Lessons from ICT and International Development

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Abstract. The abstract should briefly summarize the contents of the paper in 15–250 words.

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1 A Cautionary Tale

In 2008, in what was among the earliest, most prominent applications of AI to social good, Google released "Google Flu Trends," an online system that claimed to provide early warnings of flu outbreaks in various geographic regions, based on the incidence of Google searches related to the flu. Its creators claimed that the system generated output that was spectacularly correlated (coefficients of 0.90 and higher) with the surveillance data of the U.S. Centers for Disease Control and Prevention (CDC), but 1-2 weeks earlier [34]. The system was seminal, inspiring efforts to track other diseases [5, 78], to use other types of data [2, 53], and to provide disease surveillance to countries with weaker public health systems [62, 63]. Google Flu Trends offered the possibility of free, rapid, effortless, disease surveillance.

Critics, however, found errors: Google Flu Trends "completely [missed] the first wave of the 2009 influenza A/H1N1 pandemic, and greatly [overestimated] the intensity of the A/H3N2 epidemic during the 2012-2013 season" [61]; the latter predictions were off by a factor of 2 or worse [18]. A range of causes were suggested: overfitting of data; spurious correlations with irrelevant search terms; changing user search habits; media-influenced search behavior; differences between suspected and actual illness; and so on [49, 48]. Some researchers have proposed that the Google Flu Trends algorithm could be improved upon [24, 44, 72], or that it needs to be routinely updated [18, 49], and they are undoubtedly right – the original algorithm was based on simple linear regressions trained on a static data set. But, even with that new wisdom, the world has yet to see a "big data" illness prediction system that improves upon reliable surveillance systems of public health organizations such as the CDC, and that, too, despite a decade of dramatic advances in machine learning, the rise of passionate AI proponents seeking social impact, and a global COVID pandemic stressing the need for better outbreak prediction.

Meanwhile, others wondered what value Google Flu Trends and other similar big-data prediction platforms could have in countries without strong public health systems. Knowing about outbreaks is useful only if it results in effective actions to combat it. Among the challenges are that exactly the countries without good governance often struggle to retain staff with skills to operate, interpret, or respond to data-driven systems [38, 79]. One article concluded that those countries that had the most to gain from big data systems like Google Flu Trends also "have particular characteristics that hinder further development of these projects" [51].

Based on Google Flu Trends' performance in New Zealand, some commentators provided what serves as a good summary: "Overall, Google Flu Trends appears to provide a useful free surveillance system but it should probably be seen as supplementary rather than as an alternative" to good public-health surveillance systems [87]. In any case, in 2015, Google closed down Google Flu Trends [60].

The story of Google Flu Trends serves as the ideal cautionary tale for efforts to apply AI for social impact, embodying as it does many common features of such efforts: the huge potential benefits; the applicability of technology; the importance of data quality; the crucial role of human institutions; the requirement of ongoing socio-technical maintenance; and the difficulty of truly meaningful impact. But, if genuine impact with AI is difficult, it is certainly not impossible. Lessons from other fields that have sought to apply digital innovations for social good are worth understanding.

2 ICTD

Aspects of the Google Flu Trends story are very familiar to those of us in a research field called "information & communication technologies and development," or *ICTD*. In this highly interdisciplinary community formed in the mid-2000s, researchers seek to devise technologies that contribute to international socio-economic development and to understand technology's actual impact on development. ICTD scholars are diverse in terms of disciplinary background, geographic origin, and views of technology, with backgrounds in anthropology, economics, sociology, political science, computer science, design, and engineering, and many other fields. ICTD researchers hail from all six inhabited continents, representing a range of lower- to higher-income countries. Some ICTD research seeks primarily to observe and understand socio-technical phenomena; other work seeks to intervene through innovation; and some efforts assess the impact of interventions. Within the community, there are techno-utopians, who believe technology can solve social challenges; technology skeptics, who doubt technology alone can make much impact; and a rich continuum in between.

Most often "ICTs" are digital technologies, though some of us have worked with older technologies such as television, radio, or print media. And, "development" is broadly construed, indicating any activity that is intended to improve communities and societies, though for the most part our efforts have focused on supporting lower-income groups. In any case, there is great overlap between the concerns of ICTD and those of AI for social impact. Lessons learned from the former are likely to apply to the latter.

Over ICTD's first fifteen years or so, a number of broad conclusions have emerged as a rough consensus. Briefly stated, they are as follows:

– Technology *can* have positive social impact.
– Actual technology impact is often less than positive.
– A lot about technology's impact depends on people and institutions.
– Impactful socio-technical design is often context-specific.
– Sometimes, good technology design is universally valued.

These conclusions, born as they were out of the tensions inherent to a diverse field, lack the precision and specificity that some fields can claim. (Greater precision is a hope for future ICTD research.) In fact, there is a back-and-forth nature to the claims above, each tempering another. Yet, as with any hard-won consensus, the findings are robust, and they seem applicable to AI for social impact. In the remainder of this section, each of the conclusions will be discussed with respect to the ICTD work that gave it shape.

Technology *can* have positive social impact. Among the most influential research papers in ICTD is economist Rob Jensen's paper about the impact of mobile phones on fishing communities in Kerala, India [41]. Published in 2007, the paper was based on data collected just as cell towers were being installed along the coast of the southwestern Indian state. Jensen found that within weeks of a tower being installed, the price of sardines in the local fish markets spectacularly converged, leading to measurable benefits for the local economy.

Prior to mobile service, high price variation of fish was the norm in the coastal communities. That was a symptom of fishing boats not being aware of the different prices they could get for their catch at different marketplaces. Sometimes, multiple boats would land at the same market, and the resulting glut of fish would lower the price fishermen received while also resulting in unsold, wasted fish that was thrown out at the end of the day.

Cell service allowed fishermen to call into the markets while out at sea to seek the best price, and that had the effect of evenly spreading out the supply of fish across markets to meet demand. Without gluts and wasted fish, the economy of the area benefited: Fishermen saw an average 9% increase in profits, and local consumers saw a 4% decrease in the price of sardines. The study provided a textbook demonstration of low-cost communications leading to market efficiency.

Jensen's paper, though it was not published in an ICTD-focused journal, is among the most widely cited in ICTD research. It has served as a cornerstone for interventionist ICTD efforts, offering proof that a widely disseminated digital technology can have concrete welfare impacts on lower-income communities. Authors cite Jensen both to motivate research that investigates the impact of a disseminated technology, and to establish that digital innovation can be worthwhile for international development [14, 20, 37, 43, 52].

Within the ICTD literature, hundreds of papers have been published demonstrating the capacity for digital technology to have positive impact on a range of activities, from agriculture, education, entrepreneurship, gender dynamics, governance, healthcare, livelihoods, and so on [36, 81, 84]. It would thus be difficult for even the most pessimistic technology skeptic to argue that technology can never have positive social impact.

Actual technology impact is often less than positive. To say that technology *can* have positive impact, however, is not the same as saying that technology *necessarily* has positive impact. ICTD research also suggests that it is actually quite difficult to ensure positive social impact with ICTs. Often, digital technology has little or no impact on meaningful social outcomes; and sometimes, digital technology contributes to harmful effects that may counter or overwhelm positive impacts.

Consider, again, Jensen's study about mobile phones improving economic welfare in Kerala. It has now been 15 years since that work, but there have been few, if any, other demonstrations of similarly unambiguous positive impact with digital technology in a development context. Another economist expected to find impact analogous to Jensen's among grain farmers in Niger, but found only a relatively small reduction in price dispersion attributable to cell phones; and little could be concluded about ultimate welfare benefits [3, 4]. The muted impact can be attributed to contextual factors that have little to do with mobile technology: for example, transportation costs on land to different marketplaces can vary significantly (compared with traveling by boat to different markets on the shore), limiting farmers' ability to make decisions based on price; and grain can be easily stored (unlike fish), so there is less waste even when market gluts happen. Some scholars have shown, in fact, that Jensen's site in Kerala was unusually predisposed to benefit economically from mobile phones. For example, local unions had worked to reduce the influence of middlemen – who historically had significant power to set the price of fish – thereby enabling fishermen to sell at the market of their choice [76].[1] In other words, the background circumstances required for mobile phones to have economic impact to the degree Jensen found are actually very rare.

In fact, retrospective studies of interventionist ICTD projects find that projects with ongoing positive impact are the minority. A study by Richard Heeks based on polls and examinations of cases, suggested that 85% of e-Government projects are total or partial failures [35]. An investigation of mobile health projects by Richard Anderson & Noah Perin suggested that out of 51 projects reviewed, only 7 had achieved any degree of scale, which they defined as "impacting thousands of people" [6]; the actual impact of those 7 projects was unclear.

Meanwhile, digital technologies have also unleashed a range of negative social impacts. Social media is rampant with systematic disinformation campaigns

[1] In private conversation, Jensen told me that it took some hard thought to identify the best time, place, and product that would generate good data for his study. He chose a site that was very likely to demonstrate his thesis.

by repressive governments [15] and health-impacting misinformation from the grassroots [86]. Electronic payment systems and digital currencies have opened a new channel for illicit fund transfers and illegal trade [85]. Women and girls have suffered deeply from non-consensual disclosure of private information and imagery [71].

Whatever positive impacts powerful technologies can have, they can also propagate great harms.

A lot about technology's impact depends on people and institutions. Together, the previous two claims about technology might seem frustratingly ambivalent. They recapitulate historian of technology, Melvin Kranzberg's, First Law of Technology: "Technology is neither good nor bad; nor is it neutral" [46]. That ambivalence, though, is truth rooted deeply in reality, and it points to what is perhaps a starker, more revelatory claim about technology: The direction of any technology's actual impact – whether it is positive, negative, or something in between – is largely not a quality defined by the technology itself.

In fact, ICTD's accumulated wisdom is that a technology's impact is far more dependent on people – as individuals, as communities, as organizations, as institutions, and as societies – than it is on technology design *per se*.

For example, much about the impact of technology is dependent on individual users. Studies find, for example, that a user's degree of literacy greatly affects what they can gain from digital technology [31, 54]; that micro-entrepreneurs with stronger future-focused expectations see more business value from their mobile phones [20]; and that sufficiently motivated users will suffer through dozens of poorly designed user-interface manipulations [75].

Beyond individual users are the effects of leadership and management. One study found that the positive benefits of a text-message reminder system for community health workers in Tanzania only occurred under the watch of human supervisors [26]. Another line of work suggests that ICTD interventions work best when there are project champions committed to impact [69, 68].

Those with power over a technology often have the greatest ability to affect outcomes. They may include technology designers, engineers, tech company leaders, technology implementers, and policy makers. Gig work platforms, for example, have impacts on workers and customers that are largely determined by the companies that operate them and any policies that govern them [40, 27, 80].

Sometimes, social trends or norms that prevail independent of any power structures are what decide a technology's outcomes. The ICTD literature is filled with examples of people using technology for fun and recreation – purposes that interventionists focused on welfare impacts typically do not intend [22, 65, 73]. The field also documents a rich range of spontaneous technology use, including for intra-family remittances [55, 58], religious practice [57, 70, 88], and mate-seeking [19, 74] – little of it intended by technologists or policy makers, at least, not as people actually use them.

In the end, what all of this illustrates is that people and institutions have great sway over a technology's impact.

Impactful socio-technical design is often context-specific. If people affect technology's impact, then it follows that positive impact with technology requires attention to the larger socio-technical context of its use. In some cases, that context may require adjustment or overhaul. Context being variable, however, any adjustments may need to be site- or application-specific.

Many ICTD practitioners are trained in design or human-computer interaction (HCI), both of which value innovation that is contextualized and human-centered [81]. It is all but an axiom in these fields that any technology should be tailored to its context. Context, of course, can include just about anything pertinent to the use of a technology [8], and ICTD researchers have adapted technologies for cost [16, 32, 45], climate [16, 32], culture [64, 70], education levels [56, 54], local technology capacity [66], and so on.

Sometimes, good technology design is universally valued. However much context plays a role, though, occasionally, a technology turns out to be widely applicable and universally valued. The mobile phone, for example, is perhaps human civilization's most successful consumer product. In the 25-year period ending in 2016, the number of mobile phone accounts in the world went from nearly zero to exceeding the total human population [42]. And, it was designed largely without consideration for the diversity of eventual users – it seems unlikely that any of the key mobile innovators at Motorola, Nippon Telegraph and Telephone, or Nokia had even considered the possibility that sardine fishermen in South India might one day be using their products on the sea.

Individual ICTD studies tend to focus attention on specific contexts, and so there are few published statements of technologies having universal value in its literature. But, the total body of ICTD research demonstrates that while usage styles and preferences differ greatly across contexts, low-cost digital technologies are rapidly adopted – even in some of the world's most remote communities. Mobile payments are used by Samburu pastoralists in Kenya [47]; SMS text message enable English distance learning on the Mongolia steppes [11, 50]; and curated chunks of the Internet are distributed by USB stick in Cuba [29]. WhatsApp was widely in use outside of higher-income countries before Facebook acquired it [1, 21, 23]. And, with the global proliferation of smartphones, new apps such as TikTok can rapidly build a worldwide user base [77].

Underlying the technological phenomena is the fact that, despite differences among individuals and cultures, we are all human. We seek to communicate with one another and value low-cost real-time means to do so. We want to be entertained and appreciate rich options for music and video. We aspire to health, wealth, knowledge, power, goodness, and wisdom, and search out information that enables those qualities. Customized design is important, but some technologies hit a sweet spot in the collective human psyche.

3 Technology's Law of Amplification

One theory of technology and society that is consistent with the above findings and which emerged out of ICTD work is the *Law of Amplification*: For the most part, technology amplifies underlying human forces [83]. This simple idea explains how technology can have both positive and negative outcomes, emphasizes the role of people in deciding technological outcomes, and offers a causal mechanism for it all. At heart, amplification restates the notion that technologies are tools, and, therefore, that it is people who decide whether to wield them and for what purposes. The law may be obvious, but it has a range of direct corollaries that are not as well-understood [82, 83]:

- Technology only improves circumstances where the underlying human forces are positively intentioned and capable.
- Where negative or dysfunctional human forces prevail, even the best-designed technology cannot turn things around.
- Technology, in and of itself, does not work against human desires and goals, but it is possible for a technology to amplify the ability one group of people to work against another.
- Subtle human forces sometimes become newly visible due to a new technology.
- Technology cannot eliminate human politics, but technology often serves as an amplifying platform on which human politics is acted out.
- An even spread of technology tends to increase inequality, because underlying inequalities are also amplified.

It is worth noting that the amplification law and its corollaries apply regardless of one's definition of good and bad, positive and negative. For example, some people believe that the 2020 U.S. presidential election was incorrectly decided, and because they feel that information that supports that view is positive, they see its spread on social media to be an amplified good. But, others see such information as corrosive, and therefore, that its amplification by social media is bad. The same information is being amplified – and so, too, whatever effect one judges that information to have. Moral value comes from human interpretation and action; it is not inherent to the technology or to amplification.

Two of the corollaries deserve highlighting. First, even the best-designed technology cannot improve things in contexts where negative or dysfunctional human forces prevail. Indifferent or mediocre school systems do not improve with more educational technologies [25]. The rich and powerful can appropriate public technologies meant for efficient service provision [13]. Corrupt officials can manipulate technologies for transparency, or simply turn them off.

Second, for those who care about inequality,[2] the fact that a technology may improve everyone's lives is no guarantee that it supports equity. In fact, an even

[2] Some may not. John Rawls, whose influential political philosophy provides some cover for neoliberal capitalism, argues that once everyone's basic needs and liberties are assured, any action is justified if it improves the lives of the 'least advantaged,' even if it contributes to greater inequality [67]. His critics disagree [9, 28, 59].

use of digital technology tends to increase inequality, as the rich, the powerful, and the more educated tend to benefit more than others [30, 83].

4 Succeeding at AI for Social Impact

The Law of Amplification suggests that the most consequential question that should be asked when designing AI systems for social impact is this: *What are the underlying human forces that the system will amplify?* Below, this question will be unpacked in the context of facial recognition technologies for law enforcement.

To begin, this question is not primarily about algorithmic bias, algorithmic correctness, or algorithmic auditing. While those are all important considerations, they are preceded by the question of what the people who have power over an AI system care about. Problems with a technology itself will be addressed or mitigated post-hoc if powerful stakeholders are vested in addressing them.

Imagine, for example, that there are two Police Departments, PD-A and PD-B, each of which use the same, biased facial recognition system in their work. PD-A is committed to real justice and is meticulous about evidence before making any arrests. PD-B, in contrast, cares most about how it appears in press stories in the short-term, and seeks quick arrests and arraignments over careful detective work. Suppose further that both departments use the same facial recognition system, and that, as is the case with today's state of the art, it is biased: Among other things, people with darker skin are mis-recognized more frequently than those who are light-skinned [12, 17]. PD-A might use the facial recognition system to identify potential suspects in, say, surveillance camera footage, and sometimes, the system might misidentify someone. However, because of its diligence, it would only make arrests if there were other corroborative evidence. PD-B, under the same circumstances, would rush to make arrests, some of which would be based on recognition errors and therefore involve innocent people.[3] It is noteworthy that the relative outcomes would be similar *even if* the facial recognition system were unbiased with respect to whom it misidentifies. Any such system is bound to make occasional errors – PD-A would minimize their impact; PD-B would still arrest innocents. In other words, the human stakeholders with power over the system's use matter most; problems in the algorithm are secondary, and even a "perfect" algorithm can be misapplied.

Attending next to the critical human forces, there are two key subquestions: First, what are the positive human forces that the AI system is meant to amplify? Second, are there any negative human forces that might also be amplified? In the case of PD-A, the underlying positive forces might be the intention to conduct just, accurate police work, with a side-goal of doing so efficiently. Both forces are amplified with the facial recognition system, which in some cases would provide supplementary evidence, and which would speed up the process of generating suspect lists. PD-B appears to prioritize efficiency over accuracy, and so

[3] In reality, innocent people have been arrested due to facial recognition system errors [33, 39].

the technology has the dubious effect of speeding things up without improving accuracy.

As to negative forces, PD-B provides an example. Its culture of rushing slipshod over careful evidence-gathering would be amplified by facial recognition: The system would generate lists of suspects more quickly, and therefore also introduce more errors in the process – likely leading to more wrongful arrests. (In the absence of the facial recognition system, PD-B would be slower to generate lists of suspects.) Or, suppose, for example, that a department were racist. Its use of a facial recognition system would likely increase racial discrimination by the department, because the departmental bias would apply to interpreting the results generated by facial recognition: Potential suspects raised by the system of some races would fall under greater suspicion than those of others. Once again, this would occur regardless of any bias in the technology itself.[4]

An important point is that positive and negative forces could co-exist in a single department, and both forces would be amplified. PD-A, despite seeking just outcomes overall, might also be racist; if so, its use of a facial recognition system might simultaneously improve justice in some average sense while exacerbating racist outcomes.

What if no positive forces exist, or, as in the example above, if the negative forces outweigh the positive ones? One option is to follow the Hippocratic injunction, "First, do no harm." Sometimes, the right action is no action [10], at least no action with AI.

Another is to ensure effective, non-technological efforts to cultivate positive human forces and reduce negative ones that occur prior to or in parallel with any AI system-building. Such efforts could be taken on by those developing the impact-seeking AI system – though, in that case, a caution applies: The socio-politico-cultural effort required to align human forces in any context is often far more involved, difficult, and time-consuming than technology builders imagine [7]. A facial recognition company struggling to make a profit and with limited staff aware of law enforcement culture and policy is very unlikely to be able to ensure that their technology will have the right kind of impact.

Far more realistic is for AI system builders to work with partner organizations that are devoted to ensuring the right human forces, and on an ongoing basis. For example, if a facial recognition technology were to be used by a given law enforcement agency, oversight of the system's use and outcomes should involve civil society organizations and adequate representation of local community members. In ICTD work, experience suggests that the most common guarantor of positive impact with technology is the involvement of an organization deeply and capably committed to the social impact goals. Such an organization ensures that the human forces required for positive impact are present, and that any deployed technology are appropriate.

Finally, one key human force to consider is that of the AI system designer, perhaps *you*. All of us carry complex personal motivations, of which seeking

[4] This is not to say that the technology has no effect. Any given technology might exacerbate the department's racism to different degrees, depending on its own bias.

social impact is just one. We seek achievement, affirmation, recognition, career advancement, wealth, and power to varying extents; true saints are very few and far between. To the extent that we have power over the AI systems we build, the resulting technologies can amplify the impact of any of our intentions, whether open or hidden. Perhaps most common to people engaged in tech-for-social-good projects is the drive to take credit for what we accomplish and to be recognized for doing good. Such motivations may be benign, and it is possible that they serve positive purposes. (Project visibility can attract resources; personal rewards can incentivize people to do good.) But, they can also be in tension with actual social impact. Wanting to be recognized for technical brilliance may mean passing over simple or non-technological solutions that work better. Drawing attention to the technology or its designers may deflect it from partners doing the most crucial work. And, narratives of technology saving the day may mislead others into thinking that it is the technology alone that causes social impact.

Overall, if there is one lesson from ICTD, it might be that there is no such thing as "technology for social impact." Technology alone is insufficient. For AI to contribute meaningfully to social impact, then, it must be accompanied by significant, non-technological effort.

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