

Behavioral manifestations of brain plasticity in blind and low-vision individuals

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Tactile sensitivity enhancement (TSE) observed in blind people is probably a result of intensified tactile training. Although many researchers consider TSE in the blind to be an example of use-dependent plasticity, it is unclear whether the effects of training (Braille reading) are specific, i.e. restricted to the trained function and hand, or if they are more general. To examine this issue further, blind Braille readers, low-vision subjects (Braille readers and non-Braille readers) and sighted controls were tested in two tasks: a texture task resembling the Braille system and a dissimilar groove orientation task. Braille readers, both blind and those with low vision, performed better in both tasks than low-vision non-Braille readers or sighted controls. However, the difference was significant only for the blind (more experienced) Braille readers. In the groove orientation task, the positive influence of training was detectable irrespective of the hand used in the test, but in the coarse texture task this influence was limited to the hand trained in Braille. Thus, it appears that tactile training is of significance in TSE but its effects are, to a large extent, task- and hand-specific.

Key words: tactile acuity, visual deprivation, training, Braille

INTRODUCTION

Both intramodal and cross-modal brain plasticity effects have been recognized in blind people. Functional magnetic resonance imaging (fMRI) and transcranial magnetic stimulation (TMS) studies have demonstrated cortical reorganization in the somato-sensory and motor cortices in blind individuals, whereby the representation of the fingers involved in Braille reading expands relative to the so-called non-reading fingers (Pascual-Leone and Torres 1993, Hamilton and Pascual-Leone 1998, Sterr et al. 1998, Theoret et al. 2004). Moreover, it has been found that the occipital cortical areas – which in sighted people are implicated in visual perception – are recruited and used in congenitally and early blind individuals during auditory (Kujala et al. 1992, 2005, De Volder et al. 1999, Leclerc et al.

2000, Weeks et al. 2000, Röder et al. 2002) and tactile discrimination tasks (Uhl et al. 1991, 1993, Sadato et al. 1996, 1998, Büchel et al. 1998). Interestingly, activation of these regions was found to be functionally relevant for Braille reading (Cohen et al. 1997, Hamilton and Pascual-Leone 1998, Hamilton et al. 2000, Burton et al. 2002).

Some authors believe that these plastic changes may lead to certain behavioral effects. Although it remains a controversial issue (Grant et al. 2000, Collignon et al. 2006), quite a number of investigations have revealed that blind Braille readers perform better than sighted controls in various tasks involving tactile discrimination, suggesting an enhanced tactile sensitivity in these individuals (Stevens et al. 1996, Van Boven et al. 2000, Goldreich and Kanics 2003). However, the precise mechanisms underlying the behavioral superiority of blind individuals are not fully understood (Hummel et al. 2004). Another unresolved issue relates to which specific tactile functions are improved. Previous studies examining haptic abilities in the blind have yielded mixed

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