwa ndi anthu ena) See if the child moves his or her body in response to being played with by mum or guardian or person who is playing with child.

4. **Frolics alone, plays around moving body, kicking legs in a happy way**: (Amasewera yeuka kugwedeza thupi kuponyaponya miyendo mosangalala) Lies on his or her back and plays around with self moving body and kicking legs happily. Can ask “Kodi mwana amasewera motani?”

5. **Recognises or calms and quiets with caregivers/known family members**: (Amazindikira abale ndikukhala omasuka ndi omwe amamusamalira komanso abale ake. Funsani,”Kodi mwana amazindikira mayi ndi abale akamalira amasiya akawaoma?” ). Stops crying or quiets when mum or another known family member takes the baby.

6. **Will take phala from a spoon when fed by a caregiver**: (Amadya phala kuchokera pa supuni yomwe womusamalira wayigwira) Is able to eat porridge off a spoon when given it by mum/caregiver, but can not yet hold a spoon. Can eat it off mother’s fingers rather than spoon if this is what is usually used by mother.

7. **Helps to hold a cup while mum gives a drink** (Naye amagwira kapu akamamwetsa madzi). Can not yet manage to drink from a cup by self, but will put hand up to cup when mum puts the cup to his or her lips.

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8. Puts arms up or indicates in some way that they want to be picked up: (Amadziwongola kuti anyamulidwe.) Baby deliberately shows that they want to be picked up by either stretching out arms or trying to lift self towards her.

9. Can hold a spoon with phala but not get to mouth well: (Amagwira supuni ya phala koma osayibweretsa kukamwa kuti adzidyetsa) Can hold a spoon in hands when being fed and may try to put the spoon with phala in mouth, but can not do it very well. Need to be clear that it is a spoon with food on it.

10. Drinks form a cup well without spilling: (Amamwera mkapu opanda kudzitayira) Is able to pick up a cup of water half full and drink from it without spilling any.

11. Is able to indicate, by pointing, that they want something: (Ama kuloza chinthu chimene akufuna) Can show by either pointing or maybe by simple language/noises that they want a particular thing eg. Pointing to the water/cup when they want a drink.

12. Can the child eat by picking nsima from a plate in morsels that mum has made: (Amakhoza kutola nsima yekha yomwe amayi ake amutemera. “Kodi mwana amatha kudya pagulu potola mbanu za nsima zomwe amayi ake amutemera kale?”) Picks up the nsima in little small portions that mum has separated from the main bit of nsima. Can hold them in his or her hand and put to mouth. Recognises it is food, not just grasping it when put in hand. “Kodi mwana amatha kudya pagulu potola mbanu za nsima zomwe amayi ake amutemera kale?”

13. Puts hands out to have them washed by mum: (Amapereka manja kwa mayi kuti asambitsidwe, pakudya) Can not wash hands by self, but understands that he or she needs to have them washed before eating, therefore helps by putting or holding hands out when mum washes them. Not just having them washed in any way, but must understand that they are having them washed.

14. Can hold a spoon and take phala by self, but spills some: (Amatenga supuni ndikudzidyetsa phala, kunogozitayira pang’ono) Able to feed self with a spoon, but not that well. Spoon sometimes even turns over and spills some, but child enjoys feeding self.

15. Indicates in some way that they need to go for a poo/pee, for example by crying, pulling at pants or saying something: (Amaonetsa zizindikiro zoti akufuna kukabiba kapena kukodza monga kulira, kukoka kabudula kapena kunena mawu ena ake) As explained in instructions.

16. Wants to join in with singing games: (Amanafuna zinokula nawa masewero oyiroyimbwa ndi anzawo) Is not yet able to do the singing games, but likes them and wants to be part of it even in a small way. “Kodi amafuna kusewero masewero a nyimbo omwe ana okulirapo akusewero ngakhale iye sangathe?”

17. Able to greet either by extending hand or verbally: (Amatha kupereka moni wapamanja kapena wannau) Has learned to put out hand to greet someone or can say “moni” or similar greeting.

18. Sharing things, including food with others: (Amagawana zinthu ndi anzawo kuphatikiza zakudya) Understands to share things with others, for example if with friends
or other family members, will share food that he or she is given. “Kodi mukampatsa mwana wanu nthochi kapena chakudya chozuna, amagawira anzake?”

19. Does a poo orpees by themselves without wetting their pants: (Amathu kubiba kapena kukodza payekha osaipitsa zovala) Is able to know that they need to pee or pass a stool and do it without wetting or soiling themselves. Never wets self.

20. Can feed self phala off a spoon well without spilling: (Amatha phala ndi supuni osadzitayira) Can use a spoon well and does not spill or make a mess when using a spoon.

21. Can make own morsels of nsima and put in mouth, often with soft relish: (Amakhonza kutema mbamu za nsima ndi kuik a mkamwa (makamaka ndi ndiwo zofewa) Can separate balls of nsima from main portion and form into a ball to put into mouth and dip it into the relish. Does not need to be making a perfect ball.

22. Able to undress by themselves (take off even just 1 item of clothing, such as shorts): (Amatha kuvula zovala monga kabudula, dilesi kapena siketi) Can take off any item of clothing by themselves. Need to be able to remove it completely. Can be just one item.

23. Wants to go and visit a friend’s house (shows independence): (Amafuna kupita kukacheza kwa anzawo paokha)

24. Can go to the toilet by themselves anywhere: (Amachita chimbudzi payekha) Can go and do a poo or a pee by themselves without help, but anywhere eg. Outside, not necessarily on the toilet.

25. Can eat food/relish with bits in it or bones: (Amakhonza kudya chomwe chili ndi zinyenyeswa kapena mafupa) Is able to eat for example kapenta fish with bones in it or maybe tangerines with seeds.

26. Is able to dress but not completely: (Amatha kuvala payekha chovala ngakhale osakwanitsa bwino lomwe) Is able to put on at least one article of clothing, for example a T-shirt or skirt.

27. Washes hands well by self before/after eating: (Amasamba mmanja yekha asanadye chakudya komanso akamaliza kudya) Is able to wash his or her hands without any help before and after eating.

28. Knows to keep quiet at important meetings or ceremonies: (Amadziwa kuti ayenera kakhala chete pa gulu la anthu akulu eg. Kutchalichi, pamaliro, pamsomkhano)

29. Does household chores or helps father or mother in a useful way: eg. Drawing water/hoeing. (Amathandiza ntchito za pakhomo monga kutunga madzi). This can even be just a small amount of help, but not just pretend. Make sure there are tasks that you ask about that boys could do.

30. Able to dress by themselves completely: (Amatha kuvala payekha) Can put on clothes without help, may have help only if tying shoelaces, buttoning or zipping things which are hard to do.
31. **Understands the concept of discipline e.g.** Causes and consequences e.g. Knowing that bad words may lead to punishment. Amadziwa zotsatira za kuchita zoipa mwachitsanzo ngati ayankhula mau oipa monga kutakwana.

32. **Plays games with turn taking e.g.** Chipapapa/fly (Amasewera ma sewera opatsana mpata monga fulaye, mira, jingo…..”Ngati akasewera masewero opatsana mpata. Kodi amatha kudikira kuti nthawi yake ifike / ikwane?”)

33. **Knows how to be respectful to elders:** (Amadziwa kupereka ulemu kwa akuluakulu monga kugwada poperekana moni olo kuwodira. Is polite and shows respect when around elders. For example, putting hands together as a sign of respect or kneeling.

34. **Is able to go to the toilet/pit latrine by self:** (Amakhonza kupita kuchimbudzi payekha) Is able to go and use the pit latrine by themselves and does not need any help in any way.

Source: “MDAT instruction manual (in English and Chichewa)” by Gladstone et al. https://doi.org/10.1371/journal.pmed.1000273.s0082 is licensed under CC BY 4.0
Appendix G - Example of mind map from Co-Design Workshop

This mind map was developed by the Academics based on qualitative data collected in the field during April of 2013 and collaborative understanding built during the Co-design Workshop held May 15-16, 2013. Practices are color coded for activities happening in both Makueni and Kibera, and for those unique to each area.

Makueni and Kibera color coded for activities happening in both areas and those unique to each area.