Resilience Through Technology Adoption:
Merging the Old and the New in Iraq

Gloria Mark, Ban Al-Ani and Bryan Semaan
Department of Informatics
Donald Bren School of Information and Computer Sciences
University of California, Irvine
{gmark, balani, bsemaan@uci.edu}

ABSTRACT

Citizen response to disaster has begun to receive attention in the CHI community but little attention has so far been given to how citizens use technology to adapt when their country is at war. We report on an ethnographic interview study of how technology was adopted and used by citizens to be resilient during wartime. We interviewed 45 Iraqi citizens experiencing the current Iraq war. Based on our data we identified properties of resilience: reconfiguring social networks, self-organization, redundancy, proactive practices, and repairing trust in information. Technology supported people in being resilient by enabling them to control identity, to collaborate in travel, to create an organizational memory, and to provide alternative sources of news and information. As people adopted and used technology to be resilient we found a merging of old and new cultural practices. We discuss these systemic changes and describe implications for how technology can support people in being resilient in disrupted environments.

Author Keywords

Disrupted environments, technology adoption, culture

ACM Classification Keywords

K.4.3 [Computers and Society]: Organizational Impacts – Computer-supported cooperative work.

INTRODUCTION

In catastrophic events, such as natural disasters and wars, both formal relief groups as well as citizens in the affected area can organize to respond to the crisis [17]. As studies of citizen response to disasters are drawing more attention in the CHI community, we are learning more about the role of

technology in these situations, e.g. [16, 17, 21]. As the use of the Internet, ubiquitous, and mobile information technologies (IT) spreads globally, more citizens can participate in the effort to ameliorate the effects of crises. As global citizens, we feel it is important to examine how different cultures respond to catastrophic events using IT.

Less attention has been given specifically to how citizens use technology as they struggle to adapt when their society is in a war. Citizens in war environments face unique challenges. Disasters are generally considered single events, in time and space, which disrupt a society. Wars, in contrast, involve continual threats over time, from varied sources such as bombs or insurgents, which may last for months, or even years [7]. Citizens living in a country at war face continual risk, uncertainty, and volatility. People must learn to adapt in this climate. We are interested in the role that technology plays in supporting people facing long term disruption in their environment. Our goal in this paper is to examine these two factors—extreme disruption and technology use—in an attempt to better understand how people might be resilient in such conditions. On a broader scale, we are also interested in how these two factors might shape changes in society.

RESILIENCE DURING ENVIRONMENTAL DISRUPTIONS

We report on an ethnographic study of how technology was adopted by citizens and used during wartime. In our study, our informants remained in their regions, unlike people who must relocate to new areas due to evacuations [21]. However, their environment had become very risky and life-threatening, and trust in people and information had eroded. People needed to renegotiate how they interacted with others, traveled to work and school, obtained news and information, and on a broader level, how they continued to be workers, students, and community members in a severely disrupted environment.

This study is part of a larger research program examining how people use IT in order to continue working and living in disrupted environments. In a previous study we focused on how people restructured their daily routines in wartime,

comparing low and high tech cultures [14]. In this paper we focus on examining how technology is used for resilience.

Resilience is the ability of people or organizations to adapt to a surprise event or danger without completely breaking down [11]. Various social properties have been identified that make people and organizations resilient such as robustness, resourcefulness, redundancy, and rapidity [11]. In his analysis of firefighters killed during the Mann Gulch fire, Weick [23] discusses human characteristics of resilience: the ability to improvise, to adopt different roles, to be able to effectively seek knowledge, and to interact with others sensibly. From a group and community standpoint, resilient communities possess characteristics of resistance, recovery, and creativity [13]. Maintaining identity during crises is also associated with resilience; Wall Street brokers who could not sustain their identities after 9/11 could not adapt to smaller crises [6]. However, these studies of resilience have focused solely on social properties and have not examined how technology is used.

The role of technology in crisis recovery has received some attention. Forums and social networking sites were found to be valuable in providing emotional support and guidance during disasters [16, 17]. The role of IT in disseminating relevant information during disasters has also been investigated [21]. Residential moves also disrupt people's lives and IT has been found to be useful to restore and renegotiate social networks [20].

We consider resilience to be the ability to repair old practices and develop new practices when old ones are no longer possible. There has been a clear lack of research on how people appropriate IT to communicate and coordinate with others and to restore social and work life during wartime. If the environment constrains people's actions, IT expands people's opportunities to act. Our goal in this study is to deepen the understanding of how people use IT in disrupted environments to adapt to such conditions.

RESEARCH SETTING
In this paper we focus on citizens living in Iraq during the current Gulf War which began in 2003. Our informants reported dealing with various disruptions to their work and personal lives at the time they were interviewed. First, they faced various difficulties when traveling: 1) the U.S. Army oftentimes establishes road blocks and check-points at certain intervals, slowing down travel and forcing people to take new routes to work and to visit others; 2) militias also set up check-points of their own, forcing people to take new routes; 3) the threat of bombs exploding in the street is a reality, also altering travel habits; 4) the escalating sectarian violence has created dangerous conditions. Second, many people have been forced out of their homes based on religion, and have occupied homes in areas friendly to their religious sect. Third, a random curfew may go into effect lasting for many days, limiting people to travel only within their neighborhood. Fourth, many Iraqis have lost friends and family members to kidnapping and death, and many

people have fled the country. Last, the amenities many of us take for granted living in stable areas e.g. gasoline and electricity, are scarce, thus further disabling people's ability to act as they did prior to the war.

Following Iraq's invasion of Kuwait, the UN Security Council imposed sanctions on Iraq in 1990, limiting free trade with the country (save for medical and some food supplies). Thus, prior to the war, our Iraqi informants did not have access to many technologies. After the war began, however, technology became available and all our informants adopted various technologies in their work and social lives to some degree. We will discuss these later.

METHODOLOGY
Starting in September 2007 we have conducted interviews with 45 Iraqi citizens. All our informants were living in Iraq when the most recent conflict began in 2003, and most of them still reside there today. We used semi-structured interviews divided into two parts, focusing on our informants' lives before and after the war. This allowed us to compare and contrast activities in pre-war Iraq before 2003 with current activities. We asked our informants to describe their routine practices for socializing, working, traveling to work, and other activities that were important to them in their daily lives. We asked how these activities changed since the war started. We focused on technologies that our informants adopted and how they used these technologies in their current lives in the war zone. We also asked questions about trust in people and information in current Iraqi society. Interviews were conducted in English or Arabic; the latter were translated into English. We also obtained video blogs from two of our informants, taken during the war, and which showed their environment. Guided by grounded theory [22], we coded the interview data for patterns of how technology was used to repair activities in work and social life in the current environment.

Informants were obtained using a snowball sampling technique [5]. Our initial seeds came through friends and family, and by searching through video blogs. We asked our informants to recommend others to us to interview. Our goal was to target people who used IT in order to discover how technology was used in the disrupted environment, and given the limitations of access to larger populations for sampling in a war zone, this method allowed us to locate IT users. Snowball sampling has been used in other studies as well that target particular informant groups [20]. Our research team consisted of Arabic and English speakers so we were able to interview informants in either language.

Interviews lasted from one to four hours. This was due to the fact that our informants experienced disruption while using technologies on their end. Our interviews were cut short at times. We always started an interview by phone, and if the connection was severed we then switched to other methods, first Skype or in a few cases IM or email to complete the interview. In cases where we could not

reconnect, we had to continue the interviews on another day.

Our informants were highly diverse, of different ages and professions. They were university professors, translators, journalists, newspaper editors, a graphic designer, and a bank payroll manager, among others. Some informants were unemployed or retired. Seventeen of our 45 informants were university students in various levels, in disciplines ranging from medicine and pharmacy to engineering and computer science. One student was finishing high school.

Most of our informants reported they had not used the Internet or email before the war started in 2003. Ten informants prior to 2003 used restricted Internet and e-mail that were government monitored. The majority of websites were blocked by the former Saddam regime. Two others used only a government monitored pop3 e-mail account before the war. Other technologies, such as cell phones and satellites were banned pre-2003 and not available. After the war started, a wide range of technologies became available in Iraq. Our informants began to use unrestricted Internet, e-mail, mobile phones, flash ROMs, Internet forums, social networking sites, and digital cameras.

LIVING IN A WAR ZONE
Our informants described how their lives were completely different before the war began in 2003. People faced various challenges of living in Iraq under Saddam's regime. Most informants did not feel safe discussing their feelings towards the regime face-to-face because at any time one could accidentally say something incriminating in front of a government sympathizer. They would only speak of such matters with people who they could trust in person. Also, they did not feel secure discussing such issues over the phone, as they believed phone lines were tapped and it was unsafe to speak freely. Outside of this, our informants enjoyed what many would consider a normal life. They traveled to different provinces in Iraq to visit friends and family. They could safely drive to work and school. They were members of various clubs, socialized outside of work and school, played sports, went out with family and friends for meals, went to the theater, etc. This life changed for our informants after the war started. One informant expressed:

Before the war there was safety and we felt secure, but now there is no such sense, there is no such sense of security. We can't go out, we can't go anywhere like we did before.

In 2007, 74% of Iraqis polled reported that their freedom of movement--the ability to travel safely--was bad or very bad, and 75% reported feeling not very safe or not at all safe in their neighborhoods [9]. There are various reasons for this lack of security after 2003. First and foremost our informants are living in a war zone. Bombs create constant disruptions. Explosions from bombs are referred to as "flashes" by some informants, and combined with the threat of militias, kidnappings, car bombs, and constant roadblocks; this has made life in Iraq difficult. Our informants describe this:

Well first... I used to wake up about an hour before work started. I told you it took me about 15 minutes to get to work. I used to wake up somewhere around 6:30 to 7 o'clock in the morning. Now I wake up at 4:30 in the morning, because when I get to work there might be a road block anywhere, or the army might be using the road, and they block the road, and won't give permission for anyone to cross. Or there might be a bomb somewhere along the way the roads will be closed, or there might be some militia holding a street and a hostage, and you can't pass through them. So you have to choose the roads of which you go carefully so you won't get shot.

You have heard also about bombed cars, and killings, and kidnappings, and everything. You can be kidnapped when going outside and shutting your door. Anybody can put you in their car and take you... They were bombing near our house, really early in the morning, the airplanes come... you see bombs in the houses, and women and children were killed, almost everyday, everyday, everyday. Sometimes when I go to my work,..., it is just a chance to live or to die. It is just a chance maybe, a two minutes or three minutes chance. Sometimes I see a car explode in front of me...

The difficulty in traveling has had a major impact on people's ability to socialize face-to-face, as before the war.

But when I get home I become a prisoner in my own home because of security situation in Iraq. I cannot leave the house because it is not safe. I cannot go to plays, or clubs. No one drives and there is no public life no café, no clubs, restaurants.

Well now my life is different. Now I still go to school, but the difference is now I don't go out in the evening, we don't have a social life so we stay at home....

Nothing much has changed. I come home, I have lunch, I rest, I wash up. Sometimes we go out, our social life is very, very limited now. Much less than it was before because of the security situation that we have here. Our social life is almost non-existent now.

Yeah, you're imprisoned in that home, and you really feel you have no life at all, because you only have access to life through these channels, through these satellite channels, the cell phone, and the Internet, but you have no social interactions now with people.

Our informants reported that sectarian violence has disrupted their lives further. People fear being attacked because of their religious sect. Revealing one's identity to strangers or in public is dangerous.

Without any question, without any reason you are killed. Just you are from this sect or that sect. And by chance you go to a street and that street is guarded by that special sect, they ask your name or your identity and they will kill you easily! Without any question.

Whereas most of us do not think each day about how many hours of electricity will be supplied, or if gasoline will be available, the situation in Iraq is quite different. All our informants reported the lack of infrastructure providing electricity, which is only available one or two hours a day.

As a result of these various disruptions, people can no longer organize or plan their lives as they once did. Instead, the disruptions dictated what they could do:

You can't organize anything in Iraq. You don't know what happens in the next moment. For instance, I'm talking to you now, but the army may enter my house any minute and start turning things over to look for weapons.

...you wake up whenever you wake up, you go to sleep whenever you go to sleep, and you actually don't have routine in your life now because you can't have a routine when you've got planes going overhead and bombs going off, and all these sounds, and you've got the electricity being cut off and you've got the... So you sleep when you can, and you get your job done when you can... or your housework done when you can.

PROPERTIES OF RESILIENCE

An important change that occurred in 2003 when the war began was the introduction and adoption of technology. We discovered that our informants used technology to create resilient practices, and in some cases, resilient environments. Based on our data, we identified properties of resilience that are related to technology use. We illustrate these properties by describing how our informants negotiated different activities in the war zone: forming personal relationships, conducting economic transactions, becoming self-reliant on resources, information seeking, and pursuing education.

Reconfiguring social networks

One property of resilience that we found is using technology to reconfigure one's social network. Technology is the only way that Iraqis could interact safely in the war zone due to the risk in travel, curfews, and the lack of trust in face-to-face settings. Forty of our 45 informants stated that the most disruptive part of the war was their social life. Informants sometimes referred to being a "prisoner" in their homes.

The Internet became a means for Iraqis to achieve a social life in a war zone. Our informants were unable to meet face-to-face as they did prewar and they transferred their socializing behavior to the Internet. Further, it was common for relatives and friends to have left the country. Our informants reported that they are now using the Internet to maintain relationships both within and outside Iraq, to find new friendships, companionships and even love and marriage. Scores of online forums developed for Iraqis to meet and discuss a wide variety of topics: politics, sports, music, etc. [3]. They are also meeting and courting people in forums and other Internet sites, e.g. social networking

sites such as Myspace. What is new in the current Iraqi society is that by reconfiguring their social networks through forming friendships and dating online, it breaks the Iraqi cultural tradition of meeting, socializing, and marrying based on community ties, e.g. through family or school friends [9].

In some cases, forming relationships still rely on old cultural practices, except they are now blended with new practices as a result of using the Internet. Prior to 2003, couples came together either because they were introduced formally through acquaintances or family, or perhaps they met at school. The marriage process is then usually initiated by the groom's family and culminates with male members of both families meeting to discuss the prospect of marriage. Courtship was typically conducted face-to-face.

However, now, due to the difficulty in traveling to meet face-to-face, and with the introduction of the Internet in Iraq, the courtship process is changing. One informant, an engineer, told us of his experience in dating and courtship that was conducted online. He met Raya[1] in an Iraqi online forum, where people chat on a diverse range of topics. They initially met in a public chat room but soon took their discussions to a private virtual space using IM and SMS to keep in constant contact with each other. Their relationship continued for five months before our informant decided to take the next step and propose, without ever having met Raya in person nor having seen a picture of her.

Our informant lived in Baghdad. Raya is a second generation Iraqi-born Palestinian currently residing in another Middle Eastern country with her family. Her brother, the eldest surviving male member of the family, moved to Egypt. Following Iraqi cultural tradition, our informant traveled to Egypt to meet Raya's eldest male family member to formally ask for her hand in marriage. Marriage for Iraqis, as for most Arabs, is both an individual and a family matter [18]. Technology was a new practice for courting, used to meet another without family involvement. The couple did follow the traditional process of the male suitor asking for her hand in marriage face-to-face. Unfortunately, her family rejected him because he is Iraqi. He has not pursued other potential long-term relationships hoping that he will still marry her one day.

Not only were Iraqis resilient in changing their socializing from face-to-face to online, but we discovered that some informants began to meet others outside of their kinship networks and even others who were not Arabs. They began to meet and even court others from different nationalities and races, a practice that was challenging before the war, and before technology was introduced. One female informant met Tom, her current American fiancé, through Myspace. She initially started interacting with Americans online because she wanted to find out more about them,

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[1] All names are pseudonyms.

which was not possible to do face-to-face in the current climate of unrest. Westerners, Americans in particular, are perceived by many as occupying forces. Women in Iraq are especially subject to the demands of increased social conservatism. Meeting westerners would threaten gossip that would tarnish their reputation [2].

This informant, a medical student, started conversing with foreigners through Myspace to find out more about their culture and their traditions. She interacted with both military and civilian Americans to help her see things from their perspective. Ultimately she met Tom and while conversations were initially about the situation in Baghdad they started discussing other topics during the following months. Tom is a civilian engineer who worked in Iraq for a period of time and thus they were able to meet in the sanctuary of the Green Zone. He has since gone back to the U.S. They managed to meet again in Turkey for two weeks. She has recently traveled to Turkey once more with her family, and meeting Tom with her family is consistent with old cultural practice. In the meantime, they speak on cell phones and still chat on the Internet, a new practice.

In both of these examples we find that our informants have utilized technology and brought people outside their communities into their social networks. Their behaviors are also beyond the accepted norms of urban Iraqi society. Our informant told us that while he intended to declare his emotions, Raya "trumped" him and did it first. In both of these cases, the partners met only because they were both active in the same forum. Given the current lack of security, the negativity in which Americans are regarded by Iraqis, and the suppression of women in particular, it would have been extremely unlikely that they would have been able to meet face-to-face without the use of technology.

Our informants reported that they also began to use technology for economic transactions among people. Whereas westerners might wonder why this is an unusual act, it must be stressed that selling online in Iraq was virtually unheard of before 2003. Credit cards do not exist; only cash transactions are done face-to-face. However, meeting face-to-face was risky. One informant, a dentist, described how he was able to sell his car with the aid of technology. He told a friend that he wanted to sell his car. The friend mentioned it to his neighbor who was interested. Our informant emailed a photo of his car to his friend who showed it to his neighbor. The buyer and seller then negotiated the price by cell phone. Once an agreement was reached they met, only once, to finalize the deal and the buyer paid cash for the car.

Both the friend and his neighbor lived far from the seller. Because of the difficulty in traveling they were unable to meet in the traditional way through a car dealer or by meeting face-to-face several times (e.g. to inspect the car, take it to a mechanic, or bring a mechanic to the car to inspect it). The amount of face-to-face interaction was limited here because of the lack of security. Our informant

adhered to the norms of traditional transactions by selling his car to someone in his immediate circle of friends. He did not, for example, attempt to advertise the sale of the car on an Iraqi forum. Thus, through the use of technology our informant was able to follow a typical cultural practice.

Students also turned to the Internet as a way to interact. Our informants reported that students did not trust meeting other students even on campus. In a previous study we described how Iraqi medical students began to interact in an online forum [14]. The forum has hundreds of members including women. Whereas prior to the war women were accustomed to traveling alone, and enjoyed the same rights as men, women in Iraq today now face several challenges as a result of the recent migration towards religious conservatism in Iraq. Many women do not feel safe leaving the safety of their own homes as they may face persecution [2]. The forum enables them to interact with others without harming their reputation.

A systemic change occurred as a result of the forum. The forum evolved so that in addition to medical school topics, students now also discuss other subjects such as health, college affairs, entertainment and even jokes. Students also began to discuss sensitive issues not normally discussed in a face-to-face setting such as women's rights, violence against women, love, online relationships, religion, and homosexuality.

Self-organization
A second property of resilience that we discovered was self-organization. Our informants were resilient in creating communities that were self-reliant and robust against disruption. Our informants described how within their communities they self-organized sources of electricity, independent Internet Service Providers (ISPs), and coordinated traffic information networks. Though self-organizing did occur prewar, it was not as prevalent as it is today. Prior to the war, actions were very controlled and people needed government approval for any type of organizing.

An important means of being resilient in travel were self-organized cell-phone information networks within communities. Currently various sects and parties set up roadblocks which are indiscernible from each other. According to our informants it is not possible to tell if the roadblock is set up by the government or the U.S. or operated by militia. The consequences of being stopped or not stopping at a roadblock could be dire [12]. However, in order to go to work and to attend classes our informants described how they started using cell phone networks in which individuals would call others within their community (e.g. their neighborhood, workgroup, or university) who they knew would be traveling the same route where they had just encountered a roadblock. Students called to inform others that there were no classes because of roadblocks or to explain less time consuming alternate routes. One engineering student explained how he utilizes his cell phone

not only to reassure his family of his well-being but also to stay informed of cancelled classes. Our informants explained that they used their cell phones to help others avoid dangers and delays they have encountered or observed on a designated route. One student described that through this network he "*hears everything that is happening*" which helps him decide which direction is the safest. Some informants describe their cell phone networks:

"*...a friend of mine calls me, and says I'm in college now and nobody's here, so you don't have to come, for example. Or like he tells me if there's no school… sometimes they postpone it... those kinds of things.*"

"*For instance I have some Shia friends and they go to work and there might be some Shia militia, and they know I'm Sunni and they'll call and warn me. And vice versa that would happen also. We would use SMS and voice. We never heard about it [before 2003].*"

This phenomenon emerged as a result of the war. This cell phone network shows resilience developed through collaborations within neighborhood and work communities to overcome the constraints imposed by war. Prior to the war there were few physical constraints on travel; people could safely and readily travel and interact face-to-face.

Redundancy

Redundancy enables resilience by enabling the substitution of resources or systems if any fail [11]. Our informants created redundancy with their infrastructures. Knowing that power outages would occur, or that the Internet network might go down, they self-organized alternative power and network resources.

Electricity power stations were targeted by both the Allied forces and later by militias determined to gain power. Efforts by subsequent governments to re-build the power stations have still not met the increasing demand [15]. Consequently, all our informants report that individuals within their neighborhoods sought to provide electricity to people in their neighborhood through a network of makeshift wires in return for a monthly flat fee.

What is especially interesting is that they made sure to create redundancy with network resources. Our informants often referred to their neighborhood ISPs. These are individuals residing in the neighborhood who made the Internet available for a monthly fee. The ISPs typically set up Internet connections for houses within a certain radius. As Internet introduction was fairly recent, the fact that the community members set up an independent ISP shows their reliance on the Internet. It served as a basis for carrying out other resilient practices such as maintaining and forming relationships online. In fact, some informants reported considerable risk and effort in meeting face-to-face with the ISP to set up Internet. Creating alternative infrastructures enabled community members to be robust in their other practices if future disruptions occurred.

Proactive practices

As it was difficult to travel to the university, we discovered that students collaboratively created a resilient educational environment. Ten of our student informants (the majority were medical students in Baghdad) reported a new practice where students proactively collected course information, converted it into digital form, and gave it to their peers when they could not travel to attend lectures. They used a variety of technologies, unavailable prior to 2003.

Before the war, it was common practice for people to use photocopiers to copy and share lecture notes ad hoc. What developed after the war was a systematic and coordinative effort to make course materials available using digital technology. Here are some examples of ways that students distributed information. One student explained how students had to attend lab sessions to view microscope slides, but not enough microscopes were available. Students began to make digital records of the microscope slides. These were then distributed in class by professors, placed in a central office, or passed out by students to their peers. This became a collaborative effort in dividing up the task to capture and share the information.

...eventually, all of us needed the copied lectures… it became more important to people who couldn't come. It was their only way to study and pass.

Another medical student described a new collaborative practice of recording hospital rounds with a digital recorder. She and her colleagues attended practical sessions, where they made rounds with the doctors in the hospital, shadowing them as they visited patients. The doctors would lecture during these sessions, and because she could not write fast enough, she started recording these lectures on a digital recorder. She then passed these recordings on to her peers who could not make it to hospital rounds. Still another informant found a way to help himself retain medical concepts. He began creating animated films and gave them to others either on CDs or memory sticks.

The above are examples of proactive copying of information so that it would be available in case students could not travel to the university. One informant, a lecturer at the university, began a similar new practice of proactively making his lecture notes available. He searched for material on the Internet that could benefit his students, such as useful hyperlinks, and also obtained animations on the Internet that would help illustrate concepts in his classes. He then put together presentations he would show on a laptop in class. He would then burn this information on CDs and distribute it to his students after lecture. His reasoning for using links and animations was to make the concepts easier to learn if students had to read his lectures on their own due to their inability to travel to class.

These new practices contributed to creating a resilient educational environment where, if people were unable to attend hospital rounds, labs, or lectures, they could turn to

digitized materials in order to continue being a student. These activities were also embraced by the university.

Repairing trust in information

Information scarcity is a critical problem during disasters [16]. In Iraq, a different type of problem arose, namely the breakdown of trust in information. Whereas before the war, the media reflected a single government voice [19], our informants reported at the time of their interviews that *local* media was generally controlled by sects, sub-sects and various political parties each with their own agendas. Our informants described that they generally distrust the news from local media and consider these news sources biased. One informant, a graphic designer, describes this distrust and even expresses confusion:

"[I] used to read the newspapers before and there used to be a single point of view, which was the government's point of view, but now you've got newspapers that have been organized and published by any group of people, and each of these groups has a different point of view, and they… they have contradicting viewpoints. Getting a clear idea of what's happening and what to believe is very difficult."

After 2003, a range of media became available for news: satellite channels, countless websites, newspapers and radio channels. Most of our informants described how they repair and maintain trust in news by cross-checking information across several sources using both technology and word-of-mouth. Iraqis traditionally gather news from word-of-mouth; now their practice has changed. Our informants explained that they cross-check with other news sources and with other "trusted" people who may be eyewitnesses to the local events. A computer scientist informed us that she distrusted local Iraqi sources in particular, a sentiment shared by many of our informants. Others stated that they only trusted news from people who were actually present when an incident occurred (e.g. a bomb). One informant stated that he relies on word of mouth from people he knows; he disbelieves official sources. Some relied on traditional news sources (e.g. newspapers) combined with new technology (e.g. satellite channels) as well as word of mouth. One informant, with a long career in publishing, told us that he cross-checked news items of interest across multiple sources (satellite channels, newspapers, websites) in addition to discussing it with others who may have actually seen the incident or know of someone who did. Another informant, a journalist, relies on multiple news sources (e.g. blogs, newspapers, television channels), in an attempt to "know" and will wait up to a week to judge if news is false.

Cross-checking news and information was problematic before 2003. Our informants explained that only news that was in line with the government was made available to the general public. One informant resided in the North of Iraq prewar but attended college in Baghdad. She was able to obtain news from neighboring countries (e.g. Turkey) when in the north but was unable to confirm the news with close friends in Baghdad who only had access to the local government owned news sources. Foreign radio channels with negative reports were typically blocked. Thus, the ability to cross-check and verify information using both technology and word-of-mouth is a new practice for Iraqis and contributes toward repairing trust in news information.

DISCUSSION

Our goal in this paper was to understand how people used IT to be resilient in severely disruptive conditions. Previous studies that have identified properties of resilience have not considered the role of IT [11, 13, 23]. We found that as the environment imposed constraints, our informants used technology to devise practices that enabled them to adapt to the environment and even be productive.

Though our informants were continually faced with safety concerns they also began to address other social needs over time. As we described, nearly all our informants reported that the most disruptive aspect of the war was their social life. We identified the ability to reconfigure social networks as a property of resilience. Technology supported the ability to socialize in several respects. First, technology enabled people to continue to socialize by providing a direct connection to family and friends with who they could not meet face-to-face (not only due to risky travel but also because many left the country). However, our informants also expanded their social network by meeting new people online. Their expanded network exposed them to others outside their culture and war zone which provided them with different perspectives about their situation. Technology provided more though than just connecting to others. It enabled them to act in ways that were not possible face-to-face. Whereas our informants could not trust strangers in person, they could easily meet others in a virtual environment without fear of harm or, in their culture, tarnishing their reputation. Control of online identity--being anonymous or revealing identity—was an important factor for coping in their environment. In face-to-face encounters identity was public and this exposed them to potential harm from someone of another religious sect or political party. Anonymity also enabled many of our informants to express themselves freely without fear of retribution. In our view these are important attributes of technology that helped our informants cope with their environment.

Another property of resilience that we identified was self-organization. Technology supported people in self-organizing a travel communication network to avoid roadblocks and find safe routes. Technology made this network powerful. First, the obvious reason is that technology enabled communication of travel routes by people who were at a distance. But a more notable reason in our view is that we found cases where collaboration occurred across religious sects; for different religious sects to communicate in person would have been potentially dangerous. Through this communication network, which

extended beyond religious and kinship ties, people could expand their communication and thus increase opportunities for safe travel.

Whereas self-organization has been discussed before as a feature of resilience [23] our study highlighted how technology played a role. It is important to stress that our informants self-organized for solutions rather than waiting for instructions from a central governing power, e.g. [4]. The government, for example, did not establish a means to notify people of delays on certain routes because of explosions or blockades. The university did not organize dissemination of course materials. The Iraqi people have lived for a long time under centralized government control; self-organization is a very new type of practice.

The medical students who copied and disseminated course materials for their peers not only self-organized but they pro-actively constructed a robust learning environment in anticipation of future disruptions. Weick [23] refers to a virtual role system as a property of resilience. The medical students in our study became a self-organized system where they interchanged roles. Whoever was able to make it to class took on the role of making course materials available to others (in digital form). To do so the students had to collaboratively adopt technology to effectively produce, exchange and view the materials. The students converted ephemeral lectures and hospital round discussions into pervasive digital form in anticipation for when students could not be physically present. They created an organizational memory for students. We thus found that proactive practice is important for resilience in continually disrupted environments where adverse events may happen at any time. Technology enabled the students to proactively capture, store, and distribute information.

We also found redundancy to be a property of resilience in our study. The resilience story of our informants' effort in creating backup power generators and network infrastructure was not that these acts were aided by technology bur rather it was to make the Internet *available*. In our view their effort actually represented concerns beyond having electricity for general use. Resources were precious: they were very limited and expensive. The fact that our informants used scarce electricity for the Internet (e.g. instead of powering fans or appliances) demonstrated the importance of the Internet to them. Infrastructure provided a means to socialize, to continue education, to receive news, and more.

Discussions of resilience have not directly addressed the role of trust [6, 11, 23]. In environments with high uncertainty, trust in information or people can easily erode, as in the case of Iraq. Repairing trust in information is essential in disruptive settings to reduce the uncertainty in the environment. Technology helped repair trust in news and information by providing alternative sources but importantly the repair of trust also involved people. Thus, multiple media sources or the Internet alone were not sufficient for news. Media reports needed to be validated by individuals who are trusted or who witnessed events.

Merging old and new practices

There has to our knowledge been little discussion on societal changes that occur as resilient behaviors are developed. Our informants were in a situation different from what most studies of resilience target, which is response to a disaster or a single catastrophic event [16, 17, 21, 23]. They needed to adapt to continual long term disruption.

The adoption of technology in Iraq is staged within a very complex context. Technology is being adopted rapidly as Iraq struggles to catch up with the rest of the world after being cut off from technology by the former regime. As our informants were fairly quick to embrace the new, at the same time they did not readily give up old practices.

We found that Iraqis have started to blend together long-lasting cultural traditions with new practices that evolved with the adoption of technologies as they developed resilient practices. Iraqi cultural practices of meeting, courting, selling goods, and traveling are traditionally based on strong kinship ties. With the adoption of technology Iraqis are expanding their social network beyond their traditional family and class network [2]. In the case of dating, they are not only dating outside their kinship networks but are becoming more independent by introducing themselves to friends and potential partners online, as opposed to relying on their kinship network to formally introduce them. Using technology is leading to other societal changes as well. With technology women could act in a manner outside of their expected societal roles, as in the case where Raya revealed her emotional feelings first. The virtual environments created by the medical students for disseminating course information evolved and changed in character to become much more than just coursework repositories. They became places for discussions of issues that were not possible face-to-face such as discussing homosexuality.

Iraq, as an Arab culture, is characterized by Hall's cultural framework as "high context" [24]. High context cultures have a great deal of shared knowledge, as when interaction occurs within kinship networks. However, in their acts of resilience, and with the adoption of technology, our informants often interacted with others outside of their kinship network, where common assumptions are shared. We are observing a process of adaptation away from a high context culture, where more information needs to be made explicit. Perhaps this might explain why we found so many cases where our informants merged their familiar cultural practices with new technology practices in this process of change. For example, local news received through media channels were verified with individuals who they trusted (a high context characteristic). Our informant sold his car via email but only to someone recommended to him.

These societal changes may not be driven by resilience directly, but are perhaps an indirect result of using the Internet to act. Though traditional practices could have continued to be practiced on the Internet, they evolved. Thus, technology is not only enabling Iraqis to develop resilient practices, but the process of adopting it and adapting to their environment may be leading to deeper systemic changes in Iraqi society.

Implications for resilience
Most studies of technology use in crisis situations have been done in western countries where issues such as kinship ties or a long history of centralized control are not prominent. Thus, from a practical standpoint, developers and practitioners of technologies designed in western cultures need to be culturally aware of how nonwestern cultures will adapt to technology introduction, especially if technology needs to be adopted rapidly to aid citizen response to a disruptive situation. For example, technology can be designed to support the expansion of social networks in nonwestern cultures by utilizing kinship networks and their connections (i.e. friends of trusted friends).

Iraqis have lived under centralized governmental control for some time; self-organizing is a new practice for them. Though we found Iraqis self-organizing with infrastructure and with disseminating course materials, these acts involved face-to-face interaction. We should not assume that self-organizing can occur in purely online interaction as in the case of western countries [17]. More research is needed to understand how people in countries who share similar histories of centralized control might self-organize online.

Our data also suggests technology design that could apply to a range of disrupted environments. Best practices for adaptation can be shared online. Social-networking sites can also be used to match people with resources (e.g. Internet access, electrical power or cars). The potential of mobile devices for supporting resilience needs more exploration since they are so ubiquitous in nonwestern countries. As such technologies continue to become more robust, they can be used in several ways. First, they can harness the power of social networks and provide awareness information to others via status updates (e.g. if they are safe), as with microblogging to the Internet. Second, GPS-enabled phones can be used to communicate to others where disruptions are (e.g. bombs or roadblocks), to locate others' positions who are in one's social network, and to map safe travel routes. Last, the ability to transfer work related documents via mobile technologies becomes increasingly important. Additionally, because unanticipated events occur, developing proactive work practices, such as capturing and storing ephemeral information, would enable people to develop resources that can be utilized repeatedly.

Trust in information during crises is another important research area that needs more attention. Technology can play an important role in increasing trust in news by enabling people to verify news information online. For example, technology should enable people to establish and vet reputation online to be trusted experts [1] or find event witnesses so that people can expand their radius of trusted contacts online. The use of online forums can be explored with information discrimination and sharing, i.e. where people can collectively share and edit information.

Generalizability and Limitations
As our study was conducted in a nonwestern country we must ask, to which groups can our results generalize? We argue that our results on properties of resilience can generalize quite broadly, across different cultures. Other studies of disasters have shown that western cultures use technologies in new ways [17, 21], and our results can build on this. Regarding the merging of old and new practices, we feel that the results are likely generalizable to a nonwestern culture where technology is not yet widespread.

Our study has several limitations. First, our informants have been living in a disrupted environment for over five years, since 2003. It could be argued that much of what they reported about their routines and activities before the war is inaccurate. However, research has shown that people are very good at recalling typical activities over time fairly accurately [8]. Therefore, because we had asked informants about their recurring familiar routines and activities we feel that their responses were reliable.

Second, we observed various changes in society and we must be cautious about our attributions. For example, we cannot say whether people are meeting others online because they cannot socialize face-to-face, or whether it is due to the introduction and novelty of the Internet. We believe that the disruption in the environment served as a trigger to lead people to use online resources. For example, a large proportion of Iraqi women are confined to their homes to avoid acts of violence against them [2]. Consequently, it is less likely that women can meet others at work or school. It also means that Iraqis find it difficult if not impossible to socialize and meet others to form a lasting relationship that can lead to marriage. Thus, we argue that because people are unable to travel in order to work and socialize as they were once accustomed prior to the war, they have turned to technology. Some of our informants have reported that they preferred life before the war where they could socialize freely and possessed restricted access to technology, as opposed to the life they have now. These issues need further research.

Third, by virtue of using the snowball sampling technique [5], our results can only be generalized with caution. All our informants were educated. They also had access to a range of technologies. However, their training and professions were diverse, e.g. students, professors, doctors, translators, journalists, and more. Therefore, we believe that a range of similarly educated people would behave with technology in a similar way as our informants. It is not our goal to generalize these results to all people or cultures, but

rather the goal of our study was to understand ways that people can use technology to be resilient. We hope that the properties we identified can drive further research.

CONCLUSION

To our knowledge, no other study has addressed the HCI aspects of resilience during wartime. Resilience is about being able to continue activities when there are constraints, as well as understanding how these actions can be taken. Technology expands the options and the reach of citizens who are experiencing disruptions in their settings, enabling them to have a wider choice of actions.

We are living in a global era yet too few studies address how nonwestern cultures adopt technology. One of the lessons learned from this study is that western cultural practices, as introduced with technology adoption, may not translate well into nonwestern cultures. This is especially significant if a culture might need to adopt a technology rapidly to cope with a disaster. We hope that this study can spark further research into the HCI aspects of technology use in resilience.

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