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Tickling Healthy Subjects

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Abstract

Aim: Abnormal response to tickle stimulation has been demonstrated in schizophrenia and somatoform pain disorders. The aim of this study was to characterize the responses of healthy subjects to identical tickle stimuli applied by different individuals: 1) an experimenter, and 2) the subjects themselves, with attention to the type of device employed, the age and gender of the subject, the surface (palm, dorsum of hand) and side of the subject to which the stimulus is applied.
Method: Tickle was applied using two different pieces of apparatus: 1) a spring-loaded pointer, and 2) an artist's paint brush. 42 healthy subjects were randomly, sequentially stimulated on the palmar and dorsal surfaces of both hands. Tickle was graded using a 0-10 scale. Data were predominantly analysed using ANOVAs.
Results: For the pointer, the main effects of identity of the applier ($F_{1,41} = 19.3$, $p < 0.001$), surface ($F_{1,41} = 19.3$, $p<0.001$) and hand ($F_{1,41} = 5.2$, $p = 0.029$) were significant. Ticklishness was greater when the stimulation was applied by the experimenter, to the palm of the hand and to the right hand. For the brush, none of the main effects or interactions reached a conventional level of significance. Age and gender did not have a significant effect.
Conclusion: In healthy subjects, the existence of a perceptual difference when identical tickle stimuli are applied by an experimenter or the subject themselves, was confirmed. The results will inform future studies using this tickle paradigm (German J Psychiatry 2006,9: 107-110).

Keywords: Tickling, healthy subjects

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Introduction

Healthy subjects may perceive identical experimenter applied (EA) and self applied (SA) tactile stimuli to be different (Weiskrantz et al., 1971; Blakemore et al., 1999; Blakemore et al., 2000). SA stimuli have been reported to be less tickly, intense and pleasant than EA stimuli. Thus, evidence suggests a perception differential between EA and SA stimulation (EA-SA). An EA-SA may be due to the operation of a central monitor (Frith, 1992) or an internal forward model (Wolpert et al., 1995, Wolpert, 1997). A central monitor may compare sensory predictions which accompany intentions and actions, with actual sensory consequences. In such a situation, a match between the predicted and actual sensations would indicate a SA or self generated stimulus, and the sensation would be cancelled out to some extent. Weiskrantz et al. (1971) reasoned in this manner to explain why one cannot tickle oneself. There may be survival value in having a central monitor which produces an EA-SA, in that the organism may be less distracted by relatively unimportant internal sensations, allowing greater attention to danger signals from the environment.

The observation of an EA-SA in normal populations introduced the notion of abnormal function of the central monitor as an etiological factor in the positive and negative features of schizophrenia (Frith, 1992, Frith, 1987) and the chronic pain disorders, fibromyalgia and somatoform disorder (Karst et al., 2005).

The EA-SA has been studied in small numbers of healthy subjects. Although group findings have been reported, we could not find detailed results. Weiskrantz et al. (1971) described a device composed of a box with a slot in the upper surface, through which projected a pointer with a 1 mm diameter tip. The pointer was counterbalanced to produce an upward pressure of 17 gm. It was used to stimulate the sole of the foot and could be moved either by the subject or the experimenter. EA and SA stimuli were applied to 10 undergraduates (ages not given, presumably young adults). A unit score was assigned to the condition which was the more ticklish. All 10 subjects found the EA stimulation to be more ticklish, and the group result was highly significant.

Blakemore et al. (1999) employed a piece of foam attached the end of a robotic manipulator which moved against the palm of the subject's hand. The EA stimulus was provided by a computer program which caused the foam to move in a sinusoidal manner. The SA stimulus was produced by the subjects moving an object in a sinusoidal manner with one hand, and this movement was translated via two robots to provide the stimulus to the palm of the other hand. Sixteen healthy subjects aged 19 - 30 years participated. They rated sensations on a 0 - 10 scale for the separate descriptors, "intense, painful, tickly, pleasant and irritating". Painful and irritating received zero or very low scores and were dropped from calculations. For the group, SA stimuli were significantly less tickly, intense and pleasant than were the EA stimuli.

Blakemore et al. (2000) studied 15 healthy subjects and a group of patients with psychiatric disorders. We are concerned here only with the group of healthy subjects: 9 males and 6 females, with a mean age of 32 $\pm$ 2.07 years. A device component was a 70 cm rod with a piece of foam at one end, and a mid-point pivot which allowed sinusoidal movements of 1.5 cm amplitude. The device could be operated by either the subject or the experimenter, to allow contact of the foam with the palm of the subject's hand. Rating was on a 0 - 10 scale for "Intense, painful, tickly, pleasant and irritating", and for the group, SA stimuli were significantly less tickly, intense and pleasant than were the EA stimuli.

Karst et al. (2005) studied healthy subjects and patients suffering fibromyalgia and somatoform pain disorders. Only their healthy group is of current interest. There were 10 (8 females) with a mean age 42.9 $\pm$ 14.53 years. They used a hand fixing device with a slot on the palmar side, which admitted a pointer with a spherical tip of 1 mm diameter, counterweighted with springs to maintain a constant pressure of approximately 17 g. Subjects rated their sensation on a scale of 0 (not at all) to 10 (extremely) "intense". They found EA and SA responses of 2.85 $\pm$ 1.99 and 1.95 $\pm$ 1.29 respectively.

Smith & Cahusac (2001) reported an asymmetry of ticklishness ratings. They used the apparatus described by Weiskrantz et al. (1971) and provided EA stimuli to 34 undergraduates (ages not provided, but assumed to be young adults). Ratings were made of the intensity of the tickle using a 1-5 scale. The right foot was significantly more sensitive to tickle than the left. This was in contrast to the findings of those who had studied touch and pain. Smith & Cahusac (2001) pointed out that their results were consistent with the left hemisphere being important in positive emotions. As far as we are aware, this work has not been replicated.

Claxton (1975) studied the effect of predictability on tickle. Subjects received EA tickle with eyes open and closed. He concluded that the more predictable the stimulus the lower the tickliness rating. This is consistent with Charles Darwin's (1872) observation, "when tickled by another person, it seems the precise point to be touched must not be seen". Subjects have described tickle as becoming less strong as trials continue (Weiskrantz et al., 1971).

For the EA-SA to have clinical relevance, a thorough characterization of responses of healthy subjects is required. The aim of the present study was to characterize the responses of healthy subjects to identical tickle stimuli applied by two different agents: 1) an experimenter, and 2) the subjects themselves, with attention to the type of device employed, the age and gender of the subject, and the surface and side of the subject to which the stimulus is applied.

Method

The study was approved by the Southern Tasmania Health and Medical Human Research Ethics Committee. The subjects were members of staff and students in the Department of Psychological Medicine at the Royal Hobart Hospital, and they gave informed consent. None were taking analgesics or psychotropic medication.

Two pieces of apparatus were used, 1) the 1mm tipped spring-loaded pointer which provides a constant pressure of approximately 17 g described by Karst et al. (2005), and 2) a shovel-shaped painter's brush with a 2 cm width tip. The pointer was removed form the fixing device so that it could be applied by hand to a variety of surfaces. For each subject, one device was used for 24 trials (12 EA and 12 SA) and then, after the subject had rubbed all surfaces of his/her hands and rested for at least 3 minutes, the second device was applied for 24 trials. The subject and the examiner applied one trial in turn. The individual who applied the first trial was randomized. The order in which the devices were applied was alternated. The palms and the dorsum (excluding the fingers) of both hands were stimulated on 3 occasions. The order of the surface stimulated was randomized, with the exception that each surface was only stimulated once before changing to another surface. The device was held perpendicular to the surface and each trial consisted of six strokes moving proximal-distal and distal-proximal, each stroke taking 1 s. Subjects rated ticklishness on a 0-10 scale after each trial.

Age, gender and handedness (defined as the hand used for writing) were recorded.

Results

42 subjects were recruited (23 female, 19 male) with a mean age of 38.2 years (± 13.1, range 20-65). Two subjects were left handed, one was ambidextrous and 39 were right handed. Accordingly, comparisons between left and right handers could not be made, and all subjects were included in the analyses.

Preliminary analyses revealed that overall perception of tickle from EA stimulation (2.095) was scored higher than the SA stimulation (1.842). As the present study is the first, to our knowledge, to compare different stimulation devices data for the brush and pointer were analyzed separately in order to fully characterize the effects from each. Data were analysed using separate three-way repeated measures ANOVAs with surface (dorsum, palmar), side of hand (right, left) and identity of the applier (experimenter, self) as factors. Data are reported as mean ± one standard error of the mean.

For the brush, none of the main effects or interactions reached a conventional level of significance. However, the main effect of applier approached significance ($F_{1,41} = 3.8$, $p = 0.057$) with subjects rating EA stimulation (2.111 ± 0.183) as more intense than SA stimulation (1.905 ± 0.186).

For the pointer, the main effects of applier ($F_{1,41} = 19.3$, $p < 0.001$), surface ($F_{1,41} = 19.3$, $p<0.001$) and hand ($F_{1,41} = 5.2$, $p = 0.029$) were significant. Subjects rated EA stimulation (2.065 ± 0.162) as more intense than SA stimulation (1.762 ± 0.169), while stimulation of the palmar surface (2.151 ± 0.180) was more intense than stimulation of the dorsum of the hand (1.676 ± 0.161). Finally, stimulation of the right hand (1.971 ± 0.170) was rated as more intense than stimulation of the left hand (1.856 ± .157).

Significant two-way interactions involving surface and applier ($F_{1,41} = 7.7$, $p = 0.008$) and hand and applier ($F_{1,41} = 4.1$, $p = 0.048$) indicated that the effects of applier varied with the surface and the side stimulated. While the EA-SA was greater regardless of the surface of application, the difference was more pronounced for palmar stimulation (EA: 2.364 ± 0.178, SA: 1.938 ± 0.192) than dorsum stimulation (EA: 1.767 ± 0.164, SA: 1.585 ± 0.167). As well, the difference between EA-SA was greater for the right hand (EA: 2.166 ± 0.176, SA: 1.777 ± 0.173) than the left hand (EA: 1.965 ± 0.156, SA: 1.747 ± 0.169).

To test whether males and females differed on the above effects, subsequent ANOVAs were conducted with sex added as a between-subjects factor. Neither the main effect nor interactions involving sex were significant (all ps > 0.1), either for the brush or the pointer, indicating that males and females had a similar experience of intensity in all conditions.

Of interest was whether absolute intensity ratings and subjective differences between EA and SA stimulation varied with subject age. To assess this, mean intensity ratings were computed for EA and SA stimulation by averaging the ratings for surface and hand separately for the brush and pointer. The arithmetic difference between mean EA and SA stimulation was computed separately for the brush and pointer data. Linear regressions revealed that neither the absolute intensity rating nor the differences between EA and SA stimulation was related to subject age (all ps > 0.14).

Discussion

With 42 subjects the present study represents the largest sample to date of healthy subjects investigated using a tickle protocol. Thirty nine (92.9%) were right handed. It is possible, although unlikely, that these results may not apply in left handed individuals.

Overall, perception of tickle from EA stimulation (2.095) was scored higher than the SA stimulation (1.842). This was consistent with the earlier findings which used smaller groups (1 - 3, 8). This finding confirms that with respect to tickle, an EA-SA is a characteristic of healthy subjects.

For the pointer, the EA-SA was statistically significant, confirming the work of Karst et al. (2005). For the brush, while the EA-AS approached significance, significance was not achieved. Thus, it is not possible to recommend use of this inexpensive and readily available device; a specifically designed device appears necessary.

For the pointer, palmar surface stimulation was rated as significantly more ticklish than the dorsum. Thus, the focus of many earlier studies (Weiskrantz et al., 1971; Blakemore et al., 1999; Blakemore et al., 2000, Karst et al, 2005) cannot, on the basis of these results, be improved.

The early studies (Weiskrantz et al., 1971; Blakemore et al., 1999; Blakemore et al., 2000) used younger subjects, perhaps due to the availability of students. We found no effect of age. This is consistent with the work of Karst et al. (2005) who found a clear EA-SA using as slightly older group of subjects (42 ± 14.53 years) than in the present study. Evidence suggests somatosensory thresholds of non-noxious stimuli increase with age, whereas pressure pain thresholds decrease and heat pain thresholds show no age effect (Lautenbacher et al., 2005). Thus, stimulus specific changes may occur with age in some somatosensory modalities, but we found none with tickle sensation.

We found no effect of gender in response to tickle, which is in contrast with popular gender stereotypes. Females may have a lower tactile and pain thresholds on the cheek, but not inside the mouth (Komiyama et al., 2005). A history of childhood sexual abuse may be associated with a decreased sensitivity to pain, which may be more marked in females (Finningim et al., 2005). However, we did not consider childhood sexual abuse and the somatosensory modalities have distinct characteristics. To our knowledge this was the first study to assess the effect of gender on tickle sensation in healthy individuals.

The observation of an EA-SA in normal populations introduced the notion of possible abnormal function of the central monitor as an etiological factor in the positive and negative features of schizophrenia (Frith, 1992, Frith, 1987) and the chronic pain disorders fibromyalgia and somatoform disorder (Karst et al, 2005). The current study confirms the existence of an EA-SA in healthy individuals and encourages the use of this paradigm in the exploration of pathological conditions. Our results may inform future studies, indicating tickle is perceived to be stronger on the palm compared to the dorsum of the hand, and is not influenced by age or gender.

Finally, stimulation of the right hand (1.971 ± 0.170) was rated as more intense than stimulation of the left hand (1.856 ± .157). The EA-SA was greater for the right (EA = 2.153, SA = 1.797) than the left hand (EA = 2.037, SA = 1.886). This suggests an asymmetry, the right being more sensitive. This finding is in contrast with a lower threshold to touch (Bradshaw 1990) and pain (Chandramouli et al., 1993) on the left side and a more recent report of the absence of laterality in deep pain threshold (Rolke et al., 2005). However, this finding is consistent with the findings of Smith and Cahusac (Smith et al., 2001), who tickled feet. They suggested their results may be explained by the left hemisphere having a greater role in positive emotions. This is a question which deserves further exploration.

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