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Short communication

Interpersonal stroking touch is targeted to C tactile afferent activation

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HIGHLIGHTS

- 2 studies tested whether humans spontaneously apply C tactile fiber targeted touch.
- 60% of the participants stroked an artificial arm faster than the C tactile optimal range.
- 100% of the participants stroked their partner with C tactile fibers optimal velocities.
- we conclude that human social stroking is optimized for C tactile stimulation.

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ABSTRACT

C tactile fibers are a specialized group of fibers innervating the non-glabrous skin that are tuned to light gentle stroking applied with velocities between 1 and 10 cm/s. Those fibers add to the sensation of interpersonal caressing and pleasant touch. It is unclear whether people spontaneously apply touch that is tuned to optimally activate those fibers. This was investigated in three studies. In study one, 45 participants (21.8 ± 2.3 years, 24 women) were asked to stroke an artificial arm. In study two, 32 participants (28.3 ± 8.7years, 16 women) were asked to stroke their partner. In study three, 11 parents (29.4 ± 5.7years, 6 women) were asked to stroke their babies. Stroking velocity was tracked in all conditions. Stroking velocities were significantly slower in the partner touch and baby touch condition than in the artificial arm condition and all of the participants stroking their partner or baby used velocities that can activate C tactile fibers. We conclude that human social stroking is optimized for C tactile stimulation.

1. Introduction

Interpersonal touch holds a variety of beneficial aspects for human relationships, including the creation and strengthening of bonds between couples, groups or families (for overview see [1]). Although different nerve fibers are involved in the detection and conduction of interpersonal touch, a particular group of unmyelinated mechanoreceptors located in the hairy skin of the body has attracted a great deal of attention in the last years. Those so called C tactile afferents form a subgroup of slowly conducting, low-threshold, C fibers, which is tuned to respond to slowly moving touch performed with a stimulus temperature of about 32 °C [2,3]. Microneurography studies on the human forearm reveal that C tactile fibers respond optimally to stimulation with a velocity of 1–10 cm/s; moving stimulation performed with a velocity of 0.3 cm/s or slower or with a velocity of 30 cm/s or faster are less effective in C tactile fibers [2–4]. With those receptive characteristics, C tactile fibers are highly sensitive to human interpersonal stroking and presumably specialized for the conduction of pleasant [3] and even erotic [5] touch. Accordingly, stimulation of the skin with C tactile optimal stimuli is a pleasant sensation and the pleasantness of being stroked typically decreases when stroking is performed with velocities of 0.3 cm/s or slower or with velocities of 30 cm/s or faster [4–6].

It has therefore been argued that C tactile fibers are highly tuned to social interpersonal touch [3]. However it is yet unclear whether people actually touch each other in a way that is optimal for C fiber activation. C fiber activation might occur in a variety of forms of touch, such as in cuddling, hugging or just steady holding, when skin to skin contact changes are caused by breathing or heartbeat.

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Those forms of touch are relatively hard to investigate in a controlled experimental laboratory situation. Here, we designed three observational studies testing whether people spontaneously stroke each other with velocities that are effective in stimulating C tactile fibers in the stroke recipient. Accordingly, we hypothesized that people would stroke with velocities of 1–10 cm/s. This was tested in different conditions: In study A participants were asked to stroke an artificial arm. In study B, participants were asked to stroke their partner. In study C, parents were asked to stroke their baby.

2. Methods

2.1. Study A—stroking an artificial arm

2.1.1. Participants

In total, 45 participants were included (aged 18–29 years, mean age 21.8 ± 2.3 years standard deviation, 24 women), most of the participants were students and they received financial compensation. The study was approved by the local ethical board.

2.1.2. Material and methods

The participant was sitting in a comfortable chair in front of a table, where an artificial arm (mannequin arm made of hard plastic) was attached in prone position in a way that participants could easily reach and stroke it (compare Fig. 1). An electromagnetic Polhemus tracking device (3Space, Isotrak II) registering position and orientation data at 60 Hz was used to measure the speed of the stroke and attached to the middle finger of the dominant (as assessed by self-report) hand. The participants were asked to stroke the dorsal forearm arm in proximo-distal direction three times in a row while stroking speed was measured (compare Fig. 1A). The dorsal part of the forearm was chosen as this area is rich in C tactile fibers in humans and frequently used in experiments on C tactile fiber functioning [2,4–7]. Nineteen of the participants were instructed to: "*Imagine this arm belongs to a person. Please stroke the arm in a way, the person would like it*". The other 26 participants were instructed to: "*Please think of someone you love. Imagine that this arm belongs to this person. Please stroke the arm in the way, you would stroke the person.*" The participants did not differ in age or sex distribution.

2.1.3. Statistical analysis

Stroking velocities were extracted from the Polhemus tracker by dividing the recorded distance/time. Velocities of the three repetitions were averaged and the percentage of stroking velocities within the C tactile optimal range was calculated. Stroking velocity was normally distributed. Differences between sex of participants and differences between subjects receiving two different instructions for stroking were analyzed using *t*-test for independent samples. Tests were performed two tailed and level of significance was set to 0.05.

2.2. Study B—social stroking: partner

2.2.1. Participants

16 heterosexual couples (i.e. 16 men and 16 women, aged 19–60 years, mean age 28.3 ± 8.7 years standard deviation) were included. None of the participants was enrolled in study A. Mean duration of the relationship was 8 years ± 7 months; none of the couples had children. The majority of the participants were students and all received financial compensation. The study was approved by the local ethical board.

2.2.2. Material and methods

The stroke recipient and giver were sitting in comfortable chairs. The partners were separated by a blanket in order to avoid visual contact and the stroke giver could only see the left forearm of the partner. On the dorsal forearm a distance of 10 cm was marked by a pen. The stroke giver was instructed to "please stroke this area back and forth as you would normally caress your partner" using their dominant hand for a time period of 15 s. This was repeated 6 times. Afterwards the whole session was repeated, but partners changed places, so that the stroke giver became the recipient and vice versa. Stroking speed was monitored in the same way as in study 1. Prior to the experiment, all participants were asked to rate the satisfaction with their relationship on a visual analog scale with the anchors 0 = "not at all satisfied" to 10 = "really satisfied".

Further, heart rate was continuously monitored via electrocardiogram during the whole study and participants were asked about the experienced pleasantness of stroking. However, those data are not analyzed in the present study. After attaching the motion tracking and heart rate monitoring devices, participants were asked to watch a relaxing nature video for 5 min on a computer screen placed in front of them, in order to bring the subjects into calm mood.

2.2.3. Statistical analysis

Social stroking velocities within each of the 6 trials/participant were extracted and the percentage of stroking velocities within the C tactile optimal range was calculated. 188 single trials (out of 192:32 participants × 6 trials) were analyzable, 4 had to be omitted due to technical problems with the recording. For further analysis, velocities were averaged across trials. Velocities were normally distributed. Stroking velocities of both partners were correlated to each other and robust Spearman correlation coefficients were used, and Bonferroni–Holm corrected for the number of tests applied (factor 3). Tests were performed two tailed and level of significance was set to 0.05.

2.3. Study C—social stroking: child

2.3.1. Participants

11 parents of 6 children were included (5 fathers and 6 mothers, aged 25–45 years, mean age 29.4 ± 5.7 years standard deviation). None of the participants was enrolled in study A or B. All children were under the age of 1 year (2–12 months, mean 6.9 months ± 3.4 months standard deviation). The majority of the participants were students and all received financial compensation. The study was approved by the local ethical board.

2.3.2. Material and methods

The parents were asked to choose the position they found most comfortable and natural in order to stroke their child. Nine parents chose to hold their child close to their chest in a way that the child looked over the shoulder and to stroke the back of the child; one father placed the child on his knees in a way that both looked forward and stroked the belly. One child was asleep during the examination and was placed comfortably on a desk equipped with blankets. This child was stroked on the belly as well. On the stroking site, a distance of 10 cm was marked. This was done with tape strips attached to the clothes. Parents were asked to stroke the child within this distance for 30 s. This was repeated 3 times and videotaped. Two babies cried during the trials, 1 was asleep, 8 were awake.

2.3.3. Statistical analysis

As parents did not always use the exact 10 cm distance for stroking, the actually used distance was measured from the video recordings. Mean stroking velocity was calculated as the mean out of the three trials and was normally distributed.

The stroking speeds applied in the three studies were compared using generalized mixed models (GLM) with stroking speed as target and study group (3) as fixed effect. In order to deal with the small