Haptic, visual and cross-modal perception of interface information

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Abstract

A cross-modal interface uses different modalities to present the same information. The objective of the present experiment was to investigate to what extent information provided in an interface can be shared across the haptic and visual modalities. The experiment had three feedback conditions, haptic, visual and haptic plus visual. The feedback was displayed haptically through a rotary device and visually on a computer monitor. The experimental task was to repeatedly locate and select textures in a menu of four rendered textures. The participants practiced the textures in one feedback condition and completed a test with 36 trials in the same or in a different feedback condition. There was a cross-modal transfer, although not effortless, and the transfer from haptics to vision seemed to be easier than from vision to haptics. The participants performed better in cases with the same feedback in both the training and test and in cases with visual feedback in the test. The asymmetry of the cross-modal transfer and the enhanced visual performance might be a result of the visual information being more useful for the task at hand.

Introduction

Humans are adapted to be able to simultaneously use information from several sensory modalities, and information can also be shared across modalities (Stein & Meredith, 1993). Hence, a lack of information from one modality can be compensated for by sensory information from another modality. For example, in the dark, haptic cues can substitute for vision. Since input from one modality can substitute for another, reliable information from multiple sensory systems provide flexibility when interacting with complex systems. In human-machine interaction (HMI) activities where visual information is not sufficient or is not optimal for conveying interface information, haptic cues can prevent an overload of vision (Hale & Stanney, 2004). Burnett and Porter (2001) recommended the use of haptic cues in the interaction with in-car equipment, to allow drivers keep their eyes on the road.

Although the visual, auditory and haptic senses can be utilized in HMI, most interfaces predominantly appeal to the visual sense. Unlike vision and audition, haptic interaction involves both sensing and manipulation (Hayward et al., 2004). Accordingly a haptic HMI device allows a user both to feel and interact with an

In D. de Waard, G.R.J. Hockey, P. Nickel, and K.A. Brookhuis (Eds.) (2007), *Human Factors Issues in Complex System Performance* (pp. 399 - 409). Maastricht, the Netherlands: Shaker Publishing.