INTRODUCTION

In order to interact effectively with the everyday world, man depends heavily on the close coupling between perceptual information and motoric action. When reaching for an object in the visual surrounding, the actor typically performs a combination of eye, head and arm movements. Researchers have devoted considerable effort to understanding the mechanisms that underlie this behavior. Particularly, studies addressed to the question how eye and hand movements are coordinated with respect to a visual target have provided significant insights about the motor control mechanisms involved.

Hand-eye coordination has been studied separately at least at three different levels of visual-motor behavior. Firstly, a considerable amount of work has been done to determine whether eye and hand share common mechanisms during the preparation of the movements (e.g., Bekkering et al. 1994,1995; Biguer et al. 1982). Secondly, interactions between the oculomotor and manual motor systems have been investigated during the execution of respectively the eye and hand movements (e.g., Abrams et al. 1990; Bock 1987). Finally, the visual-spatial information for eye and hand movement's terminal accuracy have been investigated (e.g., Prablanc et al. 1979).

While investigating the preparation processes of coordinated eye and hand movements, Bekkering and colleagues (1994,1995) found an interference effect, i.e. longer eye latencies when the eye is accompanied by a goal-directed movement than when the eyes moves alone. It was suggested that a close coupling exists between the attentional mechanisms necessary to select an object in the environment and the preparation of motor actions to interact with the object.

It is well known from earlier studies on smooth pursuit eye movements that a person can more accurately track a visual target that he or she moves him- or herself than a target that is moved without internal control (e.g., Steinbach 1969), indicating that the oculomotor system has access to the efference (outflow) from the hand system which produces the target movements. Recently, Bekkering and Koch (1996) investigated interactions between eye and hand performances in the case that the externally generated visual information was presented discontinuously. The finding that interactions in the motor output of one of the two systems can be found even during the absence of a visual target, provided a strong argument in favor of the assumption that the two motor systems share common mechanisms during the execution of their respective movements who are not related to the perceptual input side.

The visual-spatial information that is used in order to plan the location of a movement target for coordinated eye and hand movements has been the focus of considerable research scrutiny. At least two types of spatial information have been identified as being relevant for movement termination: (1) distance information and (2) location information.

In this tutorial lecture I would like to present the main findings in the area of coordinated eye and hand movements with help of the scheme presented below and I
hope to be able to show some links with typically observed coordinated eye and hand movement patterns in sports.

Fig. 1. A simple overall scheme of hand and eye movement control. The performer presumably builds an internal representation of the target movement by combining retinal information about the target with information about eye position and movement. In addition, a contributory link exists between the hand and eye system. Each system, presumably, is introducing noise to the motor output as summarized by the signals Ni, Nh, and Ne, respectively.

REFERENCES


BEKKERING; H; KOCH, R.: Common mechanisms of coordinated eye and responses to a sinusoidally moving target, (in prep.).

