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Social Haptic Communication mimicked with vibrotactile patterns - an evaluation by users with deafblindness

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ABSTRACT

Many devices, such as smart phones, implement vibration motors for tactile feedback. When multiple vibration motors are placed on, for instance, the backrest of a chair it is possible to trace shapes on the back of a person by sequentially switching motors on and off. Social Haptic Communication (SHC) is a tactile mode of communication for persons with deafblindness that makes use of tracing shapes or other types of spatiotemporal patterns with the hand on the back of another person. This could be emulated using vibrotactile patterns. Here we investigated whether SHC users with deafblindness would recognize the vibrotactile patterns as SHC signs (Haptices). In several cases the participants immediately linked a vibrotactile patterns to the Haptice that is was meant to imitate. Together with the participants we improved and expanded the set of vibrotactile patterns.

CCS CONCEPTS

• Human-centered computing → Accessibility technologies.

KEYWORDS

Social Haptic Communication (SHC); vibratory patterns; co-design; users with deafblindness

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1 INTRODUCTION

Social haptic communication (SHC) is a tactile language which involves tracing shapes or other types of patterns on the back or other body part of a person with deafblindness. Often this is used to provide situational information such as, for instance, about emotions, whether there is applause or about the lay-out of a room. This form of communication, mostly used in the Nordic European countries, was first created by Naess [15] and further developed by

Palmer and Lahtinen [9, 12]. In the current study we investigated whether vibrotactile patterns can be used to mimic SHC. If this is the case, vibrotactile patterns open up possibilities for sending SHC over large distances, to several users at the same time or to even automate it. See [13] for a preliminary description of this work.

By switching vibration motors on and off a spatiotemporal pattern can be displayed. This makes it possible to, for instance, trace a shape on the back of another person. There have been examples in the literature of perception of shapes displayed with this method e.g. [1, 6, 7, 18], and also letters e.g. [4, 8, 10, 16, 19, 20]. In the current study we investigated whether SHC users would be able to readily recognize what was being communicated with the vibrotactile patterns. Also, it was discussed with users how to adapt vibrotactile patterns to increase recognizability. We collaborated with the SHC The Netherlands group because the hand gestures as specified in the Dutch handbook were designed by this same group. Members of this group provide training on SHC in co-teacher couples.

2 METHODS

2.1 Vibration patterns

Vibration patterns were created with a set of 9 vibration motors (coin-style ERM motors) placed in a 3x3 grid (horizontal spacing 4 cm and vertical spacing 6 cm) on the back rest of a chair. The vertical spacing was larger because pilot testing showed that spatial patterns felt compressed in the vertical direction. Where appropriate we used interpolation, i.e. a second motor was turned on before the first one switched off so that there was an overlap between the motors. This leads to the traced path to be perceived as smoother and more like a continuous path instead of discrete sequential vibrations [5].

For each session we took a selection of SHC signs, referred to as Haptices, from the Dutch Handbook Social Haptic Communication [3]. We tried to mimic the Haptices using vibrotactile patterns as closely as possible, but for some Haptices involving multiple fingers or the whole hand we had to deviate quite far from the regular Haptices. In sessions 2 and 3 we switched on the first motor of a traced shape for slightly longer than the other motors as pilot results suggest that this increases recognizability of the patterns.

2.2 Participants and general procedure

All 8 participants were members of SHC the Netherlands group and familiar with the Dutch handbook SHC [3]. The participants were distributed over three sessions. In each session a couple of

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one person with deafblindness and their co-teacher participated because participants were most comfortable with this setting. During sessions 2 and 3 there was also an additional member of the SHC group present. The test sessions were quite informal to encourage discussion and audio recordings of these sessions were made. Although all participants were encouraged to give their opinion, the comments from the participants with deafblindness were always leading.

In each session the participant with deafblindness tried the vibrotactile patterns first. They were seated on the chair with their back against the back rest. They described what they felt and which haptics they thought was mimicked. The vibrotactile patterns were repeated as often as they liked. After all participants had tried the vibrotactile patterns, we discussed their impressions and concrete suggestions for improvements were encouraged. Sometimes also new vibrotactile patterns were designed together during the session. The anecdotal results reported here represent the feedback from the users with deafblindness. There was mostly consensus among participants, but in any case the opinion of the participant with deafblindness was leading. In the results section the paraphrased feedback represents feedback from the participants with deafblindness. Feedback from each session was incorporated to improve vibrotactile patterns presented in subsequent sessions.

3 SESSION 1 - FIRST EXPLORATION

We selected 6 Haptics for this first test session (Fig. 1). The main feedback from both of the participants was that often the pattern was displayed too fast. Especially in the case of ‘silence’ a motion from left to right can indicate different meanings and the speed plays a role in differentiating the meaning. Another important observation was that in the case of ‘alarm’ for the participant with deafblindness the time between the end of the first line segment and the start of the second was too short. This meant that this shape was perceived to be one continuous trace instead of two separate line segments. The vibrotactile pattern for ‘laughing’ was perceived as rather aggressive and that laughing should feel more happy and playful. It was suggested that the pattern that was originally designed for laughing would be better to indicate ‘angry’. During the session we designed a new pattern for ‘laughing’ which consisted of a more gradual increase and decrease in intensity. Both participants indicated that they thought vibrotactile patterns would be easy to get used to and we incorporated their suggestions to improve the patterns included in Session 2.

4 SESSION 2 - EMOTIONS

The participants were told that all vibrotactile patterns in this session were intended to mimic Haptics from the Emotions chapter in [3] (see Fig. 2). Notably the vibrotactile patterns for ‘Happy’, ‘Unhappy’, ‘Sad’, and ‘Surprised’ were recognized immediately by the participant with deafblindness. This participant indicated that the pattern for ‘Neutral’ was difficult because it is similar to the haptic for ‘Silence’. The vibrotactile pattern for ‘Laughing’ was confused with ‘Angry’ initially. After a few repetitions the participant with deafblindness was able to tell these patterns apart.

The participant with deafblindness expressed a priority for vibrotactile patterns to be displayed fast over increasing recognizability

Figure 1: Set of vibrotactile patterns that were designed to mimic social haptic communication Haptics in test session 1. The gray arrows indicate that motors were sequentially switched on and off with an overlap between subsequent motors to induce the sensation of a shape being traced. Blue dots indicate the position of a vibration motor. For patterns in which no shape was traced the motors that were switched on are indicated with red dots. The shown feedback from the participants is paraphrased. For ‘laughing’ an alternative vibrotactile pattern was suggested by the participants. For the other patterns only changes in the duration of motor activation and breaks between motor activation were implemented.

Figure 2: Test session 2 focussed on emotions. A set of 7 vibrotactile patterns was designed to mimic Haptics indicating emotions. The shown feedback from the participants is paraphrased.

by displaying them more slowly. He would get used to the higher pace and it was important to him to not miss out on information during conversations. This differed from the participants without deafblindness in that they indicated they preferred a slower pace.

5 SESSION 3 - GENERAL INFORMATION

The participants were told that in this session all vibrotactile patterns were meant to mimic Haptics from the General chapter of [3]. These Haptics might be more difficult to recognize out of context than the emotions from session 2. The haptics for ‘Yes’ and ‘Question’ were immediately recognized by the participant with deafblindness. The Haptic for ‘No’ was difficult to recognize due to the fact that we had emphasized the starting point like in other patterns of sessions 2 and 3. However, in this particular case a confusing rhythm in the vibration pattern was introduced. The vibration pattern to mimic the haptic to ask for attention was effective for getting the attention of the participant, but was much too intense. The vibrotactile pattern for ‘OK’ was first recognized as a smiley. After feeling the patterns for ‘OK’ and the pattern for ‘Happy’ that was used in session 2, the participant indicated that the difference between the two was quite clear and that the pattern for ‘Happy’ more strongly resembled a smiley. The vibrotactile pattern to ask ‘Are you OK?’ was correctly recognized, but it should

be noted that the participant was first familiarized with the patterns for 'OK' and 'Question'. The pattern for 'Wrong' was initially recognized as an exclamation mark.

	Yes	No	Attention	OK	Question	Are you OK?	Wrong
Vibration pattern							
Feedback	This means yes, yes, yes, yes.	Maybe silent?	Just very intense.	Feels like a smiley.	Could be a question mark. There needs to be a break before the dot.	This is a question whether I am OK. The time between both signs is first.	An exclamation mark.

Figure 3: Test session 3 focussed on general information. A set of 7 vibrotactile patterns was designed to mimic Haptices. The shown feedback from the participants is paraphrased.

6 DISCUSSION

Vibrotactile stimulation can be useful for tactile communication in several ways such as to display Braille, tactile Morse code, phonemes or other types of signals e.g. [2, 11, 14, 17]. Our study clearly shows that vibrotactile patterns can also effectively mimic SHC. Participants indicated they could easily learn to recognize vibrotactile patterns that were not immediately recognized. However, especially Haptices involving the whole hand needed larger design changes. Otherwise, changes were mostly in terms of speed and duration of breaks. It was also clear that vibrotactile patterns that feel very intense will not be easily associated with mild emotions.

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