

Importance of relaying warmth in this pandemic time

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We humans need physical connection and the warmth it brings. However, it is difficult to satisfy the need when we have to follow social distancing guidelines. Social isolation, ineffective communication, and skin hunger are potential issues that could arise in the life of social distancing. This situation poses a need for haptics interfaces to relay warmth in remote communication. This position paper addresses the importance of relaying warmth in pandemic time. The haptics interfaces developed to relay warmth are introduced, together with a discussion on the future direction of this line of research.

CCS CONCEPTS • Human-centered computing→Human computer interaction (HCI) • Human-centered computing→Interaction design→Interaction design process and methods→User centered design • Applied computing→Law, social and behavioral sciences

Additional Keywords and Phrases: Physical warmth, psychological warmth, temperature interface, social distance, skin hunger, pandemic

1 Introduction

“This guy is so hot-blooded!”, “This girl gave me the cold shoulder...” Have you ever wondered why so many temperature-related metaphors are used to describe our feelings? Temperature quality, such as warm or cold, is not just a description of physical temperature; it also has emotional aspects. For example, the warmth felt when a mother holds her baby is love and care; a warm and firm handshake gives people the feeling of trustworthiness.

However, over the past decades, most of the temperature interfaces are mainly developed to create a more realistic experience in virtual environments or teleoperation [12,16,18]. Until recent years, researchers started to explore the idea of utilizing temperature feedback to express emotions and facilitate interpersonal communication (for review, see [9]). Although relaying social warmth with haptic technology is still a relatively new research area, it deserves better attention, especially during the pandemic. It is because haptics technology can provide a solution to “touch deprivation,” an adverse physical and mental health consequence of social distancing [3].

To address the importance of relaying warmth in pandemic time, this position paper begins with a discussion on the link between temperature and emotion, followed by a description of the health consequences of social distancing and touch deprivation. The haptics interfaces developed to warmth are introduced, together with a discussion on the future direction of this line of research.

2 link between temperature and emotion

In the late 50s, American psychologist Harry Harlow decided to search for an answer to a big question: “*What is love?*” In his experiment, Harlow separated infant monkeys from their biological mothers only a few hours after birth and left them “raised” by two mother surrogates. One was made of soft and warm cloth but provided no food. The other was

* Place the footnote text for the author (if applicable) here.

made of mesh wire but held a bottle with food. Surprisingly, the infant monkeys spent most of their time clinging to the soft and warm cloth mother and went to the wire mother only to feed. The infant monkeys' behavior made it obvious that contact comfort, such as warmth and softness, is vital for developing love and affection [7].

The same for the human babies, the physical contact of the caretakers not only brings warmth but also promises nourishment, security, and other things essential for survival. Over time, the link between warmth and positive emotions is implicitly rooted in lives and culture [1]. Happiness feels warm, and loneliness feels cold. These are not merely literary expressions in songs and poetry. Studies have demonstrated that emotions can have an impact on thermal regulation. Happiness makes people feel warm all over the body [15], while social exclusion makes people underestimate the room temperature and leads to lower skin temperature [10,25]. On the other hand, physical warmth has been shown to have a positive impact on social behaviors. A cup of warm drink can not only alleviate the adverse effects of loneliness [10] but also make people kinder and more generous to others [2,22]. Similarly, a warmer environment makes people feeling interpersonally closer to other people than those in the colder one [11]. These findings show that physical warmth is essential for social interactions and emotional support.

3 Consequences of social distancing

We humans need are social beings and need physical connection for emotional and physical wellbeing. Just think of the comfort and joy that a warm hug can provide. Skin-to-skin physical connection brings people to relax by reducing heart rate and blood pressure. Most importantly, the touch and warmth on the skin release oxytocin, “the cuddle” hormone involved in increasing emotional bonding and social connection and decreasing fear and anxiety at the same time [5,21].

However, since the global outbreak of the COVID-19 pandemic, large-scale interventions, such as stay-at-home order and social distancing rules, have affected every aspect of life. Anxious individuals voluntarily engage in reducing their social interactions and withdrawing from physical contact to prevent infection. While the end of this pandemic remains unforeseeable, the prolonged lockdown has left many people in solitude without touch for months.

For the worse, a life of social distancing might put some people in a condition of “touch deprivation” or “skin hunger.” Touch deprivation is not a minor concern. It severely damages people’s mental and physical health. In a short film called “*Fly in the Ointment*” the convicted murderer Peter Collins described how he craves for touch after a prolonged period in solitary confinement [17]:

“Somehow, I felt [my wife’s] fingers on my leg. Shocked and excited, I opened my eyes only to realize it was a fly walking on me. I was greedy for human touch so I closed my eyes and pretended it was her fingers. I tried to stay perfectly still because I didn’t want to frighten the fly off and be left alone.”

To maintain this only source of living touch, Collins would bite his cheek and spread a mixture of his own blood and saliva over his skin to attract the flies to linger longer on his skin.

Touch deprivation increases psychological responses such as stress, depression, anxiety, and deep feelings of loneliness. Physiologically, it triggers the release of the stress hormone cortisol, increasing heart rate and blood pressure and suppressing the digestive and immune systems. In the COVID-19 pandemic, the vicious cycle of high-stress level and weaken immune system further elevates infection risk.

Among all the age groups, older adults are especially vulnerable to the adverse consequences of social distancing and touch deprivation. It is because that they depend very much on family members or support by community services and are at high risk of affection. To protect older people from touch deprivation, “hug curtain” was first introduced [8]. It is a big plastic sheet with improvised armholes. Such a simple setup allows family members of elders to hug each other. Although hug curtain can’t convey the warmth of a genuine hug, it works very well as a substitution and quickly gains popularity worldwide. The photo that captured the moment of an 85-year-old Brazilian woman having her first hug in 5 months from a nurse through a “hug curtain” was named the World Press Photo of the Year [27]. This photo powerfully demonstrates how much a hug means to we humans, especially during a difficult time like this.

4 Interfaces for Relaying Social warmth

Remote communication has become a major means of social interactions during the pandemic. Although it is still possible to meet family and friends via online applications, the communication gets stuck, and a feeling of social disconnection arises from time to time. One of the reasons is that these online applications cannot relay human touch and warmth. As a form of non-verbal communication, touch is vital in conveying emotions, intimacy, and support. Just think how a pat on the back could solidify and build bonds between people. The current pandemic situation poses a need for haptics interfaces to replay social touch and warmth in computer-mediated communication.

Researchers started to explore the idea of utilizing temperature feedback to facilitate interpersonal communication in the last decade. Design guidelines were set based on understanding humans' subjective interpretation of and emotional responses to thermal stimuli. It has been shown that there is a strong agreement among people concerning the meaning of warmth and coldness [1,24] and that warm stimuli in general elevated the ratings of arousal and dominance [19].

Most of the temperature interfaces that have been developed so far are implemented as wearable thermo-messaging systems. These systems utilize Peltier devices to provide warming and cooling feedback to the skin. A majority of systems are worn on the forearm and allow users to send thermal messages when they want to express or emphasize their emotions [13,19,20]. Thermal hug belt is a system that allows users to send warm hugs (thermal feedback to the lower back) during instant messaging [6], and ThermalWear is a wearable on-chest thermal display used to augment the perception of neutrally-spoken voice messages with affect [4]. Some systems can detect a user's emotional state and then either conveys the state to another user using warming or cooling feedback [14] or react to the user's own emotional state with thermal feedback (e.g., provide warming feedback when feeling sad) [23]. Most of the studies have shown that users have a better social experience with these temperature interfaces. Besides the interfaces that solely focused on temperature feedback, there are also haptics interfaces that employ force, vibration, and/or temperature feedback to convey various forms of social touch, such as handshaking, hugging, and kissing (for review, please see [9]).

In response to the urgent need to relay social warmth during the pandemic, we must consider the following issues. First, the devices are intended to be studied and tested in real-life contexts (e.g., at home). Therefore, the design of the devices needs to pay special consideration to the hardware/software cost, the requirement of internet bandwidth, easiness in adoption and use, and mobility of the devices.

Second, we need to investigate what type of touch is suitable and effective in alleviating social distancing and touch deprivation. An important question to ask here is whether recreating existing forms of social touch (e.g., handshaking, hug, etc) can resolve the problem. We all know that the realism of interaction has always been a challenge. If the device can't achieve the realism expected by the users, would "uncanny valley" effect arises and result in adverse impact? There were some devices that convey affection and intimacy with a more abstract form of touch. Heartbeat Picnic, for example, is a vibrotactile system that allows people to externalize their heartbeats to a vibration speaker and literally present them to others [26]. This interaction conveys psychological intimacy beyond real-life experiences and is a promising touchstone for new directions.

Third, we need to develop a set of appropriate measures to examine the influence of the haptics interface on the consequences of social distancing and touch deprivation. It is possible to assess the mental and physical states of the users with self reports and physiological reactions, such as heartbeat, blood pressure, and hormone levels. At the same time, it will also be nice to have objective, behavioral measures to quantify the effects.

5 Conclusion

Due to the spread of COVID-19, the pandemic has changed how we live and interact as social distancing guidelines have cut off the physical connection among people. Social isolation, ineffective communication, and skin hunger are problems we have to face in the new normal. Haptic interfaces, especially those aiming to relay social warmth, can alleviate social distancing and touch deprivation during this pandemic. Our research field should respond to the urgent need to relay social warmth during the pandemic by adjusting the research direction to fit real-life scenarios. These efforts shall fill the "physical gap" caused by social distancing and mitigate the adverse impact of COVID.

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