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Supplemental Data

Phantom Tactile Sensations Modulated by Body Position

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Supplemental Experimental Procedures

MRI imaging of neural damage

Supplemental Figure 1 provides sagittal, coronal and horizontal views of the fronto-parietal damage suffered by DLE as a result of stroke that took place three years prior to the onset of this investigation.

Basic somatosensory evaluation: methodological details

The experimental testing required DLE to indicate the location of a tactile stimulus presented to either the left or right hand. Given his inability to move his right arm, all responses would need to be given with the left hand. While DLE could easily use his left hand for reporting the location of right-side stimulation (by pointing to the location of the stimulus on his hand), reporting stimulus locations on the left hand itself posed a challenge. In order to provide DLE with a method of reporting the location of stimuli presented to the left hand, the experimenter held a probe in a fixed position above DLE's left (ipsilesional) hand, and DLE moved the left hand so that the stimulated location would be directly below the probe. Although this method could be expected to be less precise than pointing, DLE was actually substantially more accurate in localizing ipsilesional left hand stimuli (using this method) compared to contralesional right hand stimuli (localized by pointing) (see Supplemental Figure 2b). In addition, we also

assessed DLE's ability to accurately point with his left hand by stimulating each of the 22 locations on his right hand (see Supplemental Figure 2a) with his eyes open. On every trial, DLE pointed accurately to the exact location he was touched, demonstrating that his inaccuracy with eyes closed for right hand stimuli was not due to some other deficit (e.g. motor). Therefore, the difference in reporting methods for the two hands cannot account for the decreased localization accuracy that DLE exhibited for stimulation to his contralesional right hand.

Mislocalization of veridical right-hand percepts

Supplemental Figure 2a depicts the 22 stimulation locations used in Task 2, and Supplemental Figures 2b and 2c depicts the locations at which DLE reported these stimulations. The gross misperception of location is apparent and documented statistically in the main body of the paper.

Localization of the synchiric, right-hand phantoms

In addition to the veridical sensations DLE experienced in response to unilateral-right (contralesional) stimulation, he also reported localizable phantom sensations on the right hand in response to unilateral-left (ipsilesional) stimulation (see Supplemental Figure 2c for these locations, reported in red). To compare the displacement in DLE's localization judgments of the right hand veridical sensations with those for the right-hand phantom percepts, for the latter we calculated displacement from the point on the right hand that was homologous to the stimulation point on the left hand. For example, for a trial on which DLE was stimulated on the dorsal segment of the index finger on his left hand, we measured displacement of the synchiric percept from the homologous dorsal segment of the index finger of the right hand. Veridical right hand displacement values

were then compared to phantom displacement values, using a paired t-test assuming unequal variances. This analysis reveals that DLE was significantly more "accurate" at localizing the *phantoms* (mean displacement, x = 2.1 mm, y = 11.1 mm) compared to the veridical percepts ($p < .001$ for both x- and y-axes). Additionally, there was no significant difference between localization accuracy for veridical stimuli presented to the left (ipsilesional) hand and the phantom percepts experienced on the contralesional right hand (x-axis, $p < .75$, y-axis, $p < .84$). As can be seen in Supplemental Figures 2b and 2c, for all 22 stimulation sites both veridical percepts on the left hand and phantom percepts experienced on the right hand were localized to highly similar homologous locations. Importantly, with respect to the right hand, while phantom percepts were perceived to originate from the 22 stimulation sites distributed across the right hand, the veridical percepts were all perceived to originate from an area around the third and fourth fingers

In Task 2, half of the bilateral stimulation trials involved stimulation to the same homologous locations on the two hands and half to different locations. On these latter trial types, DLE reported stimulation at the same location on both hands on 82% of trials. For these trials, we calculated if the location of the "phantom" sensation was more similar to the homologous location of the left-hand stimulus or to actual right-hand stimulations point. The analysis indicates that DLE experienced the "phantoms" on bilateral different-location trials as significantly closer to the homologous locations of the left-handed stimulation points (mean displacement: x = 1.1 mm, y = 1.04 mm) than to the actual stimulation points on the right hand itself (mean displacement: x = 4.15 cm, y = 5.24 cm; paired t-test, $p < .001$ for both the x- and y-axes). Furthermore, the localization

judgments for the phantoms experienced in bilateral different-location trials and phantoms experienced on unilateral-left trial had comparable (small) displacement values (paired t-test; x-axis, $p = .73$; y-axis, $p = .74$).

It is striking that while the localization of "veridical" percepts in response to stimuli delivered to the right hand is grossly distorted, the localization of the "phantom" percepts on the right hand generated from either unilateral-left or bilateral trials appeared to be very accurate (when measured relative to the homologous contralateral stimulation point). One explanation for this combination of behaviors would be that, subsequent to left side stimulation, the signal that originates in the intact right hemisphere is transmitted to the left hemisphere at some level of somatosensory system that is reasonably intact. The left hemisphere substrates that support these well-localized phantom percepts are, presumably, distinct from the damaged left hemisphere substrates recruited by bottom-up, right hand stimulation that is, presumably, processed via the left hemisphere thalamo-cortical route. However, an alternative account is that DLE is unable to accurately localize the phantom stimuli, and that, when he is uncertain about the location of a right hand percept he is biased to report stimulation at the location homologous to that of the left hand stimulus. Although a strong bias hypothesis cannot be refuted it is weakened when we consider the following. First, on bilateral different trials, DLE does report being stimulated in different locations on the same location on both hands for 9 out of 44 trials (18%). On one of these trials, DLE could not report the location of the right hand stimulus, other than to say that it was in a different location than the left hand stimulus. This provides at least some indication that DLE was not always biased to report contralesional sensation in the location of the ipsilateral stimulus. Second, on the other 8

bilateral trials where DLE reported being stimulated in different locations on the two hands, the location of the contralesional sensation clustered around the proximal segments of digits 3 and 4 (see Figure 2c, blue). These observations support the hypothesis that on bilateral trials DLE reported the actual perceived location of the contralesional percept: sometimes the right hand percept was the veridical percept based on bottom-up distorted representations and was experienced near digits 3 and 4, sometimes it was the phantom percept generated from left hand stimulation, transmitted cross-hemispherically to a higher, more intact level of left hemisphere somatosensory representation.

Figure S1

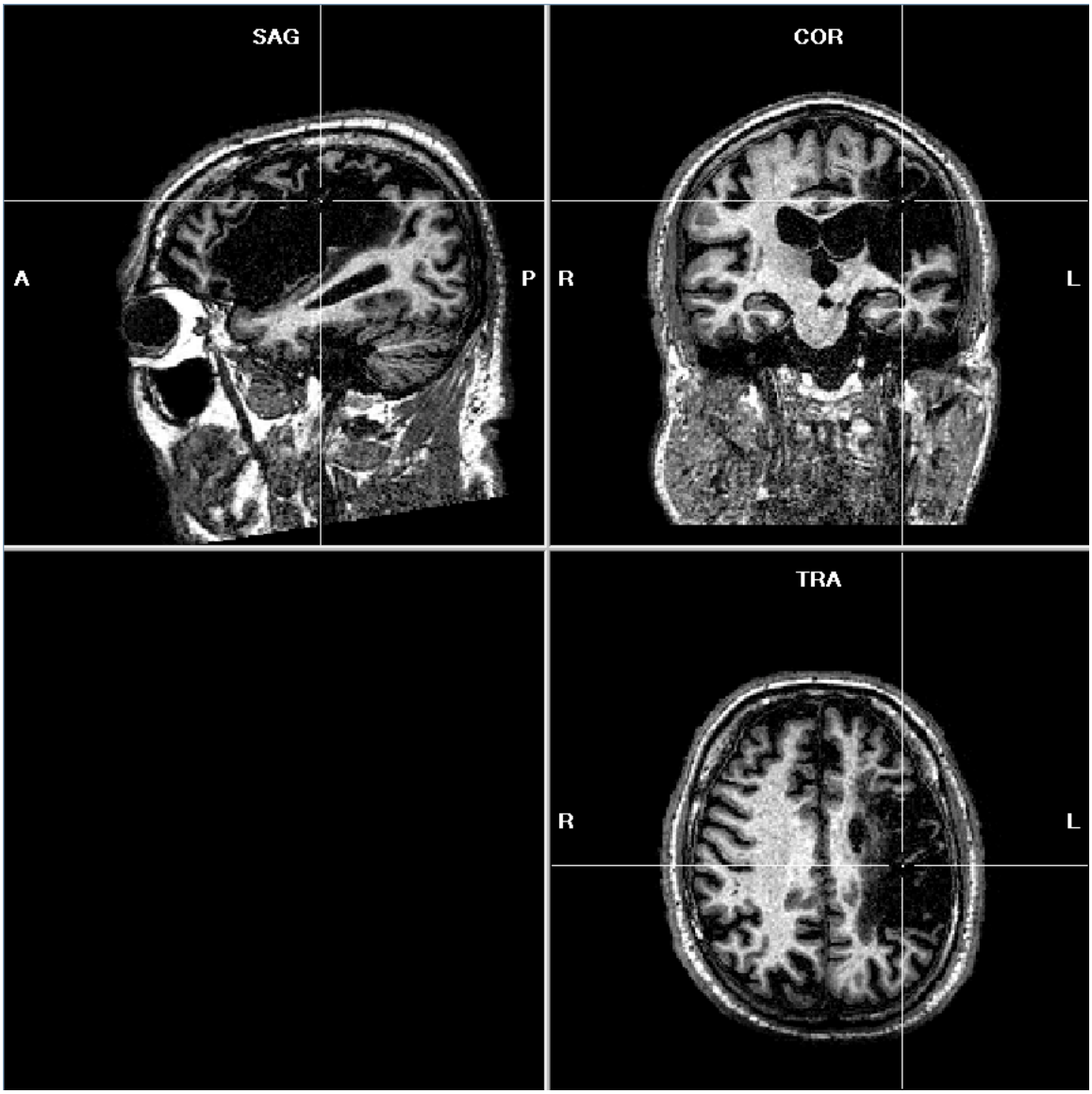
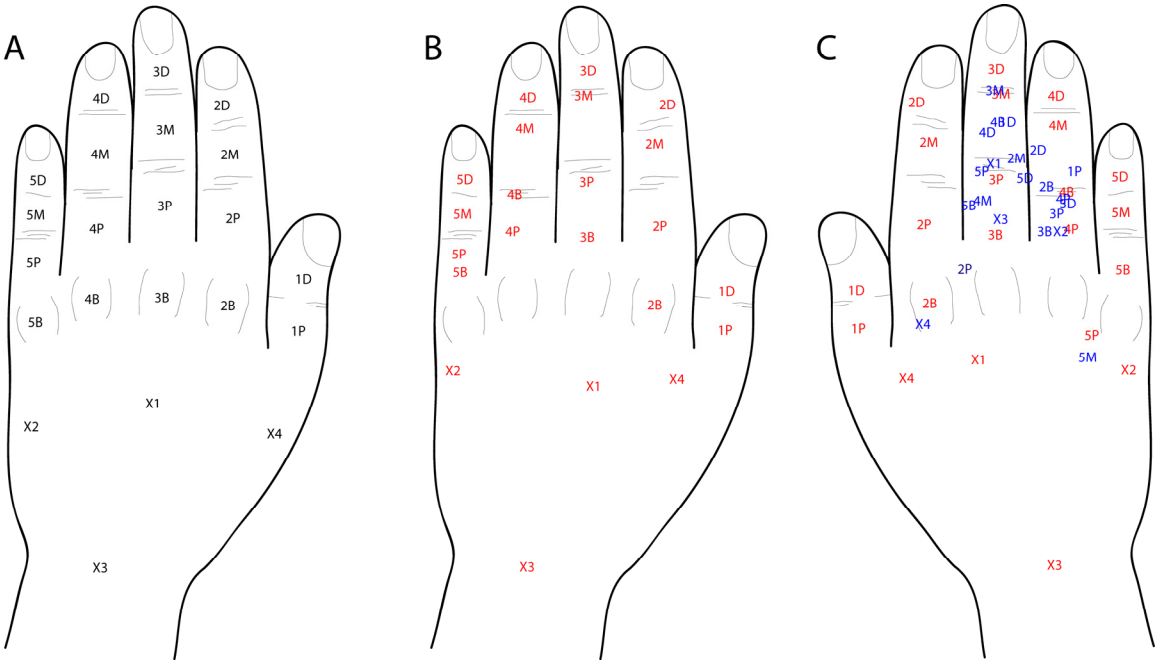


Figure S2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Supplemental Figure Legends

Figure S1. Images from Structural MRI Scanning of DLE's Brain

Figure S2. Localization of Phantom and Veridical Tactile Sensations

(a) Stimulation points depicted on the dorsal surface of the left hand. Figures (b) and (c) report DLE's mean localization judgments for each of the 22 stimulation points when stimulation was delivered to the left hand (red) and the right hand (blue). Note that (c) includes both localization judgments for veridical right-hand percepts reported subsequent to right-hand stimulation (blue), as well as phantom right-hand percepts reported subsequent to left-hand stimulation (red). D = distal finger segment, M = medial finger segment, P = proximal finger segment, B = base of finger, X = hand locations proximal to fingers. Except for X, numbers represent the finger stimulated (1 = thumb, 2 = index finger, etc.).