

Right-sided asymmetry in sensitivity to tickle

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A standard tickle apparatus was used to apply stimuli to the soles of left and right feet of subjects. Subject ratings of the strength of the tickle sensation felt after each stimulus revealed that the right foot was significantly more sensitive than the left. This effect was independent of both hand and foot preference. The results are discussed in relation to other findings on lateralisation, and it is suggested that they are consistent with evidence that the left hemisphere is more involved in positive emotions.

Although the experience of tickle is familiar enough, relatively little is known about the neuropsychology of this puzzling phenomenon. Asymmetries in hemispheric function are known for a range of sensory modalities and mental abilities. Often these asymmetries reflect hemispheric specialisations for particular abilities, for example language or handedness. Relatively little is known about asymmetries in the somatosensory system. Practised Braille readers show a preference to use the index finger of the left hand (Critchley, 1953); this being consistent with the demonstrably lower thresholds to touch on the left side of the body (Bradshaw, 1990). For pain too, the mean threshold (and the tolerance to pain) is lower on the left side (Chandramouli, Kanchan, & Ambadevi, 1993; Murray & Safferstone, 1970). One incidental observation from a study on 35 right-handed female subjects (where a 3 mg wad of cotton was applied over various parts of the torso, jaw, forearm, and thigh) was that the latency for onset of the tickle sensation was significantly shorter on the right side of the body (mean = 7.0 ± 9.3 s (\pm SD)) compared with the left side (mean = 15.3 ± 16.4 s) (Ruggieri & Milizia, 1983). We set out to investigate whether there was an asymmetry in sensitivity to tickle, and if so, whether it was dependent on hand or foot preference.

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METHOD

We used a tickle apparatus previously described in detail by Weiskrantz and colleagues (Weiskrantz, Elliott, & Darlington, 1971) with which they studied experimentally the well-known experience that self-administered tickle is less effective than tickle administered by another person. The tickle stimulus consisted of a pointed nylon rod (0.5 mm^2 tip) moved 10 cm lengthwise over the bare sole of the foot, starting 7 cm from the posterior edge of the sole. Subjects were 34 volunteer university undergraduates (21 females, 13 males) with a mean age of 21.2 years and who gave informed consent to participate in the study. They were tested between 10.00 and 16.00 hours. Foot preference was first established for each subject by noting which foot was used to kick (from the best of three kicks) a lawn tennis ball into a small goal, 0.45 metres wide, from a distance of 1.5 metres. This was a surprisingly demanding task, and comments made by subjects during their performance indicated that they believed that their skill rather than their foot preference was being assessed. As this was a complex performance-based assessment, it was a more reliable measure of foot preference compared with a questionnaire-based assessment (Coren, 1993; Gabbard & Hart, 1996). Subjects then completed a questionnaire devised to determine attitudes to tickle (Fridlund & Loftis, 1990). The questionnaire used eight of the nine items, and item 8 ("I blush easily") was replaced by the item "I find that being tickled is painful". Subjects were then seated, shoes and socks removed from both feet, while one of the investigators (JLS) applied the tickle stimuli. Three tickle strokes were made over 3 seconds: forward, backward, and forward synchronised with a metronome beat set at one-second intervals. The tickle stimulus was applied to one foot, followed, within one minute, by the same stimulus applied to the other foot. After each stimulus subjects were required to give a rating, on a scale of 1–5, for the intensity of the tickle experienced. Order effects of the stimuli were controlled for across both left/right feet and left/right foot preference (order *per se* was found to have no significant effect on the ratings). If the subject gave the same rating for both feet they were asked to decide which foot was most sensitive. Finally handedness was determined using the Edinburgh Handedness Inventory (Oldfield, 1971).

RESULTS

As expected there was a significant positive correlation between the left and right foot tickle ratings ($r = .506, p = .002$). However we were surprised to find that significantly more subjects, 26 of 34, found that their right foot was most sensitive to the tickle stimulus, $\chi^2(1) = 9.53, p = .002$. The mean tickle rating for the right foot was 3.32, which was significantly higher than the mean rating for the left foot of 2.76 (mean difference = 0.56 ± 1.2 (\pm SD), $t(33) = 2.69, p = .011$). The effect size thus was estimated to be 0.46, which is similar or larger than the

effect sizes observed for the left-sided asymmetry in pain threshold and tolerance (Chandramouli *et al.*, 1993; Murray & Safferstone, 1970). A histogram plot of the distribution of ratings (Figure 1) for the right foot (B) shows the distribution to be approximately normal with a single mode at 3. A quite different distribution of ratings was found for the left foot (A): there were

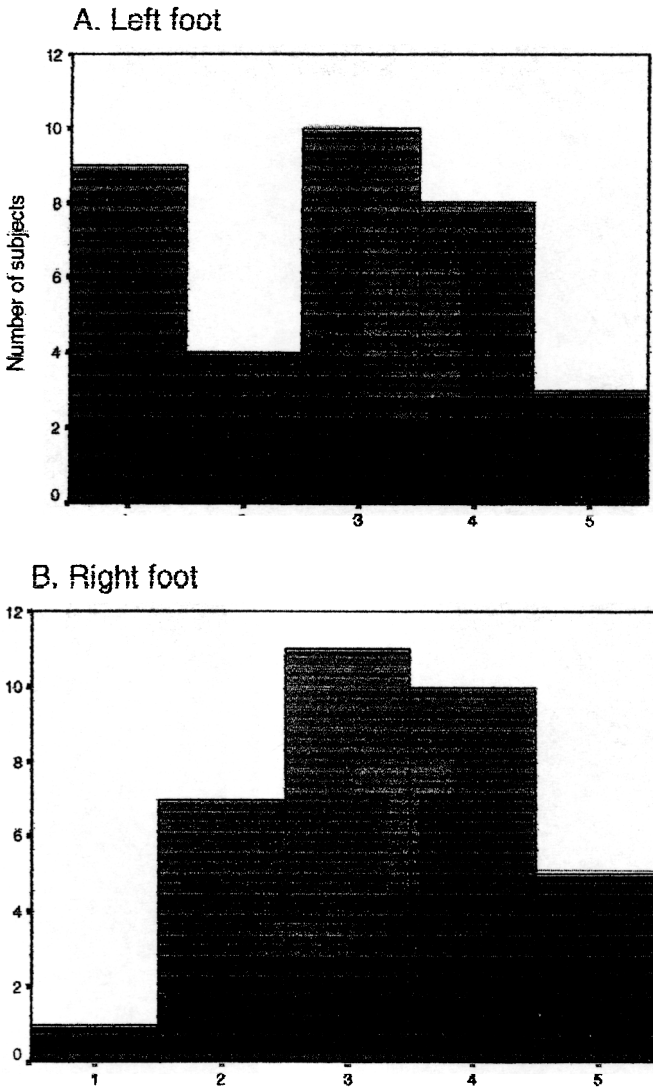


Figure 1. Histograms of tickle ratings. The distribution of subject ratings for the left foot are shown in A and those for the right foot in B.

proportionately fewer ratings above 3, and the distribution appeared to have two modes, one at 3 and the other at 1. The descriptive statistics for the data are given in Table 1.

The superior sensitivity of the right foot to tickle could not be explained by foot preference, as the observed proportions were not different from those expected under the null hypothesis of independence, Table 2 (Fisher's Exact test, one-tailed $p = .598$). Similarly, hand preference could not explain the difference, Table 2 (Fisher's Exact test, one-tailed $p = .351$). Subjects who were classified as right-handed tended to be right-footed, and those left-handed tended to be left-footed. Analyses of the mean tickle ratings for handedness and foot preference produced non-significant complementary results with those performed earlier. Finally gender was also excluded as a factor that might explain the right-sided asymmetry.

The questionnaire concerning attitudes to tickle involved marking a scale from 1 (Not at all true of me) to 4 (Somewhat true of me) to 7 (Very true of me). Subjects who gave a score of 3 or more to the item "I find that being tickled is painful" had a small and non-statistically significant difference between right and left foot tickle sensitivity rating, mean difference = 0.2, $t(14) = 0.64, p = .53$. In contrast, those subjects who gave a score of less than 3 had a large (effect size 0.72) and highly statistically significant different between right and left feet, mean difference = 0.84, $t(18) = 3.14, p = .0056$.

TABLE 1
Descriptive statistics

N	Foot tested			
	Left		Right	
	Mean	SD	Mean	SD
34	2.76	1.33	3.32	1.07

Tickle ratings according to foot tickled (as for data displayed in Figure 1).

TABLE 2
Cross-tabulation of the foot that was most sensitive to tickle with foot and hand preference

Foot Hand Preference	Most sensitive foot	
	Left	Right
Left	3 3	9 6
Right	5 5	17 20

DISCUSSION

Our results appear to show a marked difference in sensitivity to tickle between the left and right soles of the feet. This difference cannot be explained by either hand or foot preference. It is conceivable that if subjects were aware of the aim of the study, then this might bias responses or subjective experience in favour of one side. Although possible, this is highly unlikely as great care was taken to obscure the specific aim of the study from subjects. The foot preference test was generally perceived by subjects as a test of skill. The handedness questionnaire, which could cue subjects, was only administered after the tickle stimuli. Subsequent informal questioning of subjects indicated that they believed primarily that their general sensitivity and attitudes to tickle were being assessed, and not any asymmetry.

We do not know whether this asymmetry generalises to other parts of the body, although the available evidence (Ruggieri & Milizia, 1983) on latencies to evoke tickle over several regions of the body provides support for this. Against our expectations, the results contrast with those obtained with other somatosenses in which the left side is more sensitive, e.g. for pain and touch (Chandramouli et al., 1993; Bradshaw, 1990). Also against expectation was the finding that the asymmetry was independent of both handedness and foot preference; although this was similar to the independence previously observed between the asymmetry in pain thresholds (and tolerance) and hand preference (Chandramouli et al., 1993).

If tickle is generally considered to be a pleasurable experience, then the present findings may be concordant with the evidence that the left hemisphere is more involved in positive emotions (Silberman & Weingarter, 1986). This suggestion is further supported by the present study's finding that the extent of the asymmetry depended on whether or not subjects generally experienced tickle as an unpleasant experience.

Some analyses of the phenomenon of tickle have linked it to laughter, humour, and social communication (Darwin, 1872; Fridlund & Loftis, 1990; Provine, 1996). However, recent work has shown that the experience of tickle is not an interpersonal phenomenon that requires another person, and that it is more dependent on the unpredictability or uncontrollability of the stimulus (Harris & Christenfeld, 1999).

In conclusion we have demonstrated a clear enhanced sensitivity of the right foot to tickle which is independent of both handedness and foot preference. This asymmetry distinguishes the experience of tickle from that of pain and touch (both of which are generally more sensitive on the left side of the body). As this asymmetry was marked in subjects who did not rate tickling as unpleasant, the asymmetry may be related to the left hemisphere's proposed greater involvement in positive emotions. The neglected but experimentally amenable topic of tickle is worthy of greater neuropsychological and physiological study.

The experience of tickle and its production are similar in a number of respects to itch and pain (Bishop, 1948; Pritchard, 1932; Stengel, 1965) and it may be that a deeper understanding of its basis would have clinical implications for the treatment of somatosensory disorders.

Manuscript received 1 March 2000

Revised manuscript received 29 August 2000

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