

HCI for Peace: A Call for Constructive Action

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ABSTRACT

Peace is an important value for the human-computer interaction research community, yet it has not resulted in the development of a research sub-community or even a research agenda. In this paper we seek to address this void by first motivating the need for computing research on promoting peace and preventing war. We then review evidence on the factors that affect the likelihood that armed conflict will occur, as well as the aspects involved when individuals make moral decisions on whether or not to support a war. Based on this review, we propose a research agenda, citing research examples from the human-computer interaction literature and discussing new ideas.

Author Keywords

Peace, war, causes of conflict, empathy, compassion, software, technology, research agenda.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. K.3.1. Computer uses in education. K.4.1. Public policy issues.

General Terms

Human factors.

INTRODUCTION

We are members of the human-computer interaction community interested in using computing technologies to promote peace and prevent conflict. This paper aims to highlight and celebrate work already done to this end and to encourage further research with peace as its explicit goal. We hope this call to action continues community-wide discussions from which positive action can spring: our world can be no brighter than the worlds we dream of. We seek to create the conditions for peace by both promoting the precursors of peace and decreasing the known causes of conflict. The human-computer interaction community is uniquely positioned in the computing world to affect

change in this arena, its focus not only on the user sitting in front of a screen, but on the effect of technology on humanity at a societal and global scale. As 1997 Nobel Peace Prize winner Jody Williams demonstrated through her use of email to help coordinate the International Campaign to Ban Landmines [10], computer technologies can play a positive role in promoting peace. In the human-computer interaction community many research efforts have focused on precursors of peace. These include projects promoting education in developing regions (e.g., [46][57][58]), and supporting democracy through transparent, understandable, easily audited voting systems (e.g., [35][68]). There are many additional opportunities for research including the design of technologies to enable connections between opposing camps, tools to present news stories from several points of view, and technologies to support international monitoring missions to prevent the escalation of conflicts.

We saw an additional indicator of the importance of peace within the human-computer interaction community during CHI 2010. At the conference, 500 attendees became peace ambassadors, wearing peace ribbons on their name badges and engaging with other attendees in a discussion of how computing technology can be used to promote peace and prevent conflict. About 50 peace ambassadors gathered for an impromptu brainstorm for peace during the last day of the conference, generating many ideas on how the human-computer interaction community can design technologies that have peace as an explicit goal.

In this paper, we focus on peace in regards to preventing armed conflicts. In the following sections, we further motivate the need for research in this area, discuss related work and initiatives, and propose a research agenda based on our peace brainstorm and focused on the antecedents of peace at a socio-political level as well as at an individual level. Our intention is to motivate constructive action in this area and begin to build a research community dedicated to technologies to promote peace and prevent conflict¹.

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¹ Part of the paper is based on a previous publication in alt.chi (not an archival venue) [38].

² This section of the paper was inspired by Jonah Lehrer's

WHY PEACE

There are very practical reasons to pursue research on promoting peace and preventing conflict. Even the military recognizes this. For example, the 2008 National Defense Strategy, prepared by the United States Department of Defense states that “military efforts to capture or kill terrorists are likely to be subordinate to measures to promote local participation in government and economic programs to spur development, as well as efforts to understand and address the grievances that often lie at the heart of insurgencies” [16].

This last statement makes it clear that peace is not just a goal for idealists but also for pragmatists. Nobel Prize Winner Joseph Stiglitz, for example, has estimated that the Iraq war is costing every household in the United States 138 USD a month, and that by 2017 the United States will have paid 1 trillion USD in interest for the money borrowed to pursue this war [20]. Studying war in developing regions, Frances Stewart, an economist at the University of Oxford, also discusses the devastating economic impact of war, with most of the poorest countries in the world currently or recently involved in violent conflicts [69].

Notwithstanding the economic costs of war, the most horrible costs are in terms of human lives. The most atrocious example in recent history is the civil war in Rwanda that cost the lives of about 500,000 people and is still having negative consequences in neighboring Congo [18]. In addition, during the 20th century no less than 87 million people died as a direct consequence of war, a number that does not include the more than 150 million civilians deliberately put to death due to doctrinal hatred or passions [9].

PEACE AND COMPUTING RESEARCH

Given the increasingly ubiquitous nature of digital technology in people’s lives, many in the human-computer interaction community have promoted the use of computing to pursue specific values or agendas. Examples include research on technologies for environmental sustainability [8], feminist approaches to design [4], and the development of technologies for social activism [23][24].

When it comes to peace, Ben Shneiderman has long been a strong and consistent voice calling for the use of information technologies to promote world peace, arguing that peace should be part of a social impact statement in every human-computer interaction project [64]. BJ Fogg taught a peace innovation course at Stanford and has recently began the Peace Dot initiative, encouraging organizations to create a “peace” subdomain for their websites [25]. There have also been a few specific projects with the express purpose of promoting peace, which we will highlight as examples when discussing our proposed research agenda. In spite of these efforts, there is currently no research sub-community within human-computer interaction dedicated to peace, and a search for the word “peace” in the ACM Digital Library yields no papers with

at least five citations on the topic of promoting peace and preventing armed conflict.

Outside the human-computer interaction research community, the *ICT for peace foundation* is dedicated to supporting the international community in managing crises through the use of information and communications technology [42]. This foundation has strong links to international organizations such as the United Nations. Other organizations, such as the *United States Institute of Peace* and *World Peace Through Technology*, support the development of technologies for peacebuilding and benevolence [71][73].

The most comprehensive proposal for conducting computing research on peace actually came from one of the parents of computer science as an academic discipline. Just a few months after the Cuban Missile Crisis, Louis Fein wrote a paper titled *Computer-Oriented Peace Research*, which proposed the creation of the *Peace on Earth Research Center* (PERC). His vision was for PERC to construct computer models to provide a better understanding of the problems that cause armed conflict and through this understanding develop solutions that could prevent future conflicts [22].

The past 10-15 years have seen a large number of publications that have addressed Fein’s first challenge by conducting statistical analyses of empirical data on conflict to better understand the risk factors associated with war. This research, together with the increasingly ubiquitous nature of computing technologies provide a unique opportunity for human-computer interaction researchers to make a difference in designing technologies that prevent conflict and promote peace.

In addition, recent research in neuroscience is increasingly providing a clearer picture of how humans make moral decisions that involve empathy and compassion, including decisions concerning war and killing other human beings. This recent research can also provide inspiration to design technologies that make people aware of the humanity of perceived enemies when making decisions about war.

SOCIO-POLITICAL CAUSES OF WAR

Factors that Increase the Likelihood of War

In an article in the *British Medical Journal*, Stewart provides an overview of findings on the causes of armed conflict in developing countries, which have been the costliest in human lives in the past 50 years [69]. A cause she and others highlight is private motivation (e.g., economic benefits of joining armed groups, looting, and illicit trade). The main proponent of this idea is Collier, who found that economic opportunities are more likely to drive civil wars than grievances. His point is that civil wars will not occur if rebel organizations cannot be financially viable. Collier found that countries that heavily depend on primary commodity exports are much more likely to experience civil wars because it is difficult to ascertain the

origin of these commodities and they can be more easily commercialized [11][12][14]. Private motivation is not limited to causing wars in developing countries though. In his 1961 farewell address, United States President Dwight D. Eisenhower cautioned against the “unwarranted influence” of the military-industrial complex and encouraged “an alert and knowledgeable citizenry” to ensure that such a powerful entity remained compatible “with our peaceful methods and goals” [21].

A second type of cause cited by Stewart is a failure of the social contract (e.g., low incomes, short life expectancy). Collier, for example, found that rapid economic decline increases the risk for conflict by increasing the financial incentive for participating in an armed conflict [11][12][14]. DeRouen Jr. and Goldfinch also cite social unrest as a cause of violent conflict [17].

A third cause for conflict cited by Stewart is environmental stress (e.g., lack of resources). Homer-Dixon studied how environmental scarcities can contribute to violent conflicts citing examples in Senegal, Mauritania, Israel and the West Bank, Nicaragua and other countries [37].

A fourth factor Stewart mentions and that often comes first to mind is inequality (e.g., political access, economic, social, gender). While economic inequality is often part of the grievances brought up to justify violent conflicts, it does not appear to be a good predictor for conflicts [11][12][14]. Cramer provides the example of many countries with high levels of inequality (e.g., Panama, Brazil) that have not recently experienced civil war [15]. There is evidence though, that gender equality reduces the likelihood of intra- and inter-state armed conflict [56].

An interesting dimension of armed conflicts is ethnicity and other kinds of identities. DeRouen Jr. and Goldfinch found that inter and intrastate conflicts are more likely to become violent if there is an ethnic dimension to the crisis [17]. Sambonis argues that there is a difference between ethnic/religious (identity) wars and those that are not. Through a statistical analysis of civil wars, he concludes that identity wars are mostly caused by political grievances and are unlikely to occur in democratic countries [62]. Surprisingly, Collier found that ethnic and religious fractionalization reduced the risk for conflict. However, having the largest ethnic group constitute 45-90 percent of the population increased the risk of civil war. Collier speculates that ethnic groups constituting such a fraction of the population have the means and the incentive to exploit other ethnic groups [11][12][14].

Collier cites other risk factors for civil wars including having a high proportion of young men in the population and partially democratic governments [11][12][14]. DeRouen Jr. and Goldfinch add other risk factors including contiguity to an adversary, a violent trigger to the crisis, and chronic and severe problems [17]. Demonstrating the complexity behind the sources of conflict, Kenyon-Lischer provides evidence of how humanitarian aid can sometimes

contribute to conflict if it is, for example, provided to refugee camps that are used as military bases by armed groups [47].

Factors that Reduce the Likelihood of War

The most consistent finding in the literature is that fully democratic countries are less likely to have civil wars and participate in armed conflicts with other countries [11][12][14][17][60][62].

A better-educated population reduces the risk of armed conflict. Studying data on 152 countries for the period between 1965 and 1995, Collier found that each additional year of education reduces the risk of civil war by about 20 percent. He also found that economic growth and high incomes reduce the risk for civil war [11][12][13][14].

Alice Ackermann discusses the history and current practices of international conflict prevention, from the Congress of Vienna in 1815, to the Marshall Plan and the various roles the United Nations has played. Ackermann distinguishes between two types of conflict prevention practices. Operational prevention is aimed at imminent crises and includes actions such as fact-finding and monitoring missions, negotiation, mediation, facilitating dialogue between the parts and confidence building measures. A recent example is what was done to prevent an escalation of the conflict between Georgia and Russia in 2008. Structural prevention aims to prevent conflicts in the long term through actions such as facilitating governance, increasing the respect for human rights, improving educational systems and economic opportunities, and promoting democracy [1].

The research in this section provides empirical evidence on the socio-political causes of war. In the following section, we discuss the role of personal decisions and compassion.

PERSONAL DECISIONS AND WAR²

Recent developments in neuroscience are relevant to how armed conflict occurs at a micro level, in particular with regards to what makes it easier for individuals to decide that a particular war is necessary and to make the decision to kill another human being. In this section we discuss how compassion is triggered in human beings, and how it is being systematically removed from decision-making in war-related situations.

Neuroscience and Compassion

One way to understand compassion is to learn about people who lack compassion. Psychopaths are people who have perfect use of reason but who do not experience emotions in the face of fear or suffering on the part of fellow human beings [7]. In other words, psychopaths lack compassion.

² This section of the paper was inspired by Jonah Lehrer’s book *How we decide*, in particular the chapter titled *The Moral Mind* [51]

For example, a study by Blair [6] looked at how psychopaths compared to other violent offenders in judging conventional and moral transgressions. In the study participants were presented with scenarios taking place in a school. Psychopaths thought that if given permission by a teacher, it is equally fine to talk in class (a conventional transgression) as to hit another child (a moral transgression). Non-psychopaths thought it was still wrong to hit another child. Blair [7] cites neurological evidence pointing at psychopaths having impairments in specific regions of the brain that have been associated with social cognition.

Neuroscientists have made great inroads in the past decade in identifying these brain regions, helping us better understand how we make decisions involving social matters. In particular, there is increasing evidence that specific parts of the brain, such as the medial prefrontal cortex, are involved in tasks involving mental-state attribution (e.g., [27][55]). Furthermore, these regions of the brain are most developed in social primates, with the greatest development in humans [28]. In other words, the brain structures associated with empathy and compassion are part of what makes us human.

A clever example of how empathy works in our brains comes from a study by Harvard University's Joshua Greene and colleagues that tests the difference between personal and impersonal moral decisions. Greene presents participants with one of two scenarios. In one scenario a runaway trolley is heading toward five people who will be killed if nothing happens. You have the option of hitting a switch that will make the trolley go to another set of tracks, killing one person instead. Most participants (about 95%) chose to hit the switch. In another scenario, the only way to save the five people is to push someone onto the path of the trolley. Almost no participants would push someone and have them die in order to spare the life of five others. When exposed to the second scenario, participants used the regions of the brain involved in mental-state attribution [29]. They could put themselves in the other person's shoes.

Greene et al. [30] later studied what happens when there are personal moral versus utilitarian values at play. In their experiment, participants were presented with a scenario in which they had a choice of smothering a crying baby, or letting the baby cry and have everyone in a group (including the baby) killed by troops under order to do so. They found that in these cases the brain activated regions associated both with personal moral and utilitarian values and it appeared that another part of the brain, the anterior cingulate cortex, played the role of arbiter.

Soldiers face similar dilemmas, but in real-life scenarios. During World War II, Brigadier General S.L.A. Marshall surveyed thousands of United States troops after they had been in combat in the front lines in Europe and the Pacific [54]. He found that "in an average experienced infantry company in an average stern day's action, the number

engaging with any and all weapons was approximately 15 per cent of total strength. In the most aggressive infantry companies, under the most intense local pressure, the figure rarely rose above 25 per cent of total strength from the opening to the close of action." In other words, on average, more than four out of five soldiers in the front lines were not firing their weapons at all during combat. This is a clear example of the compassion displayed by what in the United States is referred to as the "greatest generation." Grossman provides evidence of similarly low firing rates for United States soldiers during the United States Civil War and World War I [31]. Marshall and the United States armed forces though, thought this was a serious problem. Marshall stated: "there is every reason why the fire ratio factor should be treated primarily as a most vital training problem."

Bypassing Compassion During Battle

Armed forces throughout the world took notice, and training was modified to bypass the activation of the regions of the brain responsible for empathy and compassion. In the United States, this has been accomplished through a combination of desensitization, conditioning and denial defense mechanisms [31]. To desensitize, training emphasizes to the soldier that "their purpose is not just to be brave or to fight well; it is to kill people" [19]. To condition soldiers, training presents tasks where soldiers learn to instinctively shoot at targets that are made to look as close as possible to real human beings. This also helps develop denial defense mechanisms in that killing on the battlefield is so similar to training that soldiers do not think of what they are doing as killing other human beings. Through these changes, firing rates for United States soldiers, for example, went significantly up, from the 15 percent S.L.A. Marshall found in World War II to 90 percent or more during the Vietnam War [31]. Lieutenant Colonel (Ret.) Grossman, who taught psychology at West Point, believes the changes in training are necessary to help soldiers complete missions and survive. But he also acknowledges the negative impact of these changes on the mental health of soldiers due to the higher levels of violence they experience. In particular, he is concerned about the increasing rates of mental health disorders for United States war veterans [31], with about 30 percent of Vietnam veterans suffering post-traumatic stress disorder at some point after deployment, and some estimates finding that as many as 40 percent of reservists returning from the current conflict in Iraq screen positive for mental health disorders [53].

Another way to make it easier to kill is to increase the distance between warriors and those they are asked to kill [31]. When you do not see the faces of those you might kill, or you do not even see their bodies, you are much less likely to use those regions of the brain involved in mental-state attribution that bring about compassionate actions. When you do not see the carnage of war, you are much more likely to support it. Hence, the increased use of

military technologies that distance the warrior from those who get killed. The latest incarnation is drones that make killing seem like playing a video game. Armed forces in several countries, joined by researchers in artificial intelligence, robotics and other disciplines are going a step further by developing autonomous battlefield robots. These are robots that will make their own decisions on who to kill. Their supporters claim that by having no emotion, the robots will avoid war crimes [3]. What they fail to consider is that the robots will have no compassion. In other words, autonomous battlefield robots will be the perfect psychopaths.

In addition, autonomous battlefield robots would be the ultimate way of separating those deciding to start a war from the carnage caused by their decision. Interestingly, there is a parallel between the automation of war and the automation of the modern economy. For example, financial decisions, such as accepting a mortgage application, used to be made by lending officers with plenty of experience who made decisions case-by-case through an examination of an applicant's credit-worthiness. Financial firms decided to replace them with statistical models and algorithms that provided excellent short-term savings, yet no one seemed to completely understand. In his recent book, Tufts University's Amar Bhidé argues they were behind the current financial crisis because these models and algorithms lacked the judgment of the individual people who used to make decisions [5]. We argue that beyond a judgment gap, automation adds a responsibility gap. Who would be responsible if autonomous robots massacre poorly armed conscripts from an opposing army with little intent to fight?

We have to realize that these technologies are very attractive to the military for several reasons. First, they minimize casualties for the side using them. Second, they are often much more accurate than many weapons used in the 20th Century (e.g., fire bombings of cities), potentially leading to lower civilian casualties. And third, because of the greater distance, they reduce the likelihood that those operating the technologies will suffer from mental disorders. Hence, there is little chance they will go away.

The problem is that the increasing use of technologies with the above characteristics (whether robots or remote controlled drones) can make it a lot easier and less painful to start wars. They not only distance the warrior from those being killed, they distance citizens in democratic countries from those being killed by their militaries.

It is also possible to increase the social distance to enemies by making them seem inferior, evil or immoral. The language of war plays a role in this respect. Ivie, for example, discusses the use of language in justifications of war by the United States, with the presentation of Americans as victims and enemies as savages driven by irrational desires [45].

Terrorist groups also understand the need to take compassion out of the equation. What works for them is the

demonization and de-humanization of people who are different. Just like military entities, they seek to increase the distance between the warrior and the people who are killed, but in this case the emphasis is on increasing the social distance [72].

This is where the human-computer interaction community can make a contribution. More specifically, we can help by designing technologies that engage people at an individual level and help understand both the humanity we share with perceived enemies, and the real costs of war in terms of human lives and human suffering. In other words, we can engage the regions of the brain that support empathy, compassion and altruism by reducing the physical and social distance with potential victims of war. The goal is to enable people to fully understand the human consequences of going to war. Not surprisingly, most of the ideas proposed during the peace brainstorm at CHI 2010 address this issue [34].

RESEARCH AGENDA

In this section we discuss the role human-computer interaction can play in promoting peace and preventing conflict. To do so we focus on proposals and examples of technologies that can promote compassion in order to prevent war. We also go through the factors that increase or decrease the likelihood of war at a socio-political level and discuss how previous projects have already made positive contributions and where there are opportunities for research. In both cases, we do not intend to provide a comprehensive collection of what has been done and what could be done, but rather provide constructive ideas for conducting human-computer interaction research for peace.

When possible, we will refer to topics that were raised during our peace brainstorm at CHI 2010. At the peace brainstorm, attendees found someone they did not personally know, discussed their ideas for peace with them and wrote the ideas on sticky notes. From these ideas, several main themes emerged: promoting education, increasing social awareness of everyday actions, creating a culture of peace, engaging other organizations, exposing the ugly side of war, promoting cross-cultural understanding, and building infrastructure and tools.

Promoting Compassion to Prevent War

Reduce the Social Distance Between Enemies

In a 2007 article in *Science*, Jonathan Haidt discusses how people make moral decisions [32]. The evidence from neuroscience suggests that most often we make these decisions based on our intuition, and then attempt to rationalize them. Imagine Sara, who is deciding whether or not to support a war, and has a long social distance between her and her perceived enemies (e.g., thinking they are inferior or immoral). How can we help her understand the humanity of her perceived enemies and the likely costs in human lives and suffering of the war she might support? Haidt presents evidence that there are at least three ways of

achieving this. The first is for her to use verbal reasoning to better evaluate the costs and benefits of her decision. The second is for her to consciously reframe the situation, to see the decision from someone else's perspective, for example. The third is for Sara to speak with other people who can help her see the question from a different perspective. Haidt points out that the first two ways are rarely used, while the third is the most common. Most changes in moral attitudes, and in our case, in decisions about supporting a war will occur through social interaction.

Hence, the development of technologies that can connect people of opposing factions in a way that they can interact with each other and learn about their common humanity could prove very useful. On peace.facebook.com, for example, it is possible to track the number of friendships between people of "opposing camps", such as Israelis and Palestinians, Greeks and Turks, and Indians and Pakistanis. Sometimes what is needed is simply to help people engage with others who are not in their immediate social circle. In this respect, in a recent article in *interactions*, Hochheiser and Shneiderman emphasize the importance of social media technologies that can restore participation in social, civic and political institutions [36].

However, there is a need to go beyond providing a means to communicate. There have to be incentives to reach out to those we disagree with. It is always tempting to stay within a social network of people who share similar ideas to ours. To counteract this, and to change people's minds about perceived enemies, research points at the power of storytelling. To understand the plight of a group of people, statistics about what they go through are much less powerful than stories about specific people, as has been found in studies on donations to charity [66]. Therefore, providing ways of sharing visual stories on people from opposing sides could greatly help in reducing the social distance between perceived enemies. Even simple storytelling through video could prove powerful, as some of our colleagues have found in places like Rwanda and Liberia (e.g., [26][63][67]).

Not surprisingly, by far the most discussed topic during our peace brainstorm at CHI 2010 was reducing conflict through emphasizing our common humanity, encouraging people to step out of their comfort zones to make cross-cultural connections and seek out information from new sources of ideas, help them learn about each other, and think from another perspective. Ideas to this effect included setting up video-conferencing classrooms across the world, creating a site for "speed friending" across the globe – particularly for countries in conflict, encouraging diverse groups of young children to communicate through playing and collaborating together across time and space, setting up partnerships for the privileged to collaborate and help people in need, and a computer-mediated pen pal system to match children in conflict prone tension areas. To seek out different perspectives, one participant suggested findyouropposite.net, a space in which one could discuss

ideas with people from different persuasions and backgrounds. A participant mentioned that it is important for everyone's voice to be heard, even if it requires extra work on our part. Microblogging could be used as a helpful tool, both for sharing experiences and for making higher numbers of contacts from other countries.

Other examples of research on highlighting the humanity of others include that of Stock et al. who presented a tool for joint narration to promote conflict negotiation and resolution, with some results from an experience between Arab and Jewish youth [70]. A few years earlier, Rosen described something similar through *KidCast for Peace*, which proposed connecting children in various parts of the world so they could share their creations and obtain feedback [61]. The *International Children's Digital Library* provides access to children's books in dozens of languages, enabling children to read books written by people from other ethnic and religious groups [39]. Other possibilities for research include tools that automatically "translate" euphemisms and dehumanizing language in news stories as well as tools that will bring up the same news story from several points of view.

Expose War, Celebrate Peace

Another way to reduce the physical distance between opposing factions is to expose the ugly side of war as wars are happening. Participants at the peace brainstorm brought up the need to educate people about the negative facts of war through pictures, stories, and anecdotes, as a way to increase empathy and compassion. Al-Ani et al., for example, discuss the use of blogs written by Iraqi citizens, and how they enable others not experiencing the war to learn about what it is like to live in a war zone [2].

A counterpart to this idea that was also discussed at the peace brainstorm is that creating a culture that values peace involves creating activities that highlight peace. One idea was the geocaching of "peace sites" in the model that war sites and battlefields are commended, including places like the ones where Gandhi and Martin Luther King Jr. spoke. Video games such as *PeaceMaker* where players win by achieving peace can also help [43].

In addition, computer technology could be used to better understand how populations are convinced to go to war. For example, an analysis of media stories could trace how pro-war messages and language are distributed and who originates them. This idea could be extended to examine how online social networks are used to promote war and peace.

Socio-Political Interventions to Promote Peace

De-Incentivize Private Motivation

Private motivation to go to war could be exposed through information visualization techniques. For example, students in one of our classes designed information visualization software to track the path of campaign contributions for the United States Presidential primaries.

It enabled users to see where the campaign contributions came from and where the politicians were spending money. Similar efforts could be used to untangle the financial interests behind wars.

Participants at our peace brainstorm discussed similar ideas. One participant noted, “conflict should not produce profit,” highlighting the frequent interplay between the two, dovetailing with another participant’s suggestion to create visualizations that illuminate the public cost of war and who profits to help people understand the forces that create conflict.

Prevent Failures of the Social Contract

Failures of the social contract that cause extreme poverty and low life expectancy can be addressed through a variety of technologies. Mobile technologies can help provide information to prevent disease, promote healthy habits, and help people in developing regions get more out of what they have by, for example, being informed of market prices and weather forecasts. In Uruguay for example, parents in rural areas whose children received laptops have used them to check on market prices for milk to schedule pick-ups [41].

Alleviate Environmental Stress

Technologies can help alleviate environmental stress in many ways. Blevis’ recommendations on sustainable interaction design can help in preventing technologies from having a negative impact on the environment [8]. Satellite imaging delivered in a user-friendly manner can be used to better understand how to manage natural resources and predict where crises may occur. Simulations and modeling can help evaluate different scenarios in the use of resources while information visualization can help the public better understand how the products they consume affect the environment.

Address Inequality

Inequality could be addressed first by making people aware of its prevalence and severity. Information visualization in combination with storytelling could be used for this purpose. For example, Shneiderman’s “details on demand” could be stories instead of numbers [65]. The more difficult task is actually reducing inequality. Efforts to democratize access to the Internet, when combined with appropriate education on how to make the most out of it could prove useful. Technologies to facilitate peer-to-peer micro-financing, such as Kiva, can also provide more people with opportunities to become economically self-sufficient [49]. Taking advantage of mobile devices to spread know-how in rural areas is another promising path [59]. Feminist perspectives can also inform the design of technologies to contribute toward gender equality [4].

Promote Democracy

According to the empirical studies reviewed in this paper, promoting full democracy with free and fair elections, freedom of assembly, press and religion, and respect for

human rights is one of the surest ways of preventing conflict. Getting there may not be so simple, but one could argue that greater exposure through the Internet to how successful countries’ governments work may contribute toward democracy. Technologies can also help implement democratic reforms more quickly through the use, for example, of well-implemented voting systems that can easily be audited and provide transparency [35][68]. As Ben Bederson said in a recent interview “The HCI community must help ensure that not only are voting systems reliable, secure and accurate, but also that the voters understand and believe in them” [33].

Promote Education

An example of a project aiming to improve educational levels in developing regions is *One Laptop Per Child* (OLPC) [58]. In spite of many setbacks and falling well short of its vision [50], in at least some locations, the project has provided children with an enormous increase in their access to content, and encouraged them to produce their own. This makes it more likely that they will acquire 21st century skills to better understand, analyze and use online information and produce digital content of their own [40]. Other examples of work on educational technologies for developing regions include the work of Kam et al. on e-learning games, and Moraveji et al. on single display groupware learning applications [46][57]. In all these efforts in developing regions it is always important to take into account the dynamic nature of culture and the impact of historical events [44].

The participants at the peace brainstorm also discussed the importance of education. Participants suggested working on raising literacy rates for women, educating children, giving opportunities to adults and elderly people, and building education ICTs. Another participant captured a popular sentiment – “peace starts from the kids.” In this vein, a movement worth noting is *Design for Change*, which started in India and is spreading throughout the world with the goal of having groups of children work for one week on solutions for a local problem of their interest. A group of children in Finland, for example, worked on a campaign to stop Finland from supporting the use of cluster bombs [48].

During our peace brainstorm at CHI 2010, some participants noted the importance of informed social awareness. One stated, simply, “think about who you’re working for and what their goals are.” Another mentioned that giving consumers tools to ascertain product origin and the conditions in which different products are created can help people make more ecologically and humanitarily sound choices. Social networking sites can allow the sharing of social pressure to maximize individuals’ social impact. Another participant stressed the need for moving beyond quick fixes by promoting long-lasting changes in attitudes and behaviors relating to informed consumer knowledge

Aid Operational Prevention

Technologies can also be of help in operational prevention tasks such as monitoring missions and confidence building measures. For example, streaming video of sensitive areas could be made available over the Internet. This could be used to ensure that ceasefires are respected by providing an easy way for all parties to monitor sensitive areas.

DISCUSSION

Our hope is that this paper continues a serious discussion within the human-computer interaction community on how we can design technologies to promote peace and prevent armed conflict. It identifies many areas where research can be conducted and where technologies can have a positive impact. In fact, from our research agenda one thing is clear: there are many ways to pursue peace through efforts involving computing. Not only that, but many in our human-computer interaction community have already made and continue to make important contributions. There are other areas though where there have not been many contributions from our field and where the opportunities are ripe for action given the wide interest within our community.

At the same time, we must always remember that technology by itself is not going to bring about peace. It will just be another tool, yet a powerful one that if used in the right ways can make a positive difference. In the end, our goal is to design technologies to augment people's capabilities in seeking peace and preventing war, not to replace people. In the same vein, we believe it is important to always question the added value of technology. Just because we specialize in computing does not mean we should blindly address all problems through it when there may be less costly and more effective alternatives.

There are many challenges ahead. Evaluating technologies for peace can be difficult. In particular, if we want to reduce armed conflicts, the efforts may need to be large or take a long time to have an effect, and it may be difficult to evaluate their impact. While it may be possible to measure shorter-term gains in areas such as education, it may take years for any of these projects to have positive measurable effects in terms of peace, and even then, it may be difficult to attribute successes to specific projects. In the case of technologies designed to increase empathy and compassion toward people from other groups, it may be possible to measure this through questionnaires before and after a technology is used.

From an academic's perspective, it is also difficult to pursue this avenue of research due to the lack of funding opportunities. This problem could be turned into a positive by making all the research in this area completely open, sharing research results, and making any software open source. This could encourage a larger community of volunteers to participate and would increase the chances of any project to succeed. Academics also face ethical challenges when deciding whether to accept funding for

conducting research that could make war easier to wage, or that could facilitate the suppression of civil liberties. Related to this is the impact of funding priorities on academic pursuits, in particular how these funding priorities can define research priorities in scientific fields [52].

It would also be important to connect with existing peace groups to combine efforts. We have already been in contact, for example, with the *United States Institute of Peace*. One of the participants at the peace brainstorm suggested hosting a *TED* talk that focused on peace and conflict in Africa or other developing regions.

Future steps should include opportunities for all those interested to join in discussions and arrange for suitable ways of communicating. We expect to host activities at CHI 2011 to continue forming a community.

CONCLUSION

In this paper, we presented a review of empirical studies on the causes of conflict. We also discussed neurological factors involved in moral decisions that are relevant to individuals deciding whether or not to support a war. We then presented a research agenda, identifying many opportunities for research. We hope that this paper will inspire others to think of many more. Instead of thinking of peace as an intangible, vague goal, we now have concrete examples of technologies that can make a positive, constructive difference.

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