Technology as Amplifier in International Development

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ABSTRACT

Amplification theories of information technology argue that technology is primarily a magnifier of existing institutional forces. In this paper, these ideas are synthesized and augmented for an amplification theory of "information and communication technology for development" (ICT4D), the study of electronic technology in international development. Three mechanisms for amplification are identified, arising out of differentials in access, capacity, and motivation, and the ideas are developed using examples from telecenters, television, and mobile phones.

The amplification thesis contradicts theories that imply that technology's impact is additive or transformative in and of itself, e.g., that access to technology levels the playing field of power, or that the Internet, *per se*, democratizes access to information.

The consequences of an amplifier theory for ICT4D are that (1) technology cannot substitute for missing institutional capacity and human intent; (2) technology tends to amplify existing inequalities; (3) technology projects in global development are most successful when they amplify already successful development efforts or positively inclined intent, rather than seek to fix, provide, or substitute for broken or missing institutional elements.

Categories and Subject Descriptors

K.4 [**Computers and Society**]

General Terms

Management, Economics, Human Factors.

Keywords

ICT4D, ICTD, information and communication technology for development, technology as amplifier, technology as magnifier, amplification model.

1. INTRODUCTION

The last two decades of the information technology industry have witnessed unimagined successes whose pace is only accelerating. Headlines routinely proclaim entrepreneurial victories and technological revolutions: "Twitter will change the way we live" [27]; "Social networking will transform learning" [52]; "The Internet democratizes access to information".

iConference 2011, February 8-11, 2011, Seattle, WA, US

Encouraged by these achievements, the technology industry has broadened its horizons and looked beyond mature economic markets to seek impact. Cognizant of a "digital divide" [55] that separates the rich from the poor, both within national boundaries and also across developed and developing countries, technologists have paid increasing attention to addressing the needs of very poor communities through the application of information technology. Eric Brewer's TIER group at the University of California, Berkeley, for example, has been a consistent champion for the need for interventionist research in this area. They summarize one prevailing belief…

> Alongside good governance, technology is considered among the greatest enablers for improved quality of life… We believe that technology has a large role to play in developing regions, that "First World" technology to date has been a poor fit in these areas, and that there is thus a need for technology research for developing regions [8].

This paragraph captures the sentiment of interventionists in a field known as "ICT4D" or "information and communication technology for development."

The statement by Brewer et al. is softened with qualifiers, but in its extreme form, it becomes an unalloyed conviction in technology to solve deep social problems such as poverty. Nicholas Negroponte, the founder of the "One Laptop Per Child" project, writes on his website, "Kids in the developing world need the newest technology, especially really rugged hardware and innovative software" [35], and he has been a tireless promoter of the idea that a laptop per child will solve the problems of third-world education. Michael Best, a pioneer of interventionist ICT4D has gone as far as to say "The Internet should be a human right in and of itself" [6], effectively putting the Internet on a par with food, water, and physical safety. And, similar statements now occur routinely in the academic literature of ICT4D: "There is a pressing need to employ information technology for rural healthcare in sub-Saharan Africa" [17], etc.

Meanwhile, another group of ICT4D researchers is more pessimistic about technology's impact. More often coming from backgrounds in the social sciences and applying tools of observation and critical theory, they are quick to point out the failures of ICT4D interventions, citing an array of problems that interventionists routinely fail to address: Projects fail because they don't… design context-appropriate technology [9][16][58], partner with local organizations [22], adhere to socio-cultural norms [22][58], account for poor infrastructure [46], build relationships with local governments [9][41], invite the participation of the community [9][47], provide services that meet local needs [9][31][51], think through a viable financial model [29][41], provide incentives for all stakeholders [31], and so on, *ad infinitum*. In short, poorly designed technology or technology by itself, rarely has impact. Richard Heeks, among the most visible to lead the critique, has offered several frameworks by

which to analyze interventions, each of which enumerate all of the different classes of things that can go wrong [19][20][21]; spun positively, they become points to address for future projects [21].

Both sides have a partial claim to the truth: Technology can have significant, visible impact in some cases, but the impact is by no means guaranteed. Although ICT4D researchers – both interventionists and critics – appear to be converging to consensus on this point, there are few theories that provide higher-level insight into why projects fail or succeed. Most theories focus on implementational particulars – what went wrong or could have been done better (as above) – or pose questions at a coarse level – "What impact does Technology X have on social issue Y?" – effectively casting technology as a fixed force that necessarily causes a certain kind of social change. Unfortunately, neither tack provides broader insight that explains the complexity in how technology relates to development efforts, or answers questions about when technology could be expected to make positive contributions, particularly without resorting to trends inappropriately extrapolated from fully industrialized countries with very different historical contexts.

This paper synthesizes and builds on existing theory from technology in politics, education, and mass media that suggests that information and communication technologies have a multiplicative, and not additive, effect on human and institutional intent and capability. Specifically, the theory denies technology's ability to substitute for deficient intent and capability on the part of project stakeholders. It then follows that information technology's direct ability to address global development is limited by existing institutional capacity to do so. For interventionist ICT4D, the consequence is that while technology can be used to augment, improve, or streamline existing development capacity, it cannot make up for the lack of human intent and capability, whether it is the ability to implement an effective national vaccination program, the capacity to provide quality agriculture extension, or the intent to govern a country without corruption.

The next section summarizes three bodies of work on which the proposed theory is built. Section 3 describes the theory as relevant for ICT4D and proposes three mechanisms by which the theory comes to pass. Section 4 considers how the amplifier theory works in two large ICT4D movements – telecenters and television. Section 5 summarizes and reflects on the applicability of the amplification theory for mobile phones.

2. PREVIOUS THEORIES

The notion that technology magnifies human power is all but common wisdom in vernacular discussion. It's clear that a gun in the right hands protects citizens and maintains peace; in the wrong hands, it kills and oppresses. The gun lobby rhetoric that "guns don't kill people; people kill people" is effective precisely because it speaks to a truth about violence – that it requires human intent first and foremost. At the same time, those who disagree with the motivation behind the slogan would counter that guns simplify people's ability to commit violence, and therefore magnify latent hurtful intent in society that would otherwise be muted or less violent. These opposing viewpoints are reconciled intellectually (if not politically) by the principle that technology amplifies underlying human forces.

Despite the power and simplicity of this principle, however, in research on information technology, it appears only sporadically. Perhaps the most succinctly and powerfully developed of such ideas is the "amplification model" of Philip Agre [1][2], who discusses the Internet's role in political processes. After critiquing the deficiencies in an array of attempts to explain the Internet's impact on politics and democracy, Agre asserts that most such lines of inquiry are asking the wrong question and presupposing the wrong kind of generality: The very question of the "Internet's impact" suggests that its impact has a particular directionality (e.g., more or less centralization of power) that does not depend on institutional context. Rather, in the political sphere, Agre writes that "the Internet changes nothing on its own, but it can amplify existing forces, and those amplified forces might change something." Thus, outcomes are context specific and depend on the exact nature of existing forces as well as how the Internet interacts with them. Agre is especially critical of whitewashed interpretations of the Internet as a democratizing force (such as in [11]), and recent evidence from a number of regimes without free speech [34] suggests that his critique was on target. Positive instances of amplification demonstrate that the Internet permits readier access to political information [36], better communication with like-minded others [2], and easier formation of coalitions [33], but mostly only for people *already* interested and involved in politics.

An analogous conclusion has been drawn for technology in education very effectively by Mark Warschauer, in a series of articles and books based on research in American schools as well as educational systems abroad [54][55][56][57]. Warschauer observes consistently that while computing technology can enhance education in well-run schools with strong teachers, it has zero or negative impact on schools struggling with the basics of education. He and his colleagues show how the digital divide in education reveals itself in multiple ways through problems with access to technology, maintenance of technology, its integration into the curriculum, and its integration into the learning process. In all cases, good (normally, richer) schools do better, while bad schools do worse. He summarizes: "[We] found no evidence to suggest that technology is serving to overcome or minimize educational inequities" within the schools they examined. "[T]echnology does not exist outside of a social structure, exerting an independent force on it…" "Rather… the introduction of information and communication technologies… serves to amplify existing forms of inequality" [56].

In 1970, Phillip Tichenor et al. found that information disseminated over mass media was absorbed most by segments of society with higher socio-economic status to begin with [48]. Their "knowledge gap hypothesis" suggests that public-service messaging results in increasing the knowledge gap between the more and less educated. Although the less educated may also benefit, inequalities of knowledge are increased. Tichenor et al. identify four mechanisms by which this might occur: The more educated acquire knowledge more easily, have a richer store of foundational information, are more socially integrated, and are more likely to voluntarily seek out information.

Incidentally, classical macroeconomic models of productivity cast economic output as the multiplicative product of technology and human capital (and financial capital). However, the focus in all such analyses is strictly in terms of economic productivity. Here, we discuss amplification in terms of non-economic outcomes, as well.

Amplification theories of technology occur in direct contrast to theories which take information technology to be a fixed or *additive* force, with either a positive or a negative directionality regardless of the context. Theories of technology as a positive (or negative), additive, force assume that the presence of a technology in a given context is necessarily better (or worse). In their extreme form, they are ridiculously naive – "People will communicate more freely and… the effect will be to increase understanding, foster tolerance, and ultimately promote world peace" [11] – yet milder versions of the belief proliferate in the academic literature.

As Agre noted, such claims polarize the discussion about a false axis, with detractors insisting that technology's impact is negative. While counterexamples point out the flaws of techno-utopianism, but they nevertheless buy into an additive theory of technology.

3. TECHNOLOGY AS AMPLIFIER

The theory of technology as amplifier explains how the same technology can appear to have both positive and negative impacts, because technology is merely a magnifier of underlying human and institutional intent and capacity, which can themselves be positive or negative.

The choice of the notion of "amplification" is very deliberate. People have intent and capacity, while technology is merely a tool that multiplies human capacity in the direction of human intent. If there is a foundation of well-intentioned human competence, then the appropriate technology can amplify that and contribute to a positive outcome. But, in circumstances with negative human intent, as in the case of corrupt government bureaucrats, or infinitesimal capacity, as in the case of people who have been denied a basic education, no amount of technology will turn things around. This means, specifically, that technology cannot substitute for human intent or capacity where it is lacking. When technology does have positive effect, it is only to the extent that people are willing and capable of putting it to positive use.

The challenge of international development, though, is that whatever the ultimate potential of poor communities, well-intentioned capability is actually in scarce supply. If technology requires a substrate of well-intentioned, capable people to work, then there is a limit to how much technology can support global development in the absence of that human substrate. The theory of technology-as-amplifier leads further to a pessimistic irony for ICT4D: Exactly in those contexts where human and institutional forces are stuck in the status quo or working against development, technology will not produce positive change.

In contrast, additive theories of technology, or hypotheses that posit societal transformation through technology, might suggest that inequalities can be lessened by simply providing the technology to have-nots, or that the social problems such as poverty and political marginalization can be mitigated primarily by a dissemination of technology. These mistaken beliefs lead to calls for universal access as a way to address inequality.

3.1 Mechanisms of Amplification

It would be nice if technology did more for the poor, undereducated, and powerless, than it did for the rich, well-educated, and mighty. But, the theory of the amplification leads to exactly the opposite conclusion as a corollary: The greater one's capacity, the more technology delivers; conversely, the lesser one's capacity, the less value technology has. In effect, technology helps the rich get proportionately richer, thus widening, not narrowing, the gaps between rich and poor. This happens through three mechanisms, each associated with an underlying differential between the haves and the have-nots.

3.1.1 Differential Access

The first mechanism is that of differential access. Due both to limited economic capacity on the part of the impoverished, as well as the strong intent to turn a profit on the part of technology producers, the power of technology is consistently more accessible to the rich and the powerful. The first half of this principle is what has been termed the "digital divide" [55]: Technology costs money, not only to acquire, but to operate, to maintain, to upgrade, and to reacquire. Therefore, those with greater financial resources have greater access to it than those with less.

On the other side of the coin are producers of technology and content. Most producers of technology are for-profit companies. It's thus natural that they cater their products towards larger groups of richer customers who are more likely to buy, and this intent is again amplified by the technology they produce. Globally, hardware tends to be designed for people working in climate-controlled offices with stable AC power [8]; software tends to be developed in languages understood by the world's largest, wealthiest populations [37]; and, content tends to be written for audiences with the greatest disposable income, just to give a few examples. Even when products appear to be free, as with TV broadcast content or Google search, they are frequently supported by advertising, which itself seeks consumers with more disposable income. The result is, again, that the disadvantaged are further disadvantaged. Africa is estimated to have over 2000 languages, and yet almost all of the software in use there is in European languages, raising the bar for computer use for anyone literate "only" in their local language. And, this inclination is self-reinforcing: If a technology isn't designed for someone, they won't buy it; and if they don't buy it, then the producers won't design for them.

Of course, as rhetoric against the digital divide exhorts, these inequalities could be addressed through progressive provision of technology. The telecenter projects to be discussed in the next section, for example, are almost always targeted at poorer clients. But, such progressive practices with respect to technology aren't particularly effective on their own, because there are still two other differentials which technology cannot undo. A level playing field doesn't solve the underlying issue, which is that there are inequalities among the players themselves.

3.1.2 Differential Capacity

Differential capacity is the second mechanism of amplification. Even if differential access to technology could be countered through a universal allocation of technology, disparities among people, such as better education, refined social skills, and influential connections all translate to a greater ability for the better-off to use technology for their own purposes. Consider the following Gedanken experiment: Imagine that an iConference researcher and a very poor farmer from a remote village were each asked to raise as much money for the charity of their choice in a 24-hour period. They are both provided unfettered access to an Internet-connected PC, and nothing else, to fulfill the task. Who would be able to raise more money? A moment of thought will reveal that the researcher's education, social ties, self-confidence, and organizational capacities, would make them far more successful. (And, of course, there are also people in the

world who could out-fundraise the average researcher.) The technology is exactly the same in both cases, so the difference must be due to non-technological qualities associated with the person. The greater one's skills and capacities, the more value technology has; conversely, with limited capacity, technology's value is minimal.

Differential capacity is perhaps the greatest factor in preventing technology from being a consistent force to diminish inequalities. It means that online political power is gated by human ability to lead, connect, and organize. It means that Internet job search sites are more useful to those with stronger resumes. It means that the value of the best educational technology is felt in proportion to the learning capacity of the pupil and the pedagogical ability of the teacher. The human capacities exist to varying degrees in people and institutions before technology, and often with an advantage to the already rich and already powerful. Technology-as-amplifier implies that those differences will only be exacerbated, not eliminated, by technology.

3.1.3 Differential Motivation

The third mechanism is differential motivation: what people want to do with the technology they have access to. It has often been mentioned by ICT4D interventionists that after working to put powerful technologies in the hands of the underprivileged, they were surprised to find that poor people don't rush to gain more education, to learn about better health practices, or to upgrade their vocational skills [45]. Instead, they seem to use technology primarily for entertainment. Surveys find that when a village has ready access to a PC – connected to the Internet or otherwise – the dominant use is by young men playing games, watching movies, or consuming adult content [30][40]. Many become proficient at the hardware manipulations and software incantations required to download YouTube videos from a PC onto a mobile phone [40] [45]. But, these same people will often forsake software-based language lessons, or accounting-tool tutors, that could put them in a different income bracket. What might be perceived by richer folk to be "productive" use of technology is trumped by what could be considered more "frivolous" desires.

But, such moral judgments are out of place. Choosing short-term pleasure over longer-term gain is a common feature of human nature [3]. After a long day at the office, most high-paid knowledge workers aren't consulting their iPhones for career counseling and tips on how to budget more wisely. Rather, technology is used for socializing and entertainment. Substitute the long day at the office for a 14-hour day of menial labor, and it becomes even more understandable that entertainment would figure as the most attractive use of information technology among wage workers.

Of course, some people do use their mobile phones to learn Ancient Greek and to keep track of their international financial portfolios. But, this highlights one of the major differences between high-achievers and the typical target of development assistance. On the whole, the latter are less likely to have ingrained habits of self-improvement. This point is greatly muted in the contemporary, hyper-politically-correct discourse of development, but it is a point frequently made among development practitioners themselves. Deep Joshi, co-founder of PRADAN, a highly regarded non-profit in India, notes that rural farmers often suffer from very low self-efficacy, as a result of which, they have little intent or motivation to improve their lives without some prodding, confidence-building, and community organization [28].

Incidentally, it should be noted that none of the mechanisms above are meant to "blame the victim" for their challenges. They are not, for example, an indictment of undereducated people or their families. Blame, if it must be attributed, falls readily on historical circumstances, social structures, and the world's failure to invest in quality, universal education. In fact, one reason for valuing education is exactly because it provides the capacity and the appetite to take advantage of information technology; education is a critical way to increase the human capacity that technology can amplify.

A more subtle point is that even individual motivation – normally considered to be entirely within the realm of personal choice and therefore of personal responsibility – is an aspect of personhood that is greatly influenced by upbringing and environment. A lifelong lack of experience with situations where effort leads to better circumstances results in learned helplessness and low self-efficacy [28]. Anyone who grows up on a half-acre farm where pests, the weather, and the local seed merchant had more impact on the harvest than any amount of tilling the soil, might learn the same lesson, too. Why struggle to find a better way, when one's actions are a negligible factor in the outcome? Conservation of energy and effort would be a more sensible philosophy of life – sensible, but probably not the optimal attitude for getting out of poverty… and not one that would take full advantage of technology, even if it were freely provided.

3.2 The "Myth of Scale"

Combined, the three mechanisms above present a daunting physics in which inequalities are nearly impossible to counteract with technology. Inevitably, technology dissemination is not the primary means of positive change; there is no shortcut to nurturing human intent and capacity.

The converse, erroneous belief is the notion that the large-scale dissemination of the appropriately designed technology, per se, can provide solutions to poverty and other social problems. Believers jump to address the scale of global problems, before confirming the value of the solution. Or, they charge in under the banners of "appropriate design," "participatory design," "human-centered design," all in the unshakeable belief that the *design* of the technology or the larger socio-technical system is what matters. They equate technology penetration with progress, and by their conviction that whatever benefits they personally gained from technology can be made universal by optimal, context-sensitive design, and irrespective of the underlying human context.

This "myth of scale" is seductive exactly because it is relatively easy to scale technology, at least compared with scaling changes in social attitudes and human capacity. It's much easier to purchase 100,000 PCs, than it is to provide a real education for 100,000 school-aged children; or to run a national text-messaging health hotline, than to convince people to boil water before ingesting. It seems obvious that scaling a technology non-solution accomplishes little of developmental value, no matter how far it reaches. Yet, the promise of scale is the red herring that technology proponents frequently use – consciously or otherwise – to promote their solutions.

4. THE LIMITS OF ICT4D

To see how the myth of scale raises hopes for technology interventions, and how the amplification theory works in practice, it's useful to consider historical cases of ICT4D projects, particularly with respect to their anticipated outcomes, their eventual disappointments, and retrospective analysis of successful instances. We thus consider telecenters, perhaps the best-studied class of ICT4D interventions, and television, an information technology that a previous generation considered for global development.

4.1 Telecenters

Telecenters are much like Internet cafés, except that they are placed in impoverished communities with the deliberate intention of accelerating their socio-economic growth [50]. Most occur in poor rural areas, where urban amenities are least available. They are often sponsored wholly or in part by outside agencies – governments, non-profits, academia, industry – which themselves seek a variety of secondary ends, ranging from revenue and PR to increased interaction with a voting constituency.

Supporters of telecenters saw the incredible power of the PC and the Internet in the developed world, and believed that these tools could be used to solve challenges of the developing world. Proponents talked of a "bouquet of services" [29]: Distance education would make every child a scholar. Telemedicine would cure dysfunctional rural healthcare systems. Government corruption would be bypassed by citizen services right in the village. One paper suggested that telecenters could double incomes in rural villages [29]. In India, there were multiple calls for a telecenter in each of its 640,000 villages, and other countries followed suit, proclaiming their own national telecenter programs.

Telecenters were meant not only to benefit their customers, but also their operators, many of whom would purchase the necessary technology in a franchise-like model. Those telecenters that operated as for-profit microenterprises were expected to make a healthy profit for the owner by charging for services. The dream of all telecenters was to duplicate the most successful cases: One telecenter in south India reported saving a farmer in its village over a hundred dollars (again, significant for people earning no more than a couple of dollars per day), because it allowed a timely video-teleconference between him and a university agriculture expert that saved his okra crop [29]. Another telecenter in northern India provided a telecenter operator with a threefold increase in income when he opened a computer training center. And, there were no end to anecdotes about confident telecenter operators who beamed with pride at their new status as local brokers to the vast store of knowledge on the Internet. Success cases like this were hailed in the international press: "Indian Soybean Farmers Join the Global Village" [53]; "Village Kiosks Bridge India's Digital Divide" [32]; "Kenyan Farmer Lauds Internet as Saviour of Potato Crop" [42]. For a while, it seemed that no problem in development was so big that a PC with Internet connectivity couldn't solve it.

But, reality failed to satisfy anticipation. While there are occasional successes in the world of telecenters, they are few, fleeting, and very far between. Most telecenters were not able to raise the cost of operations (estimated to be at over $100 per month, in a typical rural area) [14]. Not surprisingly, many telecenters closed within months or years after they were set up, because they were unable to sustain themselves financially [30]. The abundant research on telecenters, though limited in rigor and scale, confirms that telecenters are underperforming with respect to their stated goals, and generally unable to remain afloat [44].

The small minority of telecenters that do well are almost always run by devoted non-profit organizations that expend considerable effort and resources [47] or by talented, dynamic entrepreneurs who manage multiple income-generating activities.[30] In fact, telecenter studies often emphasize the need for a local champion – a person (the telecenter operator or otherwise) who devotes their energies towards making a telecenter a success [41]. Although the need for champions is buried in lists of critical success factors, the repeat lesson is that the presence of a capable, motivated person vested in a telecenter is the single best predictor of success. Such a person will find funds, seek out training, connect with technical expertise, market creative ideas, and otherwise do what it takes to keep the project going. Or, to put it another way, someone somewhere caring passionately about the development outcome, is a necessary, though not sufficient condition for technology to have a positive impact.

Thus, telecenters are a classic case of technology amplifying the intent and capacity of telecenter stakeholders. And, all three mechanisms apply.

On the one hand, telecenters are almost always targeted at poor communities as a way to counter differential access to technology. Yet, this attempt is foiled in a number of ways. First, equal access is a considerable challenge in itself, despite the best efforts of telecenter proponents. Telecenters that charge for their services immediately place a cost on access that only serves to exacerbate economic differences, and even those which don't often suffer from local norms that restrict access to the poor and marginalized. Rural villages in India, for example, are often organized into caste-based hamlets, and the site of a telecenter, typically in the busy, upper-caste sections of a village for logistical reasons, will exclude lower-caste patronage.

Second, among telecenter customers and operators, there are great differences in capacity that result in different outcomes. Telecenter customers are often educated young men exactly because they are the only ones in rural areas who can manipulate a PC and extract value from the European-language-dominated Internet. (Yet, to expect the Internet to provide education where education is lacking is not unlike expecting a student driver to drive herself to driving lessons.) Also, operators differ greatly in their entrepreneurial capacity. Those who have significant experience or instinct for marketing, for example, outperform those without [31].

Third, most telecenter customers are much less interested in the activities of "development" than in short-term entertainment. Young men play games, watch movies, and consume adult content [30][40], and families purchase baroquely Photoshop'ed photographs of themselves, almost always in preference over education, health, or job-related services. Entertainment may have development benefits, for example, in increasing the capacity to aspire [4], but its connections to widely accepted development goals such as better health or greater wealth are tenuous at best.

All of these factors cause telecenters to underperform consistently, and in spite of heroic attempts to address the details of a well-implemented telecenter project. The stark reality is that given contexts deprived of strong human capacity, there is little for the technology to amplify.

All of this is in contrast, for example to the telecenter's American counterpart: PCs in public libraries. The Internet in US public libraries is generally accepted to have a net positive benefit, particularly for lower-income populations [5] (though that benefit doesn't completely escape the differential mechanisms described above). What explains the greater performance of public PCs in the United States are differences in basic levels of education and institutional capacity between developing countries and America; these are significant, especially when comparing the relatively poor across countries. Technology, where present, simply amplifies existing capacity, and inequalities are also magnified.

4.2 Television

Well before the first telecenter, the world had already run a much larger-scale experiment with information and communication technology in developing countries. In 1964, Wilbur Schramm, the father of communications studies and a co-founder of Stanford University's Department of Communication, examined the role of the technologies of his day in international development. In one book, Schramm highlights the potential of television: "What if the full power and vividness of television teaching were to be used to help the schools develop a country's new educational pattern? What if the full persuasive and instructional power of television were to be used in support of community development and the modernization of farming?" [43]. The book is eerie in its presaging of modern ICT4D discourse, despite a focus on older technologies.

On the one hand, there has certainly been some positive impact from television in international development. There is evidence, for example, that exposure to cable television empowers rural women in India [24]. Anthropological studies support the idea that television shows vested with urban values shift social attitudes in rural areas [26]. One non-profit organization, the Population Media Center, explicitly applies this principle to influence birth rates and healthcare practices in developing countries by running soap operas with positive social messaging. These are encouraging findings, without doubt [38].

Yet, the sum total of television's development impact comes nowhere near Schramm's own measured expectations. A half-century later, we find that television has not turned out to be a consistent agent for national education or agriculture, either in the developed or the developing world. Despite 50% penetration in Indian households, for example, TV is not an effective guard against illiteracy, poverty, or poor health. In developed countries, television is routinely derided as the "boob tube" that offers a mind-numbing opium for the modern masses.

Whatever television's potential, society – both as producer and consumer of technology – has consistently failed to apply it toward effective development. Commercial television broadcast programming provides exactly what consumers want – which turns out to be primarily entertainment, with little obvious development value for either rich or poor. State-owned broadcast stations, in contrast, run controlled propaganda that again limits its value to broad-based development. The few programs that could be said to have true educational merit are often funded at a loss, and suffer from small viewership.

Again, the technology's impact is dictated by human and institutional forces that predate the technology's introduction. Educational use of television is largely restricted to schools, whose institutional mission is education; in most household living rooms, where institutional norms are around relaxation and entertainment, television's "instructional power" is not taken advantage of. Conversely, there are documented instances of negative impact around television's contributions to violence and material envy.

Thus, on the one hand, television has achieved great market penetration and economic success. There are fewer and fewer people on the planet who can claim never to have seen television, and even among poor communities, television is increasingly common. On the other hand, its development impact has been limited, because when presented with the choice between easily absorbed entertainment and education that requires active effort, those that could most benefit from education (and even most others) tend to choose the former. The technology amplifies existing human and institutional forces; it doesn't compensate for missing motivation and capacity.

5. DISCUSSION

Unfortunately, the lesson that technology only amplifies human forces is difficult for development organizations and technocrats to accept. Although the overall amplification theory is agnostic with respect to the final outcomes for technology, in global development, the result is pessimistic. Technology-as-amplifier leads to the conclusion that successful development programs that rely on technology cannot be scaled simply by scaling the technology. Rather, direct investments in building human capacity must be made. Yet, those are exactly the expensive investments that development organizations hope to avoid through technology.

To further complicate the issue, if human intent and capacity were positively aligned, it's not clear that the digital divide would stand out starkly as a problem. The problem of effective ICT4D intervention is that it has as a prerequisite, the very result that it seeks to achieve. That is, in order to apply technology effectively to address development problems, it's necessary that you already have competent, well-intentioned people. But if you had competent people, then it would obviate the explicit need for an external technology push – capable people pull in, or come up with, their own technology.

Currently, the international development community is excited about the mobile phone. "Can the mobile phone help end global poverty?" was the headline of one New York Times article considering the possibility [12]. Indeed, rigorously executed research demonstrates that cell phones can eliminate certain kinds of information inefficiencies in developing-world markets [25]. Encouraged by such findings, foundations and multilateral agencies have formed task forces and entire departments devoted to mobile phones for international development.

The magnification thesis of technology, however, suggests that this is a one-sided view of mobile phones. Certainly, talking is something that all human beings, as social animals, not only want to do, but are well-equipped to do. Therefore, phones multiply that intent and capacity, and some of the resulting value is positive. But, it's not just productive intentions that are magnified by technology, but neutral and counterproductive tendencies, as well. When a dollar-a-day rickshaw puller pays a large corporation for the privilege of changing his ring tone, it's not clear that it's a net benefit to him or to society, yet companies pump out such "value-added services," and millions of impoverished consumers readily pay for them. Others have observed in Uganda that some households prioritize talk time over family nutrition and clean water, or that patterns of gender politics

are only exacerbated by mobile phones, as men wield phones as tools of sexual exchange [10][15]. Meanwhile, in the developed world, there is mounting evidence that mobile phones contribute to distracted driving, fractured attention, and reduced cognitive ability.

A final tally of the consequences might not be so far away. The world is already running the largest experiment ever in ICT4D. In 2010, there were over 5 billion active mobile phone accounts in the world [23] – comfortably exceeding the entire adult population of the world over 20 years of age. Estimates put over 90% of the population of the world within range of a cell tower, and mobile phones are increasingly seen in the poorest, remotest communities. These numbers prompt some to go as far as to say that there is no longer a "digital divide" for real-time communication. But, if the amplification theory holds for technology in global development, it would be expected that short of dramatic co-investments in building human and institutional intent and capacity, mobile phones will only amplify existing forces, and continue to privilege richer and more powerful individuals, communities, and nations.

As for ICT4D interventionists, the amplification theory results in the recommendation that technology projects should seek to amplify the impact of existing institutions that are already contributing successfully to development goals. Instead of leading the charge with technology, technology is best employed as support and amplifier. A related issue is the careful reporting of the results of technology projects. Interventionists should strive to emphasize *all* of the critical factors to project success, not just the final technology cherry on top. Few people imagine that a failing company can be fixed with a technology, no matter how well-designed. The same intuition applies to failing healthcare systems, educational systems, governance systems, and so on. What matters first are human issues of leadership, management, staffing, and client intent and capacity.

Finally, the amplification theory proposed here is just a skeleton that could be richly fleshed out with theoretical muscle, drawing not only from ICT4D but from other areas of information technology and broader technology in general. Starting with the amplification theory as a basis shifts research questions away from additive views of technology as either positive or negative in itself. Instead, the critical questions are what human forces a technology amplifies, the precise nature of the amplification, how the amplified forces ultimately interact, and whether the notion of "amplification" itself requires adjustment.

6. ACKNOWLEDGEMENTS

Thanks are due to two gracious anonymous reviewers, as well as the Boston Review, which published a non-academic version of this paper [49].

7. REFERENCES

[1] Agre, Philip E. 1998. Yesterday's tomorrow. Times Literary Supplement. July 3, 1998, pp. 3-4.

[2] Agre, Philip E. 2002. "Real-Time Politics: The Internet and the Political Process." *The Information Society* 18:311-331.

[3] Ainslie, George. 2001. Breakdown of Will. Cambridge University Press.

[4] Appadurai, Arjun. 2004. The capacity to aspire: Culture and the terms of recognition. In Culture and public action, edited by Vijayendra Rao and Michael Walton. Stanford, Calif.: Stanford University Press.

[5] Becker, Samantha, Michael D. Crandall, Karen E. Fisher, Bo Kinney, Carol Landry, and Anita Rocha. (2010). Opportunity for All: How the American Public Benefits from Internet Access at U.S. Libraries. (IMLS-2010-RES-01). Institute of Museum and Library Services. Washington, D.C.

[6] Best, Michael L. (2004) Can the Internet be a Human Right? Human Rights & Human Welfare, Vol. 4. University of Denver.

[7] Bourges-Waldegg, P., & Scrivener, S. A. R. (2000). Applying and Testing and Approach to Design for Culturally Diverse User Groups. *Interacting with Computers, 13*(2), 111-126.

[8] Brewer, E., Demmer, M., Du, B., Ho, M., Kam, M., Nedevschi, S., Pal, J., Patra, R., Surana, S., and Fall, K. 2005. The Case for Technology in Developing Regions. *Computer* 38, 6 (Jun. 2005), 25-38.

[9] Bridges.org. (online, as of 2008) Real Access / Real Impact criteria. http://www.bridges.org/Real_Access.

[10] Burrell J., (2010): Evaluating Shared Access: Social equality and the circulation of mobile phones in rural Uganda, Journal of Computer-Mediated Communication 15; pp 230-250.

[11] Cairncross, Frances. (1997) The Death of Distance: How the Communications Revolution Will Change Our Lives. Boston: Harvard Business School Press.

[12] Corbett, Sara. (2008) Can the Cellphone Help End Global Poverty? The New York Times. April 13, 2008.

[13] Dearden, A. (2008). User-Centered Design Considered Harmful. *Infomation Technologies and International Development, 4*(3).

[14] Dhawan, Vivek (2004). Critical Success Factors for Rural ICT Projects in India. Masters Thesis, IIT-Bombay.

[15] Diga, K. (2007) Mobile Cell Phones and Poverty Reduction: Technology Spending Patterns and Poverty Level Change among Households in Uganda. Masters Thesis. University of KwaZulu-Natal, Durban.

[16] Donaldson, Krista. 2009. "The Future of Design for Development," Information Technologies and International Development 5, 4 (Winter 2009), pp. 97-100.

[17] Friedman, E. (2009) Computer-assisted medical diagnosis for rural sub-Saharan Africa. *IEEE Technology and Society*, 23(3):18-28.

[18] Garrido, M., Coward, C., Gordon, A. (2007). ICT Training for Disadvantaged Populations: The Importance of Tailoring to Local Context. Research Working Paper Series. Center for Internet & Society, University of Washington

[19] Heeks, R. (1999) Information and communication technologies, poverty and development. Institute for Development Policy and Management.

[20] Heeks, R. 2002. "Information Systems and Developing Countries: Failure, Success, and Local Improvisations." The Information Society 18, 2 (2002): 101-112.

[21] Heeks, R. (2003) Most e-government for Development projects Fail: How can risks be reduced? Institute for Development Policy and Management Working paper no. 14.

[22] Hosman, L., and Fife, E. (2008) Improving the prospects for sustainable ICT projects in the developing world. International Journal of Media and Cultural Politics, 4(1), 51-69.

[23] International Telecommunication Union. (2010) World Telecommunication/ICT Development Report 2010: Monitoring the WSIS Targets.

[24] Jensen, R. and E. Oster (2007) The Power of TV: Cable Television and Women's Status in India, NBER Working Paper 13305.
[25] Jensen, R. (2007) The Digital Provide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector. Quarterly Journal of Economics, 122(3), 879-924.
[26] Johnson, Kirk. 2001. Media and Social Change: the Modernizing Influences of Television in Rural India," Media, Culture and Society, 2001, 23(2):147-169.
[27] Johnson, Steve. 2009. "How Twitter will change the way we live." *Time Magazine*, June 5, 2009.
[28] Joshi, Deep. 2001. Removing Poverty: Role of HR and Pos. IFMR Seminar.
[29] Jhunjhunwala, A., A. Ramachandran, and A. Bandyopadhyay. (2004) "n-Logue: the story of a rural service provider in India", Journal of Community Informatics, 1:1(30-38).
[30] Kiri, K & Menon, D. (2006). For Profit Rural Kiosks in India: Achievements and Challenges, Information for Development, 4(6), 14-16.
[31] Kuriyan, R., I. Ray, K. Toyama. (2008). 'Information and communication technologies for development: The bottom of the pyramid model in practice.' The Information Society, 24: 93 – 104.
[32] Lancaster, John. 2003. Village Kiosks Bridge India's Digital Divide. The Washington Post. Oct. 12, 2003.
[33] Laumann, Edward O., and Knoke, David. 1989. Policy networks of the organizational state: Collective action in the national energy and health domains. In Networks of power: Organizational actors at the national, corporate, and community levels, eds. R. Perrucci and H. R. Potter, pp. 17–55. New York: Aldine de Gruyter.
[34] MacKinnon, R. and E. Morozov. 2009. Firewalls to Freedom. Project Syndicate. Feb. 24, 2009.
[35] Negroponte, Nicholas. n.d. Frequently Asked Questions. One Laptop Per Child website.
[36] Norris, Pippa. 1999. Who surfs? New technology, old voters and virtual democracy. In Democracy.com? Governance in a networked world, eds. E. C. Kamarck and J. S. Nye, Jr., pp. 71–94. Hollis, NH: Hollis.
[37] Nunberg, G. 2000. Will the Internet speak English? The American Prospect.
[38] Population Media Center. Sabido Methodology – Background. http://www.populationmedia.org/what/sabido-method/, retrieved Aug. 30, 2010.
[39] Rangaswamy, N. & Toyama, K. (2005). "Sociology of ICT: The Myth of the Hibernating Village." Proc. 11th Conference on Human-Computer Interaction, July 2005, Las Vegas.
[40] Ratan, A., Satpathy, S., Zia, L., Toyama, K., Blagsvedt, S., Pawar, U., & Subramaniam, T. (2009). Kelsa+: Digital Literacy for Low-income Workers. IEEE/ACM Int'l Conf. on Information and Communication Technologies for Development.
[41] Roman, R. and Colle, R. 2002. Themes and Issues in Telecentre Sustainability. Institute for Development Policy and Management Working paper no. 10.
[42] Ross, Will. 2010. Kenyan farmer lauds internet as saviour of potato crop. BBC News. Mar. 17, 2010.
[43] Schramm, Wilbur. 1964. Mass Media and National Development: The Role of Information in Developing Countries. Stanford University Press.
[44] Sey, A. (2008). Public Access to ICTs: A Review of the Literature. Research Working Paper Series. Center for Information & Society, University of Washington.
[45] Smyth, Thomas N., Kumar, S., Medhi, I., Toyama, K. (2010) Where There's a Will There's a Way: Mobile Media Sharing in Urban India. Proceedings of the 28th International Conference Extended Abstracts on Human Factors in Computing Systems. CHI '10. ACM.
[46] Surana, S., R. Patra, S. Nedevschi, E. Brewer. (2008) Depolying a rural wireless telemedicine system: experiences in sustainability. IEEE Computer, pp. 48-56, June, 2008.
[47] Swindell, J. 2006. The Village Knowledge Centres of Pondicherry. In Leal W. (ed) 2006 Innovation, Education and Communication for Sustainable Development. Peter Lang: Frankfurt.
[48] Tichenor, P.J., G.A. Donohue, C.N. Olien. (1970) Mass Media Flow and Differential Growth in Knowledge. Public Opinion Quarterly 34(2):159-170.
[49] Toyama, K. (2010) Can Technology End Poverty? The Boston Review 35(6).
[50] Toyama, K. and K. Keniston (2008) Telecentre debates. Telecentre Magazine, March 2008.
[51] Toyama, K., K Kiri, D Menon, J Pal, S Sethi, and J Srinivasan. 2005. PC Kiosk Trends in Rural India. Paper read at Policy Options and Models for Bridging Digital Divides, at Tampere, Finland.
[52] Vander Ark, Tom. 2009. "How Social Networking Will Transform Learning." *The Huffington Post*, Nov. 7, 2009.
[53] Waldman, Amy. 2004. Indian Soybean Farmers Join the Global Village. *New York Times*. Jan. 1, 2004.
[54] Warschauer, M. (2003). The allures and illusions of modernity: Technology and educational reform in Egypt. Educational Policy Analysis Archives 11(38).
[55] Warschauer, Mark. (2003). Demystifying the digital divide. *Scientific American*, *289*, p. 42-47.
[56] Warschauer, M., Knobel, M., & Slone, M. (2004). Technology and equity in schooling: Deconstructing the digital divide. Educational Policy 18(4), p. 562-588.
[57] Warschauer, M. 2006. Laptops and Literacy: Learning in the Wireless Classroom. Teachers College Press.
[58] Winschiers, Heike. 2007. A cultural appropriation of Usability Engineering and Participatory Design practices -A Namibian Experience-, in Workshop on User Centered Design and International Development.