Brain activity associated with the rubber foot illusion

（ラバーフットイリュージョンに関わる脳活動）

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Brain activity associated with the rubber foot illusion

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Highlights

- Brain activity during the rubber foot illusion was examined
- The prefrontal cortex, parietal cortex, and cerebellum were conjointly activated
- Activated brain-area distribution was similar to that in the rubber hand illusion
- These areas may be associated with the internal representation of one's own body

[1]

[1] List of abbreviations

FDR: false discovery rate

fMRI: functional magnetic resonance imaging

RFI: rubber foot illusion

RHI: rubber hand illusion

ABSTRACT

The internal representation of the body is constantly updated by sensory information based on interactions with the environment. The internal representation of the hand can be experimentally manipulated with the rubber hand illusion (RHI) paradigm. Brain activity during the RHI provides insight into the neural mechanisms underpinning the reconstruction of the internal representation of the hand. Recently, the RHI paradigm has been employed for the lower limb, revealing that the illusion is also induced in the lower limb (rubber foot illusion; RFI). However, the neural correlates of the RFI remain unknown. We used functional magnetic resonance imaging (fMRI) to examine brain activity during the RFI. Forty-four healthy volunteers participated in the fMRI experiment. Significant increases in activation were observed in the bilateral medial and middle frontal gyri, left supplemental motor area, bilateral inferior parietal lobuli, precunei, calcarine cortices, and cerebellar hemispheres; and in the vermis and bilateral thalami during the right RFI. During the left RFI, significant increases in activation were observed in the bilateral medial, middle, and superior frontal gyri; left inferior frontal gyrus and supplemental motor area, bilateral inferior parietal lobuli and middle temporal gyri, and in the left cerebellar hemisphere, vermis, and bilateral thalami. Conjunction analysis revealed that the prefrontal cortex including the bilateral medial and middle frontal gyri, parietal cortex including the bilateral inferior parietal lobuli, and cerebellum including the bilateral cerebellar hemispheres and vermis were conjointly activated during the right and left RFIs. The distribution of co-activated brain areas during the RFI was similar to the previously reported distribution of brain areas activated during the RHI. Co-activation of these brain areas may be associated with the reconstruction of the internal representation of the body. The fact that these areas are activated both in the RFI and RHI will have implications for the treatment of patients with disturbed internal bodily representation.

Keywords:

body image, rubber foot illusion, internal representation, self-consciousness, bodily illusion, body ownership

1. Introduction

In everyday life, we take for granted our ability to perceive the location of our body parts in space across many different postures and to control our spatial actions accordingly [1]. To enable this, the brain maintains an internal representation of body parts, which is based on the sensory integration of our daily interaction with the outside world and produces the feeling that my body is part of me and belongs to me. This feeling is known as body ownership [2,3], which is an essential requirement for self-consciousness.

Lower limb amputation causes substantial functional impairment in an individual due to the loss of physical limb structures. For people with lower limb amputation, the loss of physical limb structures and adequate sensory perception provokes profound challenges in activities of daily living (ADL) [4,5]. To preserve ADL function, reconstruction of the internal representation of the changed lower limb is needed, but the neural mechanisms underlying this process remain unknown.

The internal representation is constantly updated based on sensory information from interactions with the environment [6]. The feeling of ownership of the hand can be experimentally manipulated using the rubber hand illusion (RHI) paradigm, whereby a person perceives a rubber hand as his or her own by synchronously brushing the person's hidden real hand and an artificial hand that is placed in full view [7-13]. When the illusion arises, the internal representation of the hand is reconstructed so that the somatic information from the hand matches the visual information. Several functional magnetic resonance imaging (fMRI) studies have investigated brain activity associated with the RHI and revealed that activity in the ventral premotor cortices, intraparietal cortices, and cerebellum was associated with the RHI, suggesting that neural activity in these brain areas reflects the feeling of ownership of the hand [9,10]. Recently, the RHI paradigm was transferred to the lower limb, indicating that the illusion is also induced in the lower limb [4,14-16]. The neural mechanisms producing the rubber foot illusion (RFI) are expected to concern the reconstruction of the internal representation of the lower limb.

The present study aimed to examine brain activity during the RFI to help uncover which brain areas are implicated in the reconstruction of the internal representation of the lower limb.

2. Materials and methods

2.1. Participants

Forty-eight healthy volunteers (32 male, 16 female; mean age, 21 ± 1.2 years; all but one right-footed, as measured with the Waterloo Footedness Questionnaire [17]) participated in this study after signing written informed consent. This study was approved by the Ethics Committee of the Kyoto University Graduate School and Faculty of Medicine and was conducted in accordance with the Declaration of Helsinki. A pre-test was performed to detect participants who feel the RFI. Potential participants sat on a bed with both legs to examine the experience of the RFI. The procedures were the same as those followed in a previous study using the RFI [4]. The participant's real right or left foot was hidden behind a screen, and the rubber foot was placed in parallel with the participant's real foot in such a manner as to resemble the real foot. The experimenter synchronously brushed the hallux of the rubber foot and the hallux of the participant's hidden foot with a paintbrush at a frequency of 1 Hz. After a 60-s period of synchronous brushing, participants were instructed to complete a questionnaire to examine whether they experienced an illusion. The questionnaire (Supplementary Table 1) comprised nine statements adapted from a previous study [7] for application to the foot [14] instead of to the hand and was translated into Japanese. Three of the statements, namely illusion statements, referred to the extent of sensory transfer into the rubber foot. The remaining six statements served as controls to assess suggestibility. Participants completed the questionnaire after each illusion test using a seven-point visual analogue scale to rate the extent to which these statements did or did not apply. On this scale, "-3" denoted "absolutely certain that it did not apply," "0" denoted "uncertain whether or not it applied," and "3" denoted "absolutely certain that it applied." In total, 44 participants (the mean rating to the illusion statements > the mean rating to the control statements) participated in the fMRI experiment (Fig. 1).

2.2. fMRI experiment

MR images were acquired using a 3.0-T system (MAGNETOM Verio, Siemens AG, Erlangen, Germany) with a 32-channel head coil. T1-weighted anatomical images of each participant's brain were obtained for anatomical normalization. This scan was performed using a magnetization prepared rapid acquisition with gradient echo sequence. Sequence parameters were as follows: repetition time (TR) = 2250 ms, echo time (TE) = 3.51 ms, inversion time = 900 ms, flip angle = 9°, acquisition matrix = 256 × 256, field of view = 256 mm × 256 mm, pixel size = 1.0 mm × 1.0 mm, thickness = 1.0 mm, and 192 slices. Functional images were acquired using a single-shot gradient-echo echo-planar imaging sequence. Imaging parameters were as follows: TR = 2000 ms, TE = 25 ms, flip angle = 75°, acquisition matrix = 64 × 64, field of view = 224 mm × 224 mm, pixel size = 3.5 mm × 3.5 mm, thickness = 3.5 mm, and 39 slices. Elastic pads were placed to stabilize the head position during MR imaging.

Participants rested comfortably in a supine position on the bed in the MRI scanner (Fig. 2). Participants wore earplugs to reduce noise and viewed the rubber foot through a mirror attached to the head coil of the scanner (HM-32-V, Kiyohara Optics, Tokyo, Japan). Participants placed their leg (right or left) in a box, and the rubber foot (right or left) was placed at 20 cm on the inside of their leg. The participant’s legs were retained 25° apart. The proximal portion from the ankle of the rubber foot was hidden with a towel. Participants were able to see the foot of the rubber foot in the mirror. In each fMRI session, the experimenter synchronously brushed the hallux of the rubber foot and the hallux of the participant’s hidden foot with a paintbrush at a frequency of 1 Hz. Participants continued viewing the hallux of the rubber foot while the experimenter was brushing. To indicate the onset of the illusion, the participants dorsiflexed their hand when they first began perceiving the rubber foot to be their own. After the onset of the illusion, the experimenter continued to synchronously brush the rubber foot and the hidden real foot for 30 s. Then, the experimenter alternately brushed the rubber foot and the hidden real foot to erase the illusion. For each participant, this fMRI session was conducted four times per foot. The order of these sessions was counterbalanced across the participants. When the occurrence of the illusion was not indicated by participants for 90 s after the initiation of synchronous brushing, we discontinued the brushing and deemed that the illusion no longer occurred.

2.3. Data analysis

fMRI data were preprocessed and analyzed using the Statistical Parametric Mapping software (SPM8) (Wellcome Department of Imaging Neuroscience, London

UK; http://www.fil.ion.ucl.ac.uk/spm/). The images were corrected for slice timing, realigned to correct for head movements, and coregistered with each participant's anatomical MRI. All coregistered images were spatially normalized (voxel size 2 × 2 × 2 mm) to the T1 template in the Montreal Neurological Institute (MNI) space [18] and smoothed with a 6 mm full width at half maximum Gaussian kernel.

The condition before the onset of the illusion during stimulation of synchronous brushing was defined as *BI*, whereas that after the onset of illusion during stimulation of synchronous brushing was defined as *AI*. The brain activity associated with the RFI was analyzed using the contrast between *AI* and *BI*. The brain activities during *AI* and *BI* were induced under the same stimulus conditions (synchronous brushing) where the only difference was the perception being present or not. Thus, the resulting contrasts were considered to indicate simple illusory perception effects. The duration of *BI* varied among participants. The optimal length of block duration has been reported to be 15 s in blocked designs of fMRI experiments [19]. Thus, the brain activity of participants showing duration longer than or equal to 15 s was analyzed in order to obtain stable fMRI data in the present study. The brain activity for 15 s after the start of synchronous brushing of the rubber foot and hidden real foot was analyzed as the fMRI data of *BI*. Similarly, the brain activity for 15 s after the onset of the illusion was analyzed as the fMRI data of *AI*.

In statistical analyses, activated voxels in each condition were identified using a statistical model containing a boxcar function convolved with a canonical hemodynamic response function. A linear regression model (general linear model) was used to obtain participant-specific estimates for each effect. To accommodate inter-participant variability, contrast images from participants to be analyzed were entered into a random effect group analysis. To identify regions in which brain activation was associated with right and left RFIs, one-sample *t*-test was performed using contrast images of the illusory perception effect. The statistical threshold was set at $P < 0.05$ (corrected for multiple comparisons using the false discovery rate (FDR)). Moreover, to explore the common regions between group activation for the right and left RFI, we performed conjunction analyses (global null hypothesis). In these conjunction analyses, the statistical threshold was set at $P < 0.05$ (corrected for multiple comparisons using the FDR). Anatomical labels were assigned on the basis of the classification of the automated anatomical labeling atlas [20].

3. Results

All participants who experienced the illusion reported that the illusion was vivid and persisted until the end of the synchronous brushing period once the illusion occurred.

In the right foot experiment, 39 of 44 participants experienced the illusion of their own right foot being touched when viewing a right rubber foot being synchronously touched in three or four of four sessions. Twenty-one of the 39 participants showed *BI* with duration longer than or equal to 15 s, and the brain activity of 21 participants was analyzed in the sessions with duration longer than or equal to 15 s. Significant increases in activation were observed in the bilateral medial and middle frontal gyri, left supplementary motor area, bilateral inferior parietal lobuli, precunei, calcarine cortices, and cerebellar hemispheres; and in the vermis and bilateral thalami during the right RFI ($P < 0.05$, corrected for multiple comparisons using the FDR) (Table 1).

In the left foot experiment, 36 of 44 participants experienced the illusion of their own left foot being touched when viewing a left rubber foot being synchronously touched in three or four of four sessions. Twenty-three of the 36 participants showed *BI* with duration longer than or equal to 15 s, and the brain activity of 23 participants was analyzed in the sessions with duration longer than or equal to 15 s. Sixteen participants were included in both the right and left RFI analyses. Significant increases in activation were observed in the bilateral medial, middle, and superior frontal gyri, left inferior frontal gyrus and supplementary motor area, bilateral inferior parietal lobuli and middle temporal gyri, left cerebellar hemisphere; and in the vermis and bilateral thalami during the left RFI ($P < 0.05$, corrected for multiple comparisons using the FDR) (Table 1).

Conjunction analysis was performed using the 21 right foot data and 23 left foot data from 28 participants to identify the brain areas exhibiting conjointly increased activation during the right and left RFIs. Significant conjoint increases in activation were observed in the bilateral medial and middle frontal gyri, inferior parietal lobuli, calcarine cortices, and cerebellar hemispheres; and in the vermis and bilateral thalami at $P < 0.05$ (global null hypothesis, corrected) (Table 2 and Fig. 3).

4. Discussion

The RFI was similarly induced as reported in previous studies using the RFI paradigm [4,14-16]. The right and left foot fMRI experiments showed that significant increases in activation were induced in the frontal, parietal, and occipital lobes and the cerebellum and thalamus during the RFI, as shown in Table 1. Conjunction analysis was conducted to detect brain areas conjointly exhibiting increased activation during both the right and left RFIs and revealed that a common increase in activation occurred in the prefrontal cortex including the bilateral medial and middle frontal gyri, parietal cortex including the bilateral inferior parietal lobuli, and cerebellum including the bilateral cerebellar hemispheres and vermis. These areas of co-activation may be associated with the internal representation of the feet.

Electrical stimulation in the inferior parietal lobule has been reported to cause a perceived mismatch between one's awareness of the self and the physical location of one's body [21,22], indicating that the inferior parietal lobule is associated with matching one's body to one's self. The prefrontal cortex has been reported to be involved in multisensory integration of visual, tactile, and proprioceptive signals from one's own body [23-25], and the activity has been reported to reflect the feeling of ownership [9,10], suggesting that the prefrontal cortex integrates multisensory signals from one's own body in order to establish ownership. The cerebellum is known to be involved in multisensory processing and receives information from many sensory modalities including vision and proprioception [26,27]. It has been reported that cerebellar activation is induced before the onset of the RHI and is related to a recalibration process of one's own body position [9], signifying that the cerebellum is associated with recalibration of limb position to update the current body position. Thus, neural networks including the parietal cortex, which processes matching between one's body and one's self, prefrontal cortex, which processes ownership, and cerebellum, which processes the recalibration of limb position, may be implicated in the experience of the RFI. Further studies are needed to clarify the functional connectivity of these brain areas to establish the neural mechanisms underpinning the reconstruction of the internal representation of the lower limb. It was recently reported that higher cognitive functions, such as attention, can influence the occurrence of the RHI [28]: participants with higher attention had faster RHI onset times and experienced the RHI more vividly. This suggests that the factor of higher cognitive function should be taken in consideration when investigating the neural mechanism of bodily illusions. Additional studies will be also needed to investigate the influence of higher cognitive functions on the distribution of brain areas associated with bodily illusions.

In addition to the above brain areas, the thalamus and primary visual cortex (calcarine cortex) were activated when the participants perceived the rubber foot as a part of their own body. This could be explained as follows: the induced curious perceptual change in the perceived location of the participant’s own foot may have activated their sensory systems, transmitting visual and tactile sensory signals. Corticofugal projections have been reported to act as attentional filters that enhance relevant and reduce irrelevant sensory inputs [29].

If there are center areas involved in the reconstruction of the internal representation of the whole body (such as several language areas playing a critical role in speech), the areas activated during the RFI may also be activated during the RHI. The distribution of brain areas activated during the RFI was similar to that of previously reported brain areas activated during the RHI. It has been reported that increases in activity were induced in the bilateral premotor cortex, left intraparietal cortex, and bilateral cerebellum during the RHI [9,10]. These data suggest that activation of the prefrontal cortex, parietal cortex, and cerebellum is associated not only with the RFI but also with the RHI. Several studies induced the RHI and RFI using a within-subjects design to examine the concerning multisensory processing and have reported that the embodiment of a limb follows the same principles for the upper and lower parts of the body [15,16]. The conjoint activation of these brain areas may indicate an overlapping system governing the reconstruction of the internal representation of the whole body.

The RFI approach might have important clinical consequences. The prosthetic lower limbs are a key element in the rehabilitation of people with lower limb amputation [30]. The embodied experience of prothesis using the RFI, which provides the amputee the feeling that they own the foot, may improve the controllability of the prosthesis and enhance the satisfaction of the amputee in using the prosthesis [4]. Furthermore, the activation of the neural networks comprising the prefrontal cortex, parietal cortex, and cerebellum activated during the RFI may accelerate the improvement of rehabilitation outcomes.

The results of this study should be interpreted in the context of several limitations. Brain activity was not examined in all participants. The participants who did not experience the illusion during the pre-test were excluded from the subsequent fMRI experiment. In addition, to obtain stable brain activity, we further excluded participants who showed *BI* with duration shorter than 15 s. It has been reported that the rapidity of onset of the RHI is positively correlated with the strength of the perceived illusion [28]. This result suggests that the excluded participants who showed *BI* with duration shorter than 15 s experienced an illusion of stronger strength. Our data may have been mainly obtained from participants who experienced an illusion of moderate strength.

In conclusion, we used the RFI to study the neural correlates of the reconstruction of the internal representation of the lower limb. The present study showed that conjoint activation occurs in the prefrontal cortex including the bilateral medial and middle frontal gyri, parietal cortex including the bilateral inferior parietal lobuli, and cerebellum including the bilateral cerebellar hemispheres and vermis during the right and left RFIs. The distribution of these co-activated brain areas is similar to the previously reported distribution of brain areas activated during the RHI [9,10]. The conjoint activation of these brain areas may be associated with the reconstruction of the internal representation of one's own body. Our findings have implications for the treatment of patients undergoing rehabilitation after disturbed internal bodily representation after lower limb amputation.

Declarations of interest: none.

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Figure legends

Fig. 1. Questionnaire results obtained from 44 participants who experienced the RFI (the mean rating to the illusion statements > the mean rating to the control statements) in the pre-test. The questionnaire includes the nine Japanese statements shown in Supplemental Table 1, presented in a random order. Illusion statements are from S1 to S3. Participants answered the questionnaire with a seven-point visual analogue scale ranging from 3 denoting “absolutely certain that it applied” to -3 denoting “absolutely certain that it did not apply.” Solid circles indicate the mean ratings of answers. Bars indicate the standard errors of the mean. A significant difference was observed between participants’ mean ratings to illusion statements (S1-S3) and to control statements (S4-S9) (Wilcoxon’s signed-rank test, $z = -5.780$, $n = 44$, $P < 0.001$). S1-S9: statements 1-9.

Fig. 2. Experimental set-up. (A) Participants rested comfortably in a supine position on the bed in the MRI scanner. Participants viewed the rubber foot through a mirror (an arrow) mounted in the head coil. The experimenter brushed the hallux of the rubber foot and the hallux of the participant’s hidden foot with a paintbrush synchronously or asynchronously at 1 Hz. Written informed consent was obtained from the individuals for the publication of this photograph. (B) The field of vision seen by participants during the fMRI experiment. Participants were able to see the rubber foot brushed by the experimenter in the mirror. The contralateral foot was hidden to avoid detracting the participant’s attention. fMRI: functional magnetic resonance imaging.

Fig. 3. Common activation during the right and left RFIs. Conjointly increased activation was observed in the prefrontal cortex including the bilateral medial and middle frontal gyri and parietal cortex including the bilateral inferior parietal lobuli (horizontal sections at $z = 30$ (A) and 20 (B)). (C) shows conjointly increased activation in the cerebellum: the bilateral cerebellar hemispheres and vermis were activated ($z = -22$). The arrows and arrowheads indicate activation in the thalamus and calcarine cortex, respectively. All activation is illustrated at $P < 0.05$ (corrected for multiple comparisons using the false discovery rate, minimum cluster size 200 voxels). The colored bar represents *t*-values. RFI: rubber foot illusion; MeFG, medial frontal gyrus; MiFG,

middle frontal gyrus; L, left; R, right; IPL, inferior parietal lobule; cerebel, cerebellar hemisphere.

TABLE 1 Brain areas activated during the condition of synchronous stimulation after the onset of the illusion compared to the condition of synchronous stimulation before the illusion.

			MNI coordinates of peaks			
Brain areas	Side	BA	*x*	*y*	*z*	*t*-value
during the illusion for the right foot						
Frontal lobe						
medial frontal gyrus	R	10/32	4	30	28	3.85
	L	10/32	-4	24	30	4.38
middle frontal gyrus	R	9/10	28	50	10	4.60
	L	9/10	-24	46	20	4.99
supplementary motor area	L	6	-18	10	54	3.83
Parietal lobe						
inferior parietal lobule	R	39/40	38	-50	18	3.65
	L	39/40	-46	-42	38	3.67
precuneus	R	7	8	-42	58	4.83
	L	7	-4	-48	64	4.95
Occipital lobe						
calcarine cortex	R	17	6	-94	2	4.12
	L	17	-2	-68	10	3.83
Cerebellum						
hemisphere	R		20	-64	-14	5.67
	L		-38	-78	-26	4.37
vermis			2	-70	-46	3.54
Subcortical structures						
thalamus	R		16	-18	6	5.86
	L		-6	-16	16	6.46
during the illusion for the left foot						
Frontal lobe						
medial frontal gyrus	R	10/32	10	34	22	4.28
	L	10/32	-10	46	4	6.90
middle frontal gyrus	R	8/9/10	36	32	50	5.05
	L	8/9/10	-28	28	50	5.11
superior frontal gyrus	R	8/9/10	16	28	54	5.44
	L	8/9/10	-4	32	60	6.01
inferior frontal gyrus	L	47	-46	24	-14	4.73
supplementary motor area	L	6	0	-16	52	3.24
Parietal lobe						
inferior parietal lobule	R	39/40	60	-50	42	3.66
	L	39/40	-52	-50	30	4.04
Temporal lobe						
middle temporal gyrus	R	21	70	-36	-6	4.19
	L	21	-50	-58	6	2.85
Cerebellum						
hemisphere	L		-22	-50	-28	4.05
vermis			-2	-56	-40	4.10
Subcortical structures						
thalamus	R		12	-6	14	4.40
	L		-14	-4	2	4.81

All significant activations at $P < 0.05$ (false discovery rate corrected for multiple comparisons) and cluster size ≥ 50 voxels. BA, Brodmann's area; L, Left; R, Right; MNI, Montreal Neurological Institute.

TABLE 2 Brain areas conjointly activated during illusions for the right and left feet.

Brain areas	Side	BA	MNI coordinates of peaks			*t*-value
			x	*y*	*z*	
Frontal lobe						
medial frontal gyrus	R	10/32	14	42	4	2.82
	L	10/32	-2	32	26	3.29
middle frontal gyrus	R	9/10	34	44	34	2.97
	L	9/10	-28	36	24	3.23
Parietal lobe						
inferior parietal lobule	R	39/40	52	-44	20	2.85
	L	39/40	-48	-58	10	2.66
Occipital lobe						
calcarine cortex	R	17	4	-64	10	2.99
	L	17	0	-90	0	3.11
Cerebellum						
hemisphere	R		20	-48	-20	2.33
	L		-30	-74	-30	3.55
vermis			2	-56	-22	2.44
Subcortical structures						
thalamus	R		2	-10	4	3.37
	L		-8	-10	14	4.63

All significant activations at $P < 0.05$ (false discovery rate corrected for multiple comparisons), when tested against the global null hypothesis, minimum cluster size 200 voxels. BA, Brodmann's area; L, Left; R, Right; MNI, Montreal Neurological Institute.

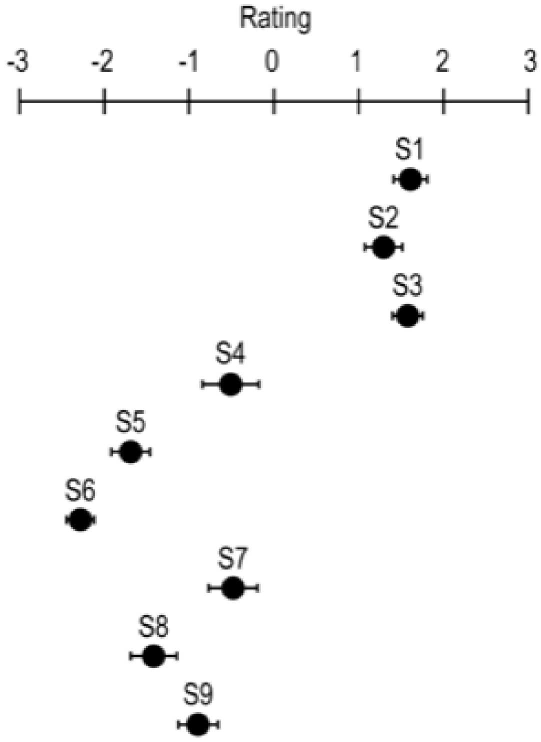

Figure 1

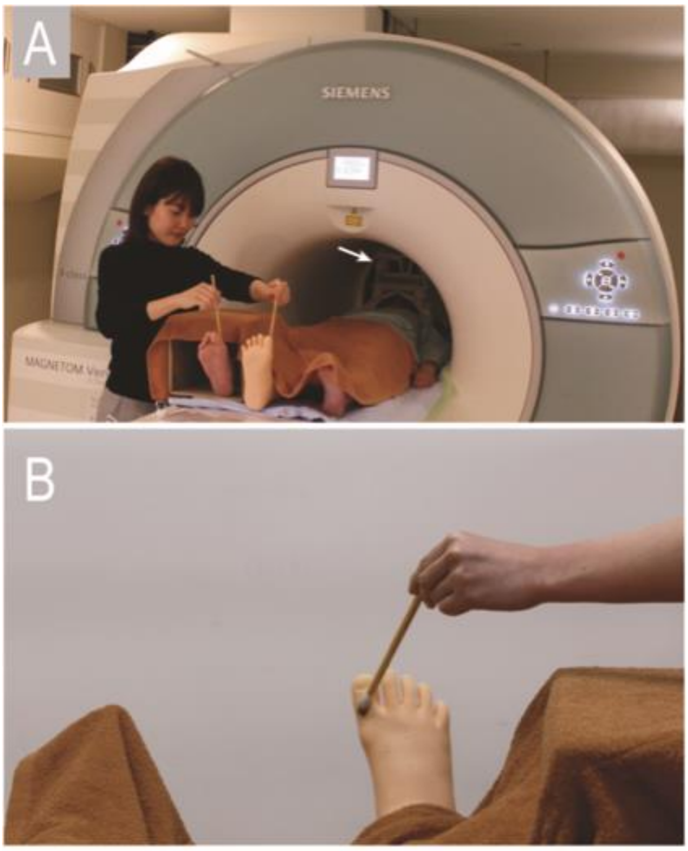

Figure 2

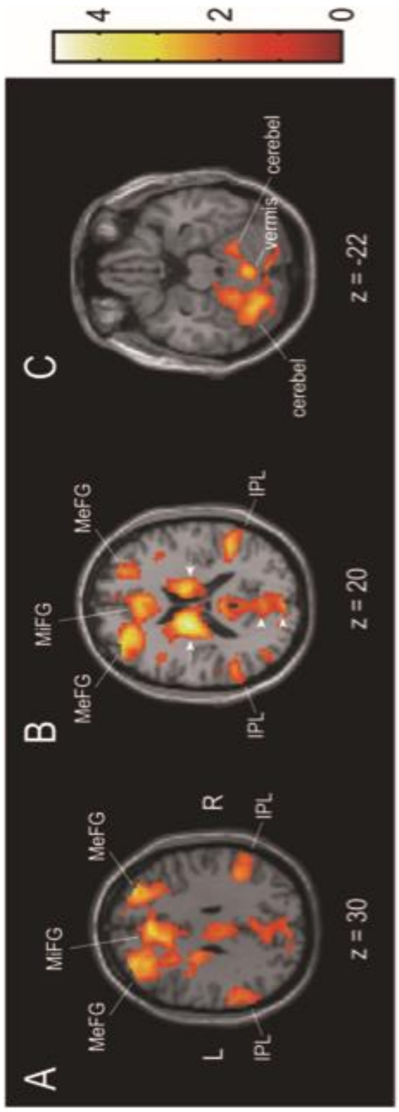
A
B
C
L
R
MeFG
MiFG
MeFG
IPL
IPL
z = 30
MeFG
MiFG
MeFG
IPL
IPL
z = 20
cerebel
vermis
cerebel
z = -22
4
2
0

Figure 3

Supplemental Table 1

Questionnaire. Statements from S1 to S3 are illusion statements. Statements from S4 to S9 serve as controls for assessing suggestibility. Original statements arefrom the original English version [7]. The word “hand” in the statements is replaced with the word “foot” in statements of Replaced version foot [14] and are translated into Japanese (statements of Translated Japanese version foot).

Original statement	Replaced version foot	Translated Japanese version foot
S1. It seemed as if I were feeling the touch of the paintbrush in the location where I saw the rubber hand touched.	S1. It seemed as if I were feeling the touch of the paintbrush in the location where I saw the rubber foot touched.	S1. マネキンの足が触れられた部分で筆の感触を感じたようだった。
S2. It seemed as though the touch I felt was caused by the paintbrush touching the rubber hand.	S2. It seemed as though the touch I felt was caused by the paintbrush touching the rubber foot.	S2. マネキンの足が触れられているのに、自分の足が触れられているように感じた。
S3. I felt as if the rubber hand were my hand.	S3. I felt as if the rubber foot were my foot.	S3. マネキンの足が自分の足のように感じた。
S4. It felt as if my (real) hand were drifting towards the right (towards the rubber hand).	S4. It felt as if my (real) foot were drifting towards the right/left (towards the rubber foot).	S4. 自分の足がマネキンの足の方に動いたように感じた。
S5. It seemed as if I might have more than one left hand or arm.	S5. It seemed as if I might have more than one right/left foot or leg.	S5. 触られていた自分の足が２本あるかのように感じた。
S6. It seemed as if the touch I was feeling came from somewhere between my own hand and the rubber hand.	S6. It seemed as if the touch I was feeling came from somewhere between my own foot and the rubber foot.	S6. 自分の足とマネキンの足の間の部分が筆で触られているように感じた。
S7. It felt as if my (real) hand were turning ‘rubbery’.	S7. It felt as if my (real) foot were turning ‘rubbery’.	S7. 自分の足がゴムになったように感じた。
S8. It appeared (visually) as if the rubber hand were drifting towards the left (towards my hand).	S8. It appeared (visually) as if the rubber foot were drifting towards the right/left (towards my foot).	S8. マネキンの足が自分の足の方に動いたように感じた。
S9. The rubber hand began to resemble my own (real) hand, in terms of shape, skin tone, freckles or some other visual feature.	S9. The rubber foot began to resemble my own (real) foot, in terms of shape, skin tone, freckles or some other visual feature.	S9. マネキンの足の形・肌の色などの見た目が自分の足に似てきたように感じた。