Anticipatory dynamic vision and human factors

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Abstract

Modern neuroscience regards vision as based on two fairly independent subsystems, which serve processing of *static* detail or of *dynamic* events, respectively. This means that dynamic visual performance cannot be predicted by only testing static visual function. Moreover, most tasks require *anticipatory dynamic vision* which extrapolates sensory information in advance and thus transcends mere sensory function. A psychophysical method and quantitative model for testing anticipatory dynamic function is presented and applied to normal and highly skilled subjects. Professional motorcyclists and highly trained tennis players showed significantly better anticipatory visual performance, especially less error variance, than untrained subjects, suggesting that the present approach affords assessment of anticipatory dynamic vision related to motor skills.

Introduction

Within the past two decades, firm evidence has converged from different disciplines (psychophysics, neurophysiology, neuroanatomy, neurology and neuropsychology) that vision is not a unitary process, but that it relies on separated processing streams, the magnocellular and the parvocellular (M and P) systems, which serve dynamic and static vision, respectively (e.g., Zeki, 1993; Eysel, 1998). M-cells have large receptive fields with a fine temporal, but coarse spatial resolution, whereas P cells have small receptive fields with a high spatial, but low temporal resolution. Therefore, the two systems are optimally tuned to detect dynamic events or static details, respectively.

Already at the retinal level we find specialised M and P cells and this specialisation continues, with increasing specificity of cell function, through the optic nerve, optic tract, the lateral geniculate nucleus, optic radiation to the primary visual cortex (V1) and adjacent visual areas (V2 – V5, see Zeki, 1993). M and P processing streams finally split into parietal and temporal cortical pathways which further connect to cortex areas that serve motor and memory functions, respectively. The current view of the dual processing of vision is summarised in fig. 1.

The dual processing of visual information affords fast action or reaction to dynamic events, on the one hand, and sustained fixation and recognition of static patterns, on the other. So far, ophthalmological testing of visual function is biased against M functions by using static test patterns and allowing for unlimited inspection. This