

Automaticity, Body Schema, and Somatosensation: Insights from Acquired and Congenital Deafferentation

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While normal movement is highly dependent on sensory feedback, it is not clear to what extent automaticity of movement and unconscious awareness of the body can develop or be maintained in the absence of sensation. We contrast two “deafferented” adults, one who acquired large fibre sensory loss as an adult (IW) and another who was born without somatosensation (KS). We postulated that KS’s life-long absence of proprioception and touch might have allowed her to develop visuomotor circuits that allow automatic, unconscious control of actions analogous to those of neurologically normal adults, whereas IW appears only to use conscious processes to control his actions. To assess automaticity, we tested these two, and two age-matched control groups, on writing and drawing tasks performed with and without an audio-verbal echoing task that added a cognitive demand. We found little evidence that IW was able to automate even the simplest drawing tasks and no evidence for automaticity in his writing. In contrast, KS did show evidence of automaticity in simple writing and drawing actions. Comparing their performance on tracing in a mirror – a task that requires overcoming a conflict between vision and action, we found that KS suffered the conflict badly at first but was able to quickly improve her performance; IW suffered much less but did not improve with practice. This hints at KS having a more flexible visuo-motor planning process. We next compared their responses and the controls in three perceptual tasks, aimed to address the accuracy of their body image and the presence of a body schema. Both KS and IW were able to give consistent responses about their unseen hand shape and arm length. Reach distance was overestimated by both IW and KS, as it was for controls. IW displayed a better awareness of hand shape than both KS and controls; KS demonstrated poorer awareness than both IW and controls. In an attentional task, IW showed no dependency between reaction times and proximity of the visual targets to his seen or unseen hand, suggesting that he has no peri-personal bias of attention. In contrast, KS did show target proximity-dependent modulation of reaction times, like controls, but only when her hands were visible. Unlike IW and KS, controls also modulated reaction times when the hands were unseen. We suggest that both IW and KS can access a conscious body image, although its accuracy may reflect their different experience of hand action. Acquired sensory loss has deprived IW of any subconscious body awareness, and he has no automaticity of action. The congenital absence of somatosensation may have led to its partial replacement by a form of visual proprioception in KS, allowing automatic control of some movement and the formation of an unconscious body schema.