How Do Couples Use CheekTouch over Phone Calls?

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ABSTRACT

In this paper we introduce CheekTouch, an affective audio-tactile communication technique that transmits multi-finger touch gestures applied on a sender's mobile phone to a receiver's cheek in real time during a call. We made a pair of CheekTouch prototypes each with a multi-touch screen and vibrotactile display to enable bidirectional touch delivery. We observed four romantic couples in their twenties using our prototype system in a lab setting over five consecutive days, and analyzed how CheekTouch affected their non-verbal and emotional communication. The results of the user study showed that CheekTouch could effectively support audio-tactile communication in various ways – persuading, conveying status, delivering information, emphasizing emotion/words, calling for attention, and being playful.

Author Keywords

Affective communication; on-the-cheek interaction; multi-finger touch; vibrotactile feedback; remote touch; mobile phone;

ACM Classification Keywords

H.5.2 [Information Interfaces And Presentation]: User Interfaces - Input devices and strategies;

General Terms

Design;

INTRODUCTION

Mobile phones are now an essential medium of our daily communication. We use mobile phones to share information, ideas, music, photos, feelings and emotions with family members, friends, and colleagues. Because mobile phones help us feel connected with others, their importance as an emotional communication medium is growing as our life style is being more individualized and isolated.

Emotional communication using traditional phones depends on phonetic information such as amplitude variation, pitch inflection, tempo, duration, filtration, tonality and rhythm. For effective emotional communication, however, verbal

and non-verbal behaviors such as facial expressions and touches should be in harmony.

A number of past projects have explored touch channels to support emotional communication in distance. However, most of them required additional equipment, such as pads [3], woofers [5], rollers [1], and arm-band type devices [7]; users should put their palm on the desk, or push the device with both hands to use. They make remote emotional communication arguably difficult; users cannot maintain the conventional phone calling posture, which consists of the receiver on the ear and the transmitter on the mouth [4], that is, a device on the cheek. In addition, they have rarely been evaluated in real time [2] and discussed in enough detail to show their practicality in remote emotional communication [3].

In this paper, we suggest a novel audio-tactile communication technique called CheekTouch, which allows sharing touches over phone calls by transmitting multi-finger touch gestures applied on a sender's touch screen of a mobile phone to a receiver's cheek using vibrotactile stimulation, in real time. In addition to applying only components that current smart phones normally use while not requiring additional special devices, it makes possible for users to share their emotions in the conventional phone call posture. To examine its usefulness, we observed four romantic couples using CheekTouch in phone call situations over five consecutive days. Here we illustrate the potential of CheekTouch with findings of the user study about how it can help non-verbal and emotional communication.

CHEEKTOUCH

To make remote emotional communication natural and effective without changing the conventional style to use phones, we identified the following design considerations.

- One-hand interaction: Users should express touch gestures with the fingers of the hand holding the phone.

- On-the-cheek interaction: Users should apply finger gestures and feel tactile feedback without the need of taking the phone away from the cheek.

- Localized tactile rendering: The area to which vibrotactile stimulation applies should be minimized (on the cheek only while not spreading to the hand holding it and other components of the mobile device).

- Real-time touch communication: Touches during a voice call should be delivered immediately.

Touch Input

We used a portable multi-touch mobile device, the iPod touch (Figure 1(f) and (i)), to enable multi-finger touch input while speaking on the phone.

Vibrotactile Output

First, we used an existing mobile phone's vibration motor because they can be easily adapted even if they are used in large numbers compared to other actuators. We placed nine coin-type vibrotactile actuators (10mm diameter, 3mm thickness) in a 3×3 grid (Figure 1(c)) to represent simple finger touch patterns (tapping, sliding back and forth), which might be applied with one or two fingers of the hand holding the phone during a call. The distance between each of the nine actuators was set to 7mm because the two-point discrimination threshold on the cheek is 7mm on average. We inserted (8mm depth) the coin-type actuators (Figure 1(c)) into a high-density sponge (Figure 1(b)) so that each actuator's axis of rotation is perpendicular to the sponge surface's normal vector, in order to stimulate local cheek area more efficiently. Also, we inserted an acrylic panel (8mm thickness, Figure 1(a)) and sponges (5mm thickness, Figure 1(e)) between the actuator part (Figure 1(b) and (c)) and the iPod touch (Figure 1(f)) to prevent undesired vibration from spreading over the entire device. Figure 1(g) and (h) show the actual CheekTouch prototype fully implemented. During our observation, we covered the protruding actuators with thin tissue (Figure 1(d)) in order for them not to directly contact participants' cheeks.
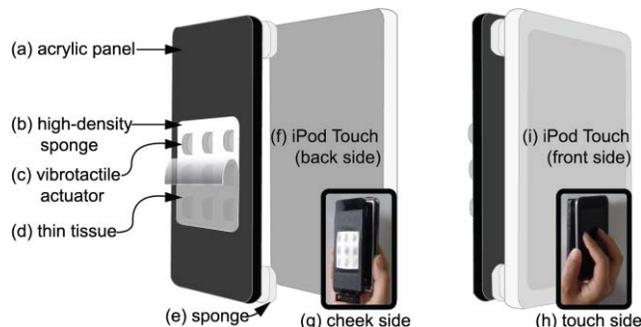

Figure 1. Implemented CheekTouch prototype.

Touch Input to Vibrotactile Output

Figure 2 shows the bidirectional communication diagram of CheekTouch. When one user's finger(s) touches on the touch input area, the touch information is sent to the other user's PC in an OSC (Open Sound Control) message using OSCemote [6] through a Wi-Fi network (- - - →).
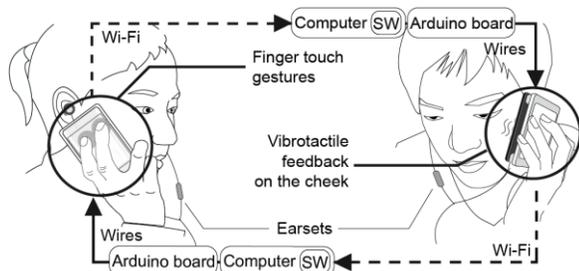

Figure 2. Communication diagram of CheekTouch.

The received information is used to activate the vibrotactile actuator(s) that corresponds to the touch location by using the Arduino board (——→). In this way, one user's finger motion on the touch screen is rendered on the other user's vibrotactile display in real time.

EXPLORATIVE USER STUDY

We conducted an explorative user study to find the usage patterns of CheekTouch in phone call situations and examine its usefulness. Specifically, what kinds of touch gestures are exchanged in what situations in CheekTouch communication? And do the touch gestures help non-verbal and emotional communication?

Four couples in romantic relationships (aged 25 ~ 30) participated. We expected that real couples would express more feelings and emotions in their communication than people in formal relationships. Each couple was led to two separate rooms for five consecutive days, and asked to have a phone call using CheekTouch for 20 minutes per day. The rooms were well set for natural phone conversations. On Day 1, we taught them the basics of CheekTouch for five to ten minutes, including how to hold the device, how to apply touches, and how to receive tactile feedback. Because we wanted to find as many potential usage patterns using CheekTouch as possible, we ran a minimal instruction session and did not introduce any predefined gestures. A short interview was conducted every day after the call. As our observation was done in a lab setting, we could record the voice communication and videotape the finger gestures; all the touch event signals were logged by our gesture analyzing software. In the daily interview, we gathered each couple' comments on differences between the usual audio-only call and audio-tactile call using CheekTouch based on the day's experience, how well their specific touch gestures were conveyed to each other, and overall usability issues.

FINDINGS: CHEEKTOUCH USAGE PATTERNS

We identified 675 touch gestures from 400 minutes of phone calls made by the four couples (Figure 3). That is, CheekTouch was used every 35 seconds on average. Through a careful examination of the audio and voice records, we found numerous unique patterns which could not be seen in regular voice phone calls.

Persuading

- Comforting: Patting with one or two fingers was used for meaning *"It's okay."* In particular, C1 (Couple 1: Sally and Charlie – we use aliases) used a total of 21 times with voice (6 times) or without voice (15 times). Sally was depressed because the roommate – her best friend – left the dorm after graduation. Charlie patted with two fingers on the CheekTouch device while saying *"It's okay <pat>, you can find a better roommate. I know you have a lot of good friends in the school. Don't worry."* Sally said that Charlie's patting on her cheek was comforting like his tapping on her shoulder in their face-to-face conversation.
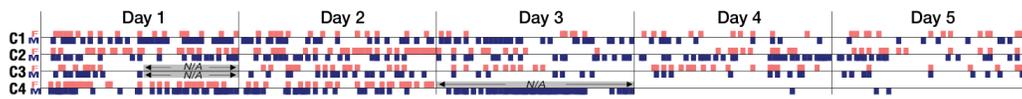
Figure 3. CheekTouch usage log showing all the frequency of CheekTouch uses by male (M) and female (F) participants of the four couples (C1 ~ C4) over five consecutive days (Day 1 ~ Day 5).

- Whining*, grumbling, pestering, urging and forcing:* We found 59 cases in which touch gestures were used to whine and grumble. These changed the atmosphere of conversation in a positive way, making the other laugh. Single tapping, multi tapping, drawing Z's or squares and long press-and-holding were used.

- Negative opinions: When it was difficult to answer directly through voice, they expressed their opinions using touch gestures in indirect and passive ways. In C1's conversation, Charlie responded with multi tapping (patting) without directly saying *"No"* when Sally made unreasonable demands. Sally said that she could detect his reluctance to accept her requests, and then changed topics not to hurt the conversation mood. Similarly, when the other's talk was boring or hard to listen to, they indirectly expressed their opinions by multi tapping or applying tickling gestures to prevent their conversation from turning sour**.**

Conveying Status
- I'm hearing: In all four couples' conversations, we found that touch gestures were used to express that they were listening to the other's talk sincerely; they used drawing circles, stroking, and multi tapping using one or two fingers.

- I'm thinking: We observed stroking and double tapping were used to express that they were thinking and considering seriously. For example, *"Well, I don't know … <double taps>" "Um….<double taps>" and "<multi taps>… That goes for you too!"*

- I'm still here: CheekTouch was used to fill the gaps that happened during the conversation. By horizontally stroking, drawing circles or squares, multi tapping, and tickling, they conveyed their presence to the other even when nobody talked on the phone. *"Charlie (C1): We often scribble on the other's hand when we meet. When I sensed Sally was doing something, even though the feelings of the tactile gesture were not that precise, it seemed to me we were more closely connected."*

- Mimicking: The participating couples often mimicked the other's tactile patterns in turn. Colin (C4) created tactile patterns in the middle of conversations habitually, and Emily (C4) liked to imitate them. They said they could confirm the other's presence in a positive way. Also C3 unconsciously killed time for 2~5 minutes when the verbal conversation died down by mimicking each other's tactile gestures.

Information
- Number: Multi tapping was used to count objects.

- Shape: They used touch gestures to describe the shape of objects or body behaviors, for example, expressing the shape of objects like hair and noodles, or expressing the behaviors like clapping, body twisting, sighing, and crying. In particular, C3 described the structure and shape of the room where they were seated by drawing patterns on the touch input screen. C2 and C4 mentioned that they could actually feel the expression of noodles and clapping in the context of conversation and the following conversation proceeded in a delightful direction. Furthermore, CheekTouch was used with various onomatopoeia (e.g., licking, sobbing, humming, ambulance sounds) while tapping, stroking, and alternating finger gestures. Also there were cases that used CheekTouch in expressing mimetic words; Emily (C4) mentioned that wriggling and simmering have the image of shaking, which was similar to the feeling of the vibration.

- Delimiting: Some touch gestures such as side-to-side, tapping, drawing circles or squares, tickling, and stroking, were used to depict the end of a sentence as if they were a period, question mark, or exclamation mark. Interestingly, single tapping replaced *"Yes"* sometimes.

Emphasis
- Emotion: CheekTouch was often used for highlighting emotions like envy, vexation, surprise, and love. Double tapping, tickling, pinching, and patting were used depending on the situation.

- Word/syllables: Single tapping was used to put an emphasis on a particular word or even each syllable of a word.

Attention
- When they wanted to call for the other's attention, they used to press the input screen with one finger to generate a long vibration. If the person on the line was quiet, sometimes they applied tapping gestures to check whether s/he was there. Some tapped when they started a conversation to notify the other.

Play
- They played with CheekTouch during a call – mimicking touch patterns with complex rhythm, giving a quiz for pattern matching, teasing with tickling or slapping gestures. C4 used CheekTouch to massage the back of the other's neck using the vibration; they mentioned that the vibration delivered by touching the screen with three or four fingers for a long time was like a real massage with hands. In addition, C2 used CheekTouch in a role playing game; Rachel played a dentist treating Brian's cavities by placing the device close to the cheek near his teeth.

DISCUSSIONS

CheekTouch in Negative Atmosphere

CheekTouch was not used much when they were angry, or were expressing negative emotions directly. They mentioned that tactile stimulation on the cheek in a negative situation could make them angrier and more irritated. We found in C4's conversation, *"Keep your hand off"* in this kind of situation. *"Colin (C4): I might not use it when I feel bad. Because I think it would be better not to stimulate her. I try not to touch Emily until the atmosphere becomes better."* C4 only used CheekTouch for three times on the fourth and fifth days of the experiment, during which they fought. Interestingly, we observed that they pressed the touch screen hard for a long time to express angry feelings.

Vibration Control

All four couples mentioned that the vibrotactile feedback didn't disturb their conversation. Some said they could hear weak vibrating sound, however in most cases it was not continuous and did not cause any inconvenience. *"Sally (C1): Vibration noise didn't disturb at all. Even I could not hear the sound.* However, C1 and C2 mentioned the needs of turning on and off, or controlling vibration intensity. *"Brian (C2): When I feel good, it's okay, but when I feel bad, it makes me feel worse, so there should be an on/off function."* *"Charlie (C1): I don't know if it is vibrating when I am concentrating on something. There should be a function to control the strength of vibration stimulation."*

Gesture Ambiguity

Some participants wanted to confirm if their gestures had been delivered safely and see the other's actual finger motions that resulted in the incoming tactile stimulus. *"Colin (C4): I was concerned that I could not know if my gesture patterns had been delivered. I hoped to have established some patterns that she and I both knew. Sometimes I asked her the meaning of tactile patterns that she had sent."* *"Brian (C2): I wanted to know what and how Rachel was touching. I wish I could see it from the screen."*

Unintended Touch

Sometimes the fingers unconsciously touched the touch screen during a phone call and a vibration was sent to the other inadvertently. *"Brian (C2): I didn't know that I was touching the screen until she asked me to stop touching it."*

Needs for Free Gestures

Touch gestures used were different depending on the context of the conversation and each individual's character and habits. Especially, a variety of touch gestures were used when asking, answering, whining, forcing, and calling for attention. The participant who usually gave short answers mostly did single or double tapping gestures; positive answers like *"Yeah, it's okay"* were often accompanied with tickling gestures. Answers like *"Um…I don't know exactly"* with scratching gestures on the screen were like they usually scratch their head; questions like *"Does your head or back hurt?"* with patting gestures; playful questions with interesting scratching patterns; questions for short answers with single or double tapping gestures. Active and delightful people like Sally (C1) often used double tapping gestures when whining and pestering, whereas quiet and shy people like Emily (C4) moved fingers side-to-side weakly when asking for something.

CONCLUSIONS

In this study, we developed CheekTouch to enrich emotional mobile communication with touch while preserving the traditional interaction style of phone calls. We observed that CheekTouch could help phone calls in terms of supporting non-verbal communication and delivering tele-presence. CheekTouch can be used effectively to give comfort and lead a conversation in a positive way, which might had flowed in a negative way with voice alone. It allows touches normally seen in face-to-face communication, which emphasize emotion/words, which call for attention, and which describe the shape of objects and body motions, in mobile phone conversations. Also it helps people going through remote communication feel more closely connected by giving ways of revealing their presence with touches, which fill conversation gaps during a call and express *"I'm hearing/thinking/here,"* and which mimic each other's touch patterns. Built on current smart phone technologies, CheekTouch has shown a new possibility of enriching emotions with touch over phone calls in the near future.

ACKNOWLEDGMENTS

REFERENCES

1. Brave, S., Ishii, H. and Dahley, A. Tangible interfaces for remote collaboration and communication. Proc. CSCW 1998, ACM Press (1998), 169-178.

2. Brown, L., Sellen, A., Krishna, R. and Harper, R. Exploring the potential of audio-tactile messaging for remote interpersonal communication. Proc. CHI 2009, ACM Press (2009), 1527-1530.

3. Chang, A., O'Modhrain, S., Jacob, R., Gunther, E. and Ishii, H. ComTouch: design of a vibrotactile communication device. Proc. DIS 2002, ACM Press (2002), 312-320.

4. Fukumoto, M. and Tonomura, Y. Whisper: a wrist-watch style wearable handset. Proc. CHI 1999, ACM Press (1999), 112-119.

5. Hashimoto, Y. and Kajimoto, H. Emotional touch: a novel interface to display emotional tactile information to a palm. SIGGRAPH 2008 new tech demos, ACM Press (2008), Article 5.

6. OSCemote. www.appstorehq.com/oscemote-iphone/.

7. Wang, R. and Quek, F. Touch & talk: contextualizing remote touch for affective interaction. Proc. TEI 2010, ACM Press (2010), 13-20.