dimensions, such as pitch. The aim of the study we conducted was to investigate whether the crossmodal correspondences robustly documented between auditory pitch and visual elevation have analogues in the audio–tactile domain. Across four experiments, we measured the compatibility effects between intuitively congruent pairs of stimuli (proximal-to-distal tactile movement, i.e. going from the inside of the finger toward the fingertip, and increasing pitch or between distal-to-proximal tactile movement and decreasing pitch) and incongruent pairs of stimuli (i.e., the reverse associations). A speeded classification method, commonly used to test crossmodal correspondences, requires participants to focus on one of two signals presented simultaneously, while ignoring the other. This method did not reveal any significant compatibility effect. However, a variant of the implicit association task, relying on distinct presentations and associations in the response buttons revealed a significant compatibility effect. This effect was similar in the conditions where the finger was placed vertically and horizontally, revealing that this association occurs in these two bodily positions. In addition, with the implicit association task, the compatibility effect observed in sighted people turned out to be absent in early and late blind people. These results have implications for the design of sensory substitution devices. In particular, many visual-to-auditory conversion systems that were designed to assist blind persons in navigation and recognition activities used the correspondence between direction of pitch and direction of movement; however without testing if this correspondence was also relevant for blind people. The results of our study question the relevance of this coding for blind individuals and provide an interesting methodological tool to investigate further the extent to which certain crossmodal correspondences depend on prior visual experience.

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When plasticity matters

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Background: Both computational models and functionalist theories have led to the consideration that the study of the physical realization of mental processes – noticeably their embodied or neurological basis – would not reveal anything substantial about these mental states. At best, the study of the physical realization of a given mental process would be of local interest. It could help for instance to 'repair' the physical damage causing a loss of function, but would be of limited relevance to larger theories of the mind. This talk challenges this assumption, stressing why crossmodal plasticity is of fundamental importance in our understanding of sensory substitution.
Method: fMRI
Results: The results of our recent studies (Ptito et al., 2012, 2014 for reviews) demonstrate the occurrence of training-induced plasticity in congenitally blind users of sensory substitution devices, something that does not occur in equally trained sighted users.
Discussion: Sensory substitution devices trigger our brain's remarkable capacity for reorganizing/rewiring the neural network of the sensory systems that are deprived of their normal input, a process more specifically known as crossmodal plasticity (Frost et al., 2000; Bavelier and Neville, 2002). Most importantly, the neurological changes studied in the blind show the recruitment of the same cortical network used for visual tasks in sighted people.
Conclusion: This neurological specificity, is essential to the proper understanding of sensory substitution, and in this respect, challenges a widespread indifference to physical realizations of mental processes.

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Unmasking visual routes in cortical blindness

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The study of congenital blindness offers a unique window into the brain's sensory architecture. The condition of cortical blindness has the same potential but for very different reasons. In this presentation we review recent findings from studies with cortically blind patients. The overall argument we will develop is that cortical blindness in adult age leads to unmasking of alternative visual pathways and that following that process, the road to functional reorganization is opened. We will discuss results from studies in object and face recognition, where visual information is presented in combination with mental imagery and with auditory information. In support of our approach we will compare patient results with findings from experiments that have used various techniques to induce cortical blindness in normal controls.

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The blind brain: How (lack of) vision shapes the development of the morphological and functional architecture of the human brain

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How what we perceive is transformed into a coherent and integrated representation of the world around us is a question that has fascinated humans since the early days. What happens in our brain that enables us to make sense of what we see, hear, touch, smell or taste? How does the brain of someone who has never had any visual perception form an image of the external world? Do brains from sighted and blind individuals differ and how? In this presentation, we will discuss recent findings from studies on the morphological and functional development of the human brain in the absence of visual experience. We have been pursuing this question in my lab for over a decade, with the initial question being how much is visual experience necessary for the brain to develop the Object Form Topography organization that we described in the sighted brain (Haxby et al. Science 2001). We have then demonstrated that a similar organization develops in the absence of any visual experience (Pietrini et al., PNAS, 2004): indeed, the ventro-temporal 'visual' cortex is able to provide a specific neural response to distinct object categories also when information is carried to the brain by non-visual sensory modalities, specifically the tactile one, both in sighted and in congenitally blind individuals. Such a modality-independent functional organization — that we named supramodality — has been shown to extend to most of the so-called 'visual cortex' (Ricciardi et al., Cereb Cortex 2007, Sani et al., Front Syst Neurosci. 2010, Ricciardi et al, Exp Biol Med, 2011) as well as to other brain systems, including the Mirror Neuron System (Ricciardi et al., J Neurosci 2009, Ricciardi and Pietrini Curr Opinion Neurol 2011) and the action recognition system (Ricciardi et al. PLoS One, 2013). Visual experience, however, does affect functional sub-segregation within supramodal cortical regions as well as their interregional correlations (Ricciardi et al. Cereb Cortex, 2007). Altogether, the results of these studies indicate that the human brain is to a great extent programmed to develop its morphological and functional architecture independently from visual experience. These findings may contribute to explain how congenitally blind individuals interact efficiently with a world they have never seen and may have important implication for novel educational and teaching approaches in sensory deprived subjects.

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