Information and Communication Technologies for Displacement: Report from an NSF Workshop

Carleen Maitland, Ph.D.
Penn State University

Jeff Landale
"X-Lab at Penn State University"

Recently, the world has been witnessing a crisis of displacement comparable only to the mass refugee crises of the 1940s. Whether fleeing gang violence in Central America, a political crisis in Burundi or civil war in Syria, the complex and diverse circumstances of the displaced has catapulted into the world's consciousness.

In these trying times, information and communication technologies (ICTs) serve as critical tools to ameliorate the pain of forced migration, from route planning and family finding, to resource tracking and food allocation by refugees and humanitarian agencies. However, while valuable, the use of these tools highlighted many shortcomings, not only with the available technologies but also with the organizational and governmental policies that directed or constrained their use. Looking at innovative architectures likely to be implemented in the next 10 years, this report identifies research directions that strike a balance between short term benefits and long term relevance.

These research directions were identified by an interdisciplinary mix of academics and practitioners, thereby combining insights on ground-breaking technologies, theories and methods, with practical experience. Supported by the National Science Foundation, the Penn State University Institute for Information Policy, the "X-Labat Penn State University" and the PeaceTech Lab, the workshop[1] was held at U.S. Institute of Peace in Washington, D.C. on April 15th[2]. There, participants, shown in Table 1, engaged in small group discussions and lively debates.

Carleen Maitland – *Penn State University*	**Jeff Landdale** – *"X-Lab at Penn State University"*
John Pope – *PeaceTech Lab*	**Karen Fisher** – *University of Washington*
Brian Tomaszewski – *Rochester Institute of Technology*	**Scott Edwards** – *Amnesty International*
Galya Ruffer – *Northwestern University*	**Lindsey Kingston** – *Webster University*
Lisa Singh – *Georgetown University*	**Colleen Connolly-Ahern** – *Penn State University*
Christina Clark-Kazak - *York University*	**Jay Chen** – *New York University*
Paul Schmitt – *UC Santa Barbara*	

Table 1: Workshop Participants

[1] More detailed information about the workshop can be found at http://cmaitland.ist.psu.edu/displacedworkshop2016/ and was funded under NSF award #1343520.

[2] An earlier workshop was held in 2013, in Stellenbosch, South Africa and information can be found at https://sites.google.com/site/dpew13/

The discussion was broken into two segments, the first addressed technologies and the second, specific application domains within the context of displacement (i.e. forced migration, crisis displacement, refugee and economic migration). The outcome of these discussions is a research agenda consisting of both disciplinary and interdisciplinary research areas spanning computer, data and social sciences as well as legal scholarship. In the following sections, we summarize the key issues discussed by participants and then offer recommendations on future research domains.

Technology

The technologies discussed covered six domains, namely video, 3D & virtual reality, biometrics, small data, multilingual analyses, and network access. In each of the first five, the discussions considered the current state-of-the-art and likely future developments, methods for analyzing the associated data and how these technologies might be used in aiding the displaced.

Video

Advances in the diversity of sources generating video have potentially profound impacts on displacement, ranging from providing evidence of the drivers of displacement, in some cases human rights abuses, to its use in refugee status determination cases and to support migrants. Indicative of this trend, the firm StatisticBrain[3] reports roughly 300 hours of video are uploaded to YouTube every minute. Video is also becoming a bigger component of the social media data, embedded in Facebook posts or through (mostly) video-specific services as such SnapChat and Vine.

Video is also an important source of evidence for human rights violations, particularly where information is censored. A major challenge to using any of these data for evidentiary purposes is establishing the video's chain of custody. There has been much attention paid to the issues of image and video forensics in the computer science field, with an ACM Computing Survey article on the topic published in 2011 (see (Rocha, Scheirer, Boult, & Goldenstein, 2011)) and several workshops devoted to related topics such as Information Hiding and Multimedia Security (2014) and Multimedia in Forensics (2009). While the technical issues continue to evolve along with solutions, usability by a broad range of users will continue to be a challenge.

In the human rights domain, for video evidence to be used widely, authenticity tools and processes, as well as technical means to promote privacy, need to be accessible to every documentarian, many of whom stumble across situations with little intention of playing that role. Apps for using video in documenting human rights violations have been developed by the International Bar Association as well as the Guardian Project[4]. The latter, a non-profit organization developing secure, privacy-enhanced mobile phones and apps, has two apps in

[3] http://www.statisticbrain.com/youtube-statistics/

[4] See https://blogs.state.gov/stories/2015/04/06/state-rights-citizen-witnesses-documenting-human-rights

particular, the ObscuraCam app and the Secure Smart Camera App, which support privacy and verification for video to be used as evidence. Privacy may also be a concern with video as it may be critical to ensuring a fair trial. YouTube's face blurring tool was also noted as an important innovation in this domain. Despite these positive technological developments, as noted by workshop participants, the challenge will be to ensure video camera operators use these technologies. As with many security and privacy features, usability is key to adoption.

In addition to chain of evidence, workshop participants also discussed video as part of the complex domain of 'big data' and how it can combined with other sources and formats of data to improve analyses. Before video can be combined with other data sources it likely needs to be analyzed independently. Algorithms are needed to identify materials of interest and there currently there is a lack of analytic tools. Many approaches seek to code video content, generating textual data that can be more easily integrated with the wide range of textual data sources, include social media, government statistics and spatial data.

A participant from Amnesty International noted that Amnesty faces structural challenges over the next few years in analyzing all the data it receives. This has led to a change in strategies, evolving from making tools for data capture to a focus on analyzing publicly available video data. Realizing humans alone will not be able to analyze this volume of data, they are working with computer vision experts at Carnegie Mellon to develop training algorithms. This approach can greatly increase the efficiency of analyses, however it requires pre-specifying the search query.

An additional approach has been to combine machine-learning with crowd sourcing, creating hybrid techniques that potentially enable broader investigations. Examples include Wu et al. (2015) 's system, which was tested on online shopping customer reviews, and Cheng and Bernstein (2015) 's Flock program, which has been applied to video analyses. Even with this hybrid approach, integrating video into any multidimensional analysis will require some specification of the question driving the analysis. While many application domains for big data analytics inherently assume flexible analytic processes (aka fishing expeditions), video analytics, which need to be more narrowly constrained, may limit the scope of an integrated analysis.

These hybrid analyses are being tested at Amnesty International as well. Their Alt-Click project, which is framed as an alternative to 'clicktivism' aims to bring the organizations broad network of members into data analytics. Through micro-tasking, similar to that used on Amazon's Mechanical Turk, the Alt Click program aims to engage volunteers in analyzing satellite imagery to document human rights abuses. Destruction of slum dwellings, the paths made by tanks, and environmental destruction are just some of the evidence that can be gathered from these images. The platform provides some automation for comparing assessments of individual analysts, such as comparing how many analysts identified a tank in a picture. The team hopes to integrate more advanced machine learning approaches as the project evolves.

3D, Augmented and Virtual Reality

As technology has moved from Google Glass toward more immersive technologies such as Google Cardboard, Microsoft Hololens, and Facebook's Oculus Rift, the implications for displacement are being considered. Similar to 2D, chain of custody and verification of 3D video will be key as will analytics. Used as evidence, the more embedded nature of 3D video may help overcome some of the limitations of 2D, providing a more complete picture of an overall scene.

These tools are being tested by journalists, to better engage the citizenry and provide more contextualized information on news events. Pavlik and Bridges (2013) equate the functions of augmented reality and news, in that both augment the users' experience with the real-world, natural environment. They both connect the user to a wider viewpoint, taking into account history and a broader social context than a single person is likely to experience on their own.

The data for 3D, augmented and virtual reality is likely to be even more complex to analyze than simple video. For example, the hybrid crowd and machine learning methods, discussed above, will need to adjust, taking into account the extra information and perhaps uncertainty derived from the third dimension. It may be the case that individuals have different perceptions of space in these 3D and virtual environments. As maps can play an important role in mobility and navigation, the implications of 3D and AR for cartography and spatial science need to be explored.

Biometrics, DNA Profiling and Body Hacking

The third technology theme was in the area of biometrics, DNA profiling and body hacking. Each rely on technological developments that are interesting in themselves, but most critical is the use and management of the data they generate.

Biometrics have been widely adopted in the humanitarian community both in operations providing services to refugees as well as for managing staff. While the most common form is digital finger printing, iris scans are gaining in popularity and plans are in place to implement facial scans as well. Despite adoption, systems and best practices are lagging. For example, UNHCR only released its policy on biometrics use in the spring of 2015, years after the agency began implementing the technology. A December 2015 report by the U.S. Public Broadcasting Service (PBS) citing a U.N. official reported the organization now holds the iris scan data for roughly 1.6 million refugees in the Middle East and Europe[5]. The PBS story was touting the potential of iris scans for ensuring refugees offered resettlement, that is safe passage and legal residence in a third country, meet security requirements (i.e. are not criminals or terrorists).

Workshop participants pointed to some positive elements of biometrics for providing identification, particularly for stateless displaced persons or those fleeing places where IDs were either destroyed due to natural disasters or war, were not available to them due to conflict, or

[5] http://www.pbs.org/wgbh/frontline/article/can-biometrics-solve-the-refugee-debate/

were never issued in the first place. However, despite the potential advantages, workshop participants voiced concerns about the many complications associated with biometrics data.

The first concern was consent in the data collection process. While the UNHCR's May 2015 data policy states refugees must consent to data collection, in reality it is likely a prerequisite for access to crucial goods and services. Further, concerns were raised about the integrity of data, loss of data and displaced persons' ability to correct inaccurate data. A participant noted that biometric data can be hacked but, unlike a PIN, it cannot be replaced. If stolen, a replicable fingerprint could permanently compromise a person's ability to authenticate their identity.

These concerns about management of biometric data for the displaced reflect those that arose from programs aimed at citizens, who were not in crisis or mobile. Biometrics-based identity programs proposed or implemented at the national scale in the UK and India in recent years, highlighted the challenges of data management and data-oriented strategies (Johri & Srinivasan, 2014; Martin & Whitley, 2013). If deploying these technologies among stable government entities with stable populations raised challenges, it is logical their use in displacement contexts is likely to be far more complicated.

Simply a refugee's mobility across jurisdictions raises concerns about subsequent sharing of biometric data and consent. If biometric data are shared by UNHCR during the resettlement process, what happens to the data? For example, biometric data were used in the process of resettling Syrians in Canada, thereby making these data available to the Canadian government. However, a cessation clause means the resettlement may not be permanent. If the refugee is forced to leave, will the Canadian government pass along those data? Does the refugee have the right to deny sharing of data? While the threat of abuse of biometric data by the Canadian government is unlikely, refugees are often persecuted by state-actors and hence unrestricted inter-state data sharing can put them at risk.

Further, if biometric data is to be used for assessing criminality or other behavioral characteristics, triangulation with other data are required. Pairing biometric to interpolate who is what, and who is doing what can lead to overly broad searches and privacy violations. Also, the need to triangulate provides the motivation for collecting ever more data, bringing the entire system further down a slippery slope.

In a specific example, a 2015 joint report of the Inspector Generals of the World Food Program (WFP) and the UN Refugee Agency (UNHCR) on their biometric-based food distribution system in Dadaab refugee camp in Kenya[6], articulates interesting findings. As for the benefits, the two organizations found the program generated food distribution savings of approximately $1.4 million (USD) per month. This represents a return on investment of roughly 1300 percent over five years. However, the report also noted the data management system lacked key protections. In particular, the report noted "The laptops used at the litigation desks are not equipped with the Microsoft recommended encryption tools for protecting sensitive information and for preventing

[6] See http://documents.wfp.org/stellent/groups/public/documents/reports/wfp277842.pdf

unauthorized access." And that "No expert testing of the implemented safeguarding protocol has been performed to ensure the network connection is secure." These findings highlight the challenge biometrics create in that the systems for collecting the data are relatively easy and increasingly less expensive to implement, but once collected, safeguarding the data is much more challenging.

The participants discussed the likelihood that use of biometrics would morph into DNA profiling or body hacking in the form of inserting chips – which from a purely technical perspective may be seen as the ultimate form of identity verification and control. The consensus was that traditional forms of tracking through mobile phones, which are becoming, if not already, widely used among the displaced, are sufficient for these purposes. Also, it was noted that some displaced persons want to be tracked, happy to know someone cares about or is aware of their movement because it implies the possibility of assistance. However, given that the UK identity management scheme had proposed DNA profiling, there was some concern this technique might begin to be used in a number of domains, such as in refugee status determination to establish one's ethnic or tribal origins or familial ties. Currently, conflicts in definitions of familial ties are treated somewhat liberally. However, DNA testing could change that. For example, a Somali refugee entering the U.S. with multiple wives might claim one or more are sisters or cousins. In exposing this falsehood, DNA testing may bring into focus information that heretofore with the consent of those most involved in the process remained 'fuzzy.' Also noted was the range of information DNA expose such as diseases. The availability of such information might be difficult to ignore by some states, further complicating the RSD or resettlement processes. Further, it was noted the cost of these technologies was being driven down by cancer research and that the portability and ease-of-use of these tests are advancing rapidly.

This discussion raised questions as to the drivers of biometrics use, and potential drivers of DNA profiling and body hacking. Clearly from the joint WFP and UNHCR report, a main driver for their joint use is accountability to donors in the use of resources in provision of services. However, it was also noted that this could be seen as a sub-theme of the greater drive for precision and control. This drive for precision has many implications for data beyond biometrics, as more data are collected through traditional monitoring and evaluation programs but also applies to greater control over the displaced, by tracking their movements and knowledge of their daily activities.

Further, in humanitarian work, unlike healthcare, there's no proof that this level of precision helps. Do we need this level of detail? The technical feasibility of collecting more data can in turn increase the demand for data, creating a never ending cycle and funneling precious resources away from real needs. Cost-benefit analyses of monitoring may find negative unintended consequences. For example, a person may line up multiple times claiming rations for different households as a service to a sick or elderly neighbor, with redistribution occurring as intended. With biometrics, will the systems allow this type of flexibility? If not, at what cost to beneficiaries?

Small Data

While much of the discussion was couched in terms of the widespread data availability often associated with big data, the participants were also keenly aware that many of the issues were actually those of small data, both for organizations and the displaced. Among the examples provided above those relating to small data for organizations include the use of video and DNA data for RSD, which would be submitted on a case-by-case basis. The use of AR/VR data for improving services and public engagement with displacement scenarios would also likely exist on a situation-specific basis. One company, IRIS ID[7], claims an iris scan file is only 512 bytes (~.5kb). Consequently, the 1.6 million refugee iris scans held by UNHCR, would require 800Mb of storage and could easily fit on a memory stick. So depending on the centrality of data storage, even operations relying on iris scans could be considered a small data problem. For organizations serving the displaced, many of the small data challenges are related to the highly distributed nature of data collection, storage, analytics and management. As compared to more centralized architectures, the distributed nature of the system creates challenges for control as well as training, since it inherently implies there are many people involved.

Refugee Personal Data Management and Analytics

The explosion of data also has implications for personal data management for the displaced. Increasingly, one of the most important items people take when fleeing are mobile phones, tablets and laptops. These devices may contain data primarily for personal use, the equivalent of the family photo album, may be key to arriving safely at the destination, such as through contact lists, or may also contain evidence of persecution to be shared with authorities.

As the next step in the evolution of the data lifecycle, it is likely personal analytics will also become an important tool for the displaced in the future. As was discussed above, the merging of multiple forms of information is becoming more automated, providing the displaced with more accurate information about safe routes, options available in different places, and current conditions. The popular traffic and route guidance app, Waze, is an example of merging passively and actively collected data from users to inform decision making. This data combined with social media feeds about current conditions at the destination, conditions including weather, police actions, and services available may be merged together as personal analytics. The key is where and how will refugees access data? Part of the solution to refugee data access must include data warehousing systems in processes where refugees maintain access long after aid organizations have left.

Multilingual Analyses

For both organizational and personal analytics, particularly where displacement involves crossing national borders and the international humanitarian community is involved, multilingual data management and analytics will be critical. In the current crisis, where the displaced transit through many language areas, stories abound about the importance of translation apps and

[7] http://www.irisid.com/productssolutions/technology-2/howitcompares/

websites. These critical services need to be expanded to smaller and smaller language groups, using potential migration path as a driver for choosing translation pairs.

In addition to transit, nearly all the examples provided above presume some form of translation and subsequent multilingual analysis. For example, simply translating various sources of evidence into English and then conducting a multivariate analysis does not allow non-English speakers to engage in the analytic process. Multilingual and collaborative analytic processes can have important implications for information and knowledge flows.

Network Access

Naturally, the implications of the technologies discussed above all presume a robust and reliable network infrastructure, which is particularly challenging for the displaced. Network connectivity can be a challenge, particularly when moving to or through rural areas where network coverage is limited, but also in urban areas with coverage but where temporary network access is limited.

The above discussion also presumes a certain level of freedom in data transfer and access, which are hindered where censorship is severe. This can present a critical challenge for collecting data on human rights abuses. To avoid centralized network censorship and surveillance, mesh networking, where devices connect to one another rather than a centralized network, could serve a critical role in distributing evidence of human rights abuses.

The advances envisioned for 5G mobile network technology, expected to be rolled out in 2020, are expected to bring mesh-like architectures to mobile phones. With Internet-of-Things as an important use case, 5G cellular technology will enable machine-to-machine communications and this should also include inter-phone connections.

5G's developers also envision this type of architecture will better support emergency communications for natural disasters. However, this may envision a disaster where some network connectivity exists, just at a distance that can be traversed by phone-to-phone communication. If this is indeed the mechanism, the need may still exist for 'rapidly deployable networks' that can be established on a temporary basis where extensive network damage has occurred or where the displaced settle in locations with a lack of or only limited coverage.

Network access for the displaced must also contend with affordability (Commission, 2015). The lack of financial resources that often accompany displacement, whether due to a loss of homes and livelihoods from a natural disaster or limited economic opportunities caused by long-term armed conflict, create challenges for maintaining access. Services that allow free network connectivity for limited access, often referred to as zero-rating, may have an important role to play in ensuring network access for everyone.

Application Domains

Workshop participants also considered the implications of these technological changes for specific application domains within the broader area of displacement. Five areas were delineated, namely 1. migration and mobility decisions, 2. human rights and refugee status determination, 3. youth and elderly, and 4. engagement, experience and cultural competence.

Migration and Mobility Decisions

Forced migration or displacement imply mobility under duress and often set in place either individual or societal change. For the displaced, the mobility may not be a singular event, but many moves, that may or may not end in their place of origin. Both forced migration and displacement are expected to increase due to instances of armed conflict and instability as well as climate change. While the term migration typically applies to persons crossing international borders, displacement may exist within or between countries, the former typically resulting in internally displaced persons (IDPs).

One of the implications of the increased availability of data is the desire for governments and other bodies is remote tracking or analysis of people's movement. A variety of data types from an increasing diversity of sources are used, from satellite data and surveillance blimps to cellular network call data records and social media. These efforts have raised the questions: What can we tell from people's movements? And what of the implications?

One possible outcome of such analyses is to better understand the causes of migration. Pinpointing movements can help establish whether migration was voluntary, typically for economic gain, versus involuntary, due to a crisis or persecution. These determinations can be critical as obtaining refugee status, and hence legal entry into a country, can require establishing persecution exists. Understanding movements can be particularly important where people frequently cross borders, going back and forth to visit family or engage in trade. For example, in western Africa, people may move seasonally and time series analyses can help identify these cyclical trends. They may also identify locations where prima facie status is granted such as U.S. State Department work on famine and migration in Somalia. However, where movement is normal but then something happens and people cross, it may look like normal movement but is not. This is a cautionary statement – our data-based conceptions about movement have to be grounded in the context to really understand their causes.

Also, even if a person fled due to persecution, they may go back temporarily. In many instances, asylum seekers move back and forth between countries. This has been frequently observed in the Syrian crisis, where Syrians move back and forth between Jordan, Lebanon and Turkey and their home country. Their reasons for a temporary return, even while placing the person at risk, vary and may including retrieving a precious item left behind, supporting those who chose to stay, checking on property or simply taking a break from the difficult life in displacement. These kinds of movements are problematic when they are used to support a claim that someone is not

truly a refugee. In fact, an important value of citizenship for resettled refugees in the US has been having the diplomatic protection of the US government in order to visit home country.

It may also be the case that ICTs are actually making borders less noticeable and consequential. Workshop participants observed that something about the ability of communication technologies has changed the mindset around borders. As people constantly interact across borders, they mean less. One participant pondered – are Syrian refugees crossing numerous international borders in Europe looking at them the same way as previous generations?

While much of the media attention on displacement focuses on the developing world, economically advanced nations also suffer natural disasters that can leave people displaced for months if not years. In the U.S., in response to large scale disasters the Federal Emergency Management Agency (FEMA) must sometimes build trailer sites, similar to those used in refugee camps. Many of the challenges faced by residents are the same – conflict with authorities, displacement from employment, disrupted social networks and ties.

However, not all displaced persons find housing in the form of group housing or camps. In wealthy and less developed countries alike, the displaced often end up living with family and friends and often times find themselves in urban environments. There, their dispersion can make it difficult to find and provide support services.

The decision on when and where to flee is complex, whether examined at the individual or family level. Even at the community level there are a number of factors that explain who flees, when and to where. Oftentimes, people with greater access to information and resources, typically the wealthy and more educated, flee earlier. The decision to flee may be made several times. In the Syrian crisis, there are many examples of people fleeing to other countries, even Europe, and then returning to Syria. Or they may first go to Jordan and then resettle in a Gulf state.

These decisions are greatly influenced by the availability of information and for this reason network availability is key. According to media reports, in Greece the first step in the asylum application process is a Skype-based appointment. For Syrians interested in resettling in Canada the Canadian government chose to interact via SMS. In the end only 20% said yes, as refugees felt Canada was too cold and far away. While these anecdotes suggest technology plays an important role in these decisions, more research is needed to understand precisely how and why.

A critical component of such an investigation would be the reliability of the information. With situations rapidly changing, it is possible for people to flee to a location only to find they are a week too late. The migration and asylum processes are rife with misinformation. A participant provided an example of asylum claimants coming to Canada with the same story again and again, after being told that this is a story which can grant asylum. However, using the story they are turned down, even though their truthful story could have won them asylum. Information

sharing has to be fast and accurate to be helpful. Participants felt visual information may be helpful in aiding these decisions.

An important part of that information is the reality of the place one is fleeing to. With the wide variety of social media data, both official and unofficial information concerning the real time realities on the ground and perceptions of those realities would likely be helpful. For example, knowing more about a place may help potential refugees gain access to resources and avoid problems.

Data can also be useful for predicting migration, which can in turn improve preparations or potentially address issues before they turn into a crisis. In one effort at Georgetown, a team has specified a set of roughly 25 factors, putting them together in a model to predict potential movement. Each factor is reflected in a variety of metrics, open source data sets used to derive perceptions of or 'buzz' about an event. One outcome of their work was identifying the early sell off of cattle and other livestock as an early indicator there might be a crisis brewing.

Predicting migration may also require the tackling of the multilingual data issue raised above. Typically a model has to be built in a single language as the training procedures used in machine learning would be difficult and complex across data sets in different languages. So data sources are either rnonolingual or are translated into a single language. It is also the case that regardless of language, Algorithms will have to keep adapting to different spaces as people switch social media.

As important as predicting and supporting migration are, these are only the first steps in what can be a long process. The displaced may be granted temporary asylum, which may last years. If they are lucky, they may be given the option for permanent resettlement in a place that offers them many opportunities. Regardless, connecting with people back home or relatives who were forced to scatter to different locales or nations is critical.

The communications can be vital for social and emotional support while in displacement and may also play a critical role in the decision to return. One participant noted that interviews with Tamil refugees about decisions not to go back indicated that people who planned to go back were in constant communication with people in Sri Lanka. Yet the Indian government was trying to keep them from having cell phones.

Information is crucial to the decision to return but the conditions to which people might return may also be influenced by ICTs. One challenge of crises and post-conflict reconstruction is the issue of brain-drain, where the educated have left and this creates even greater challenges in res-establishing the institutions needed for development. As one participant posed -
How do we move beyond resettlement to give people a way to bridge back to their society and country and what roles can ICTs play? We haven't crafted technologies and policies to enable a bridge back, such as the possibility of working remotely, living in displacement but contributing to the home country. Many studies have shown the relationship between international call volumes and the remittances vital to supporting those who stay behind. However, remittances

do not help a country recover through higher order economic development and recovery activities. Remote work could also solve an important issue for refugee programs – employment.

Human Rights and Refugee Status Determination

As discussed above, several technological developments have implications for both human rights and refugee status determination. The human rights community has found the developments around and widespread use of video to be an important potential tool for documenting human rights abuses. Similarly, evidence of such abuses may begin to be used in the Refugee Status Determination (RSD) process. In both domains, there were many questions raised concerning the nature of the framing of the video and AR/VR, and whose framing would lead. Questions also were raised about how experience with the context influences conclusions drawn from AR/VR and whether or not someone who had not experienced the context, both in terms of actions (i.e. violence, verbal assault) and in terms of geography, would draw conclusions.

Implications for RSD were also mentioned in our discussions of biometrics and DNA profiling. Lessons drawn from national level implementations of biometrics can only go so far, as refugees do not have the same rights as nationals. Indeed, the turn around by the UK government, and their decision to dismantle their biometric-based identity system, exemplifies the differences between refugees, who had no voice in whether or not or how these systems are used by UNHCR, and the rights of citizens. Potential uses of biometrics and DNA profiling in RSD are verification and identification (Martin and Whitley 2013)(Martin & Whitley, 2013) as well as establishing ethnic/tribal identity as a point of assessing claims of persecution and familial ties for entry by families. These uses raise many potential benefits as well as concerns.

As a precursor to or outcome of RSD, our discussion of biometrics and DNA profiling and data management, highlighted the importance of securing data over the lifetime of the displaced person, particularly in cases where they the person does not receive a permanent status. For example, where a person receives temporary asylum, who controls, owns and manages the data? What processes are in place to ensure a displaced person can take their data with them when they are either permanently resettled or return to their country of origin? To whom does the data transfer, the individual, the state, or both? Does the individual have a say?

Youth and Elderly

The third application domain consists of the issues related to youth and the elderly in displacement. The UN defines youth as persons between the age of 15 and 25, and in some contexts such as Germany and in camps in Jordan, the majority of refugees are youth. The characteristics of this population group vary significantly. For example, a 15-year-old ‘girl’ may be married with children, have suffered the trauma of war, or may be similar to a 15-year-old from most contexts. This exemplifies the issue of using chronological age and its arbitrariness. Other potential markers include education or marriage, or biological markers such as reaching

puberty. Of course, however, these alternate indicators are more difficult to capture and compare.

In some cases, the displaced include unaccompanied minors, who may be separated from their families for a variety of reasons. While it is often assumed these minors are separated from their families unintentionally in transit, it may be the case that minors are sent ahead or depart of their own accord and in some cases do not recognize themselves as minors. These circumstances become tricky from a human rights perspective. In some cases, the youth is sent ahead because the family figures they are more likely to gain access and are less likely to be sent back. In this way, the family gains a foothold in, for example, Europe. In the case of Syria, a family might not be able to afford to have the entire family travel so they send young sons, who are more likely to find employment. Worried about these 'beachhead' efforts, in the U.S., the policy on unaccompanied minors is to send them back to their country of origin. Similarly, in Canada if an unaccompanied minor 'finds' their family overseas, the minor is not allowed to sponsor their family for Canadian immigration. Refugee rights activists raise issue with the policy, pointing to the potential that the youth might have a legitimate refugee claim.

In highlighting the complexity of these cases, a participant also noted that it is important not to normatively assume a family is inherently protective, as some minor asylum seekers claim abuse within the family and that their nation state has failed to protect them. Unaccompanied minors or child migration may also become conflated with issues of human trafficking. While some states promote the narrative that child migrants are being trafficked, others take the stance that they aren't victims but rather individuals trying to reach family in a foreign land (see (Bhabha, 2009)). Further, oftentimes these minors do not want to be identified as such.

Youth are often seen as avid users of technology. Indeed, research has shown how immigrant and refugee youth serve as ICT wayfarers on behalf of others in their communities. Research shows that when people immigrate and come into other countries, the youth and young people are the most mobile, picking up languages, geographies, acting as interpreters of language, but also complex situations, such as health care and legal issues.

Participants also recognized a focus on youth can come at a cost of a lack of attention to the elderly. The elderly face many challenges in displacement, including fleeing, accessing appropriate services and competing for resources, such as employment. The disadvantages faced by the elderly are exemplified by the Canadian immigration system, in which points are given to younger applicants and those over 45 years are given zero points. The Canadian government policy reflects the attitude that only younger immigrants provide value.

Instead of considering the young and old separately, the participants favored a focus on intergenerational relationships, intergenerational roles, and how those roles might change. For example, in displacement, a young person might serve as the spokesperson for a family, when traditionally this might be a role for elders. It is also important to understand how people are part of generational structures, and how those structures intersect with others such as social class.

Engagement, Experience and Cultural Competence

The use of 3D video and virtual and augmented reality creates unique potential for serving the displaced, particularly in using 3D video as evidence and in forecasting, using VR and AR in raising awareness of the plight of the displaced, and using VR and AR in improving the cultural and situational competence of staff providing services.

Our discussion concerning AR/VR included implications for spatial thinking and cognition and how people perceive place. Participants contemplated the role of immersive environments as tools for training staff, teachers and others who might work with resettled refugees but have very little insight into their lived experiences. Some felt that value of immersive environments could help development empathy and potentially insight, beyond what is currently available through media such as books and movies. However, others saw potential problems with overestimating the effects of these technologies. In general, arguments were made about the value of 'being there,' the depth of cultural competence required and the related limitations of AR/VR.

Research Agenda

The above discussion raises a number of both fundamental and applied research questions across several domains. In the following, research agendas are specified for five domains: (1) Computer science and human-computer interaction, (2) Data science and spatial science, (3) Technology management, organizational and individual use and social impacts, (4) Legal scholarship, and (5) Interdisciplinary scholarship.

Computer science and human-computer interaction

A computer science research agenda that can inform and improve displacement includes the following elements. For data generated from videos in 2D and 3D formats, both authenticity and privacy preserving technologies will be key. Also, the greater importance of images and videos in the lives of the displaced calls for lightweight image and video processing software that enable the search and retrieval of images and video, such that a person could search through images and videos of family stored on a mobile phone. Further, despite the promises of cloud technologies, continued advances in lightweight storage for files on mobile devices may be key.

A computer science *networking* research agenda must embrace mobility and rapid deployability to enable connectivity while fleeing. Research should also address the need to connect and transmit data in alternative architectures such as mesh networks to avoid censorship. These technologies must confront the challenges created by security concerns. Finally, it is crucial technologies be developed with intermittent connectivity, a lack of power infrastructure, and affordability in mind.

The contexts of displacement call for significant research in *human-computer interaction* to ensure usability of these technologies by diverse users. The context of displacement often

brings a set of challenges such as mobility, exposure to the elements (being outside), limited access to power, and intermittent network connectivity. In addition to these rugged physical contexts, the users of the data and applications will be extremely diverse. Whereas it is often the case technologies are designed for use in a single language environment, displacement drives the need to simultaneously consume data in multiple languages. Diverse users such as staff in international courts as well as diverse and multilingual displaced persons and their advocates must be considered.

Data Science and Spatial Science

While the opportunities to improve the lives of the displaced through data science are nearly limitless, this potential relies on the ability of organizations to share data. This limit exists in many contexts, but given the time constraints, range of partners that come together on a temporary basis and diversity of users, displacement represents a unique context for data sharing. At the intersection of data and computer science, there is a strong need for intelligent data sharing platforms that maintain provenance, protect data and reduce barriers to cleaning data to enable some fields to be shared, while others remain protected.

Forced migration forecasting also demands better data and data analysis methods. In order to get realistic forecasting data, we need timely access to both direct and indirect indicators of forced migration. For this reason, social media and mobility data may be key to a better understanding of when people decide to move. From open source data, we may be able to accurately determine buzz, event, and perception variables that are crucial for attempting to understand why people make different migration choices. Technologies that help parse these data and the algorithms to analyze and make the data usable are in their infancy. Forecasting would also benefit from a better understanding of the representativeness of various publicly available data sets, such as Twitter data. This is particularly of concern to statisticians and computer scientists attempting to forecast demographic, perception, and buzz trends from these data. How representative are these samples? Is it a reasonable approximation of populations? Which populations? Pew showed that Twitter was representative across certain types of ethnicities and demographics. Tools that can measure the confidence and reliability of different data sources and use these partial data to augment more traditional forced migration data sets will be invaluable for development of more accurate and timely forecasting tools that can be used by policy makers and humanitarian organizations.

Data science might also address accessibility of data, such as certifications. When people flee, being able to establish and retrieve these data residing on public servers back in their home country can be crucial. There is also a need to consider what types of information can be captured, stored and processed. For example, is it possible to search for data to substantiate a claim of education, training or birth?

In terms of *spatial science*, research issues for displacement might include the implications of AR/VR for spatial thinking and cognition and how changes influence the process and outcomes of displacement. Further, while likely a topic beyond spatial science, AR/VR also raise questions

about the differences between representation and immersion. An important question may become how are the symbols of cartography (representation) changed by the immersive nature of AR/VR and, in turn, how does this change influence displacement? In this case, displacement is likely a critical use case as people often flee under dire circumstances. Mobile phones have made the use of maps while fleeing more likely and many of the AR/VR technologies are being developed for the mobile platform.

Technology management, organizational and individual use and social impacts

A second general category of necessary research covers the domains of technology management, organizational and individual use and social impacts. These research efforts complement the more technologically focused areas above by providing a critical perspective on the potential uses and impacts of the emerging technologies.

Our discussion of the use of biometrics, DNA profiling and body hacking raised the issue of an increasing drive for precision, which is based partly on the explosion in the availability of data. This area of research requires a critical perspective, questioning where and when uses of data are appropriate. For example, if the widespread availability of data for processes such as refugee status determination raise the bar for evidence, where will the 'bar raising' stop? Can we envision a future where every person fleeing persecution is required to have 3D video evidence? Will these data-based requirements provide any advantage to the current process? In other words, are our current decisions so uncertain and are the number of system abuses so egregious, that the cost incurred in using video and other technologies is justified?

In addition to critical analyses of when and where data should be used, the more pragmatic challenges of data sharing also need to be researched. At the organizational level, the institutional context of the humanitarian community must be taken into account. For example, as donors generate many stipulations in the operations of humanitarian organizations, they can influence data sharing. For example, just the ability to acquire and use technology as part of the project budget and not overhead, opened up the possibility for greater ICT use in general.

Research could examine frameworks involving funders to incentivize data sharing and the mechanisms and platforms for helping independent projects agree to share data and establish success stories.

Humanitarian organizations need incentives to share data because they are competitive and in many cases the data they collect are oriented toward operations rather than effectively answering research questions. Also, evaluation data can be sensitive as there is a concern with sharing negative information. This situation creates complexities in sharing information on a one-shot basis versus maintaining continuous access.

Two domains where information sharing is less problematic are data for security concerns and GIS data. Data for security are shared out of comradery and a shared sense of vulnerability. GIS data are shared due to the layered nature of maps, with each organization contributing one

or more layers of location information (schools, clinics, etc.) to make a complete map. Also, open source platform technologies such as Open Street Map help make data more widely accessible. Research might examine how open source technologies or characteristics of platforms can be used to help facilitate data sharing as well as collaborative analytics.

Legal scholarship
Legal scholarship on the role of data in human rights and refugee status determination is required. In particular, research on how current frameworks will be challenged by the availability of data, necessary constraints on the use of data, and where data use should be pursued.

Interdisciplinary scholarship
Interdisciplinary efforts will be a key component of a displacement research agenda. The potential created by technological innovation can only be realized by a holistic approach that includes research on users, organizations and societal change as well as the role of legal frameworks. One example of an interdisciplinary program through which displacement research could be supported is NSF's Big Data Hubs program. Other similar programs that engage a variety of funding organizations that span the continuum from fundamental to applied research are needed to ensure the displaced and their supporters benefit from and are not harmed by new technologies.

Conclusions

The effective use of ICTs by and for refugees will continue to evolve, ideally providing informational support to the displaced when and where it is needed. The co-evolving technical and social domains discussed above will create a continuously emergent environment, one creating many opportunities for researchers as well as potential challenges for practitioners. It is our hope the research agenda proposed herein accurately anticipates these changes and is positioned to help the community both make positive use of ICTs as well as thwart potential negative effects.

Implementation of the research agenda will depend on the concerted and coordinated efforts of researchers, practitioners and funders alike. Transparency, public availability of data and research outcomes, as well as open communication will be critical such that new uses and approaches are open to objective research to establish how technologies can be used in ways that are most effective and beneficial for all.

References

Bhabha, J. (2009). Arendt's Children: Do Today's Migrant Children have a right to have rights? *Human Rights Quarterly, 31*(2), 410-451.

Cheng, J., & Bernstein, M. S. (2015). *Flock: Hybrid crowd-machine learning classifiers.* Paper presented at the Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing.

Commission, U. B. (2015). The State of Broadband 2015: Broadband as a Foundation for Sustainable Development (pp. 97). Geneva, Switzerland: ITU and UNESCO.

Johri, A., & Srinivasan, J. (2014). *The role of data in aligning the'unique identity'infrastructure in India.* Paper presented at the Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing.

Martin, A. K., & Whitley, E. A. (2013). Fixing identity? Biometrics and the tensions of material practices. *Media, culture & society, 35*(1), 52-60.

Pavlik, J. V., & Bridges, F. (2013). The emergence of augmented reality (AR) as a storytelling medium in journalism. *Journalism & Communication Monographs, 15*(1), 4-59.

Rocha, A., Scheirer, W., Boult, T., & Goldenstein, S. (2011). Vision of the unseen: Current trends and challenges in digital image and video forensics. *ACM Computing Surveys (CSUR), 43*(4), 26.

Wu, H., Sun, H., Fang, Y., Hu, K., Xie, Y., Song, Y., & Liu, X. (2015). *Combining Machine Learning and Crowdsourcing for Better Understanding Commodity Reviews.* Paper presented at the AAAI.