"My Happiness Makes You Smile": Towards Understanding Telepathic Superpower Design via Brain-Muscle Interfaces

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ABSTRACT

In Human-Computer Interaction (HCI) research, there is growing interest in designing superpowers, abilities that extend beyond natural human limits and are experienced as originating from one's own body. While superpower designs hold the promise of enhancing human capabilities, they may also introduce negative side effects as superpower interactions transition from short demonstrations to integration into everyday life. To explore the positive and negative side effects of superpower design, we developed "EmoPals," a system inspired by telepathy superpower. EmoPals detects one user's emotions through a brain-computer interface and replicates them on the other user's face through electrical muscle stimulation, therefore one user's happiness makes the other smile and vice versa. This system demonstrates both the potential to strengthen emotional connections and the risks of amplifying negative emotions or causing social discomfort. Ultimately, this research contributes to a deeper understanding of superpower design and its integration into everyday life.

CCS CONCEPTS

• **Human-centered computing → Interaction paradigms**.

KEYWORDS

superpower, telepathy, electrical muscle stimulation, wearables, human augmentation, brain-computer interface

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1 INTRODUCTION AND RELATED WORK

In Human-Computer Interaction (HCI) research, there is growing interest in designing superpowers, abilities that extend beyond natural human limits and are experienced as originating from one's own body [5, 16]. Among these, telepathy seems to be a prominent superpower in science fiction [14, 15, 19, 22], refers to the ability to directly perceive the thoughts of others and transmit them without relying on language or traditional channels of communication [2, 18]. While telepathy superpower are described as "fortunate" for fostering deeper connections, they are also associated with negative side effects, such as privacy invasion [6] or immense psychological stress [3]. These portrayals underline the dual nature of superpowers: while they offer opportunities to enhance human abilities, they also introduce ethical and emotional challenges. These dualities are particularly noticeable when integrating such superpowers into everyday life, where unintended negative side effects could emerge.

To investigate both the positive and possible negative side effects of such superpower design, we developed "EmoPals', a novel system consisting of a pair of networked wearable brain-muscle interfaces, where one user's happiness makes the other smile and vice versa. The emotional state of one person is classified (happy, sad, neutral) through electroencephalography (EEG) from a brain-computer interface and replicated on the face of the other user through electrical muscle stimulation (EMS), which actuates the muscles of the face to elicit a smile, sadness or neutral. EmoPals introduces a telepathy superpower beyond common affective communications, enabling users to directly share emotions without relying on language or traditional cues. The design of EmoPals builds on prior research demonstrating the reliability of EEG signals for emotion recognition [17, 21, 24, 27, 28] and the ability of EMS-induced facial expressions to influence emotions [9, 29]. By leveraging these technologies, EmoPals enables users to become aware of each other's emotional states, positively fostering empathy [8, 13, 23]. However, this transparency of emotional sharing

comes with challenges, such as involuntarily disclosure of emotions [7, 25], and conflicts between induced and personal emotions [22, 26], potentially leading to a loss of agency [4, 10]. By exploring these trade-offs, this research aims to deepen our understanding of superpower design and its integration into daily life.

2 EMOPALS

EmoPals is a wearable, wireless system that connects two users, enabling emotion sensing and facial expression actuation, even over a distance. The system comprises two main components: EEG-based emotion sensing and EMS-based facial expression actuation. The sensing component consists of an OpenBCI Cyton board [1], eight Ag/AgCI dry comb electrodes embedded in a baseball cap and two reference ear clips. The electrodes directly contact the scalp and are placed according to the 10–20 electrode positioning convention [11, 12]. The raw EEG signals are trained with the SEED dataset, yielding a classification accuracy of 78.64%. Classified emotion results are automatically uploaded to a MongoDB Atlas cloud database [20] for use by the actuating component. The actuating component consisted of a battery-powered EMS device, two 5V relays and a Raspberry Pi microcontroller. Four electrode pads (2 pairs) are used for facial expression generation. Two rectangular electrode pads (5cm x 2cm) are placed on the Zygomatic and Buccal branches to induce a smiling facial expression, while two square electrode pads (2cm x 2cm) on the Marginal mandibular induce a sad facial expression.

3 CONCLUSION

In this paper, we explored telepathic superpower design, examining both its positive and negative side effects. We developed a system called EmoPals that consists of a pair of brain-to-muscle interfaces that senses one user's emotions through EEG signals and expresses them on the other user's face via EMS actuation, and vice versa. While the system enhanced emotional connections and empathy, it also amplified negative emotions and social discomfort. Ultimately, this research aims to deepen our understanding of superpower design and its integration into everyday life, especially considering not only their positive but also any possible negative side effects.

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