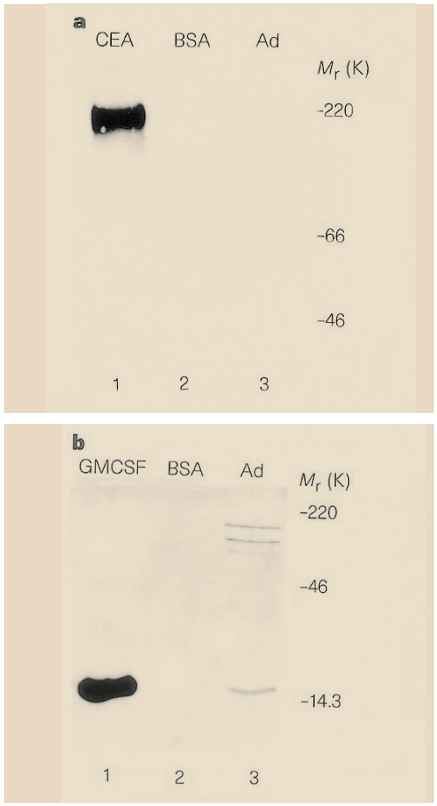

Figure 1 a, Detection of antibodies to the human CEA protein by western blot analysis. Serum from a vaccinated mouse taken one month after applying AdCMV-hcea to the skin was diluted 1:500 and reacted with purified human CEA protein (provided by T. Strong) and adenoviral proteins separated on a 5% SDS–polyacrylamide gel. The products were transferred to membranes as in ref. 3. Lane 1, human CEA (0.5 μg); lane 2, BSA (0.5 μg); lane 3, adenovirus (10^7 PFU). **b,** Detection of antibodies against the human GM-CSF protein. Purified human GM-CSF protein (CalBiochem), separated on a 15% SDS–polyacrylamide gel, was transferred to membranes and allowed to react with diluted serum. Lane 1, human GM-CSF (0.25 μg); lane 2, BSA (0.25 μg); lane 3, adenovirus (10^7 PFU).

To our knowledge, this is the first demonstration that animals can be vaccinated in a simple, painless, and economical manner by topical application of genetic vectors onto the skin. This strategy may allow the development of vaccines that could be administered by individuals without specialized medical training or equipment.

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Seeing where your hands are

Some patients with brain damage fail to identify a sensory stimulus presented on the opposite side to their lesion (contralesional) when a competing stimulus is presented on the same side (ipsilesional)[1]. This phenomenon has become known as extinction. It is commonly studied using a single sense such as sight or touch (unimodal extinction)[2]. We have studied a 75-year-old right-handed man (patient GS) who has severe left tactile extinction resulting from damage to the right frontotemporal cortex caused by a stroke. We found that an ipsilesional visual stimulus could induce extinction of a contralesional tactile stimulus (cross-modal extinction). We also found that the visual stimulus operates in a reference system attached to the hand, and not in egocentric coordinates (that is retinal, head or trunk-centred coordinates).

We tested the extinction phenomenon under six experimental conditions. Patient GS sat at a table opposite the experimenter, with his hands positioned on the table surface. In condition 1, tactile stimuli were applied to one or both hands which were placed beneath a cardboard shield to prevent him from viewing them directly. Each stimulus consisted of a light touch to the third finger. In condition 2, the shields were removed and the experimenter applied visual stimuli just in front of GS's third fingers (the same movement as the touch). GS was asked to say how many stimuli he had detected. In both conditions, he reported unilateral stimuli without errors. On stimulation of both sides simultaneously, GS showed marked tactile (1/30 correct trials) but not visual extinction.

In condition 3, GS's left hand was screened with the shield, whereas his right hand was in his view. A tactile stimulus was given to the left hand and a visual stimulus near to the right hand. On single-stimulus trials, his performance was flawless. In contrast, on double-stimulus trials, GS showed a severe left tactile extinction (0/30 correct).

Condition 4 was like condition 3, except that GS's right hand was placed behind his back to allow us to assess whether a visual stimulus presented at the same visual field location as in condition 3, but far from the ipsilesional hand, also produces a cross-modal extinction. In both single and double stimulus trials, GS performed correctly.

Condition 5 was like condition 3 except that the visual stimulus was presented far above the right hand, at the level of patient's eye. Again, GS's performance was faultless. Visuotactile extinction therefore manifested itself only when the visual stimulus was presented in an area immediately adjacent to the ipsilesional hand, and disappeared when it was far from the hand.

Condition 6 was like condition 3, except that GS's hands were crossed. He performed normally in single-stimulus trials, but in double-stimulus trials, he showed a severe extinction of the tactile stimuli (1/30 correct) applied to left hand (in right hemispace). Extinction is not modulated by the positions of the hands in space.

Our findings may be explained by referring to the activity of bimodal, visuotactile neurons in the premotor cortex which have receptive fields attached to some relevant body parts[3–6]. Some of these neurons have tactile receptive fields on the hand and corresponding visual receptive fields that extend outward from the tactile field into the space near the hand. As a consequence, activation of these bimodal neurons by a visual stimulus delivered near the hand also activates the corresponding perceptual representation of the hand. Here the simultaneous activation of the somatosensory representation of the left hand (by a tactile stimulus) and of the right hand (by a visual stimulus) produces an extinction of those stimuli presented in the weaker representation, in this case that of the left-hand.

Extinction phenomena (as well as neglect) occur when there is competition between two[7,8] or more neural representations[9]. In addition, single-neuron studies have shown that visuotactile premotor neurons do not respond when visual stimuli are presented far from the tactile receptive field. This may explain the absence of visuotactile extinction found here and in a previous study[10], when the visual stimulus was presented far from the ipsilesional hand. Our findings confirm the hypothesis that near space is coded in body-part-centered coordinates, and demonstrate the modular nature of human visual space.

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