**Neural Correlates of the Cueing Effect of Another Person's Gaze Studied with fMRI**

C. Kato[1,2], K. Matsuo[2], T. Nakai[2]

[1]Department of Management and Information Science, Toyohashi Sozo College, Toyohashi, Aichi, Japan, [2]Medical Vision Lab, AIST, Ikeda, Osaka, Japan

## Introduction

Spatial peripheral cues induce a shift of visual attention reflexively. Eye gaze also induces reflexive attentional shift although eye gaze is not a peripheral but a central cue [1,2,4]. Activation of the contralateral premotor and the left inferior parietal cortex in the previous study suggested that the pattern of the eyes as like as an arrow might elicit preparation and/or attention of motor response even if the cues are not predictive for the location of a target [3]. However, the study depended upon the longer stimulus onset asynchrony (SOA) of 3000 msec between the cue and the target. The aim of the present study was to examine the activation of the front-parietal motor network involved in the attentional shift depending upon the shorter cue-target SOA.

## Material and Methods

Subjects and Data Acquisition: Seven right-handed volunteers (4 females, age 25-43) who gave written informed consent participated in this study. A gradient recalled echo spiral sequence (TR 2000 msec, TE 30 msec, FA 70 deg, FOV 22 cm, slice thickness 6 mm, 20 axial slices) was used for functional studies on a 3.0 T MR scanner (GE, Signa VH/i 3.0T).

Task Design: Four experiments were designed: EYE100, EYE500, ARW100, and ARW500 (Fig.1). As a cue, a pair of eyes was used in the half of the experiments and an arrow was used in the other half (Fig.1A). Each cue was directed left or right. The cue for 80 msec was followed by a target for 80 msec at an SOA of 100 or 500 msec (Fig.1B). In the one-third of trials, the target was not presented (no-go trials). When the target was presented, it appeared to the left or right of fixation independently of the direction of the cue. Therefore, all cues were totally uninformative to the target location. Depending on the SOA, the intertrial interval (ITI) was 2420 or 2820 msec. Each trial lasted 3 sec. Subjects were instructed to hold central fixation throughout the experiments and to press a button with their right index or middle finger when they had detected the target on the left or right, respectively. In each experiment, the baseline block of 36 sec and the task block of 72 sec were alternatively repeated for 4 times. In the baseline blocks, a fixation cross was presented from the beginning of the trial without the cue. A comparison between the task and baseline blocks was designed to correspond only to the effect of the uninformative central cues. The fMRI data were analyzed using SPM99. A random-effect model was applied ($p < 0.005$ for comparisons between the experiments).

## Results

Only in the experiment using the eyes at the longer SOA (EYE500), the left precentral (prCS) and intraparietal sucli (IPS) were activated (Fig. 2). The activation in these areas was significant in comparison with the experiment at the shorter SOA (EYE100), although it was not significant in comparison with the experiment using the arrow at the same SOA (ARW500).

## Discussion

The left premotor and parietal activation induced by the eye gaze was replicated in this study. Furthermore, significant difference in this activation was detected between the shorter and the longer SOA. In the cueing paradigm, target detection is faster at the location predicted by the cue, even if the cue is totally uninformative. This cueing effect induced by the central symbolic cues is maintained at the longer SOA. In contrast, the cueing effects induced by peripheral cues peak at SOA of around 100-150 msec. Although the eye gaze is a central cue, the cueing effect is relatively short-lived as like as in the reflexive orienting [2,4]. The difference of the left premotor and parietal activation between EYE500-EYE100 and ARW500-ARW100 may be related to the difference of the life of the cueing effects between them. This study demonstrated the neural correlates of the cueing effect of another person's gaze on the motor network.

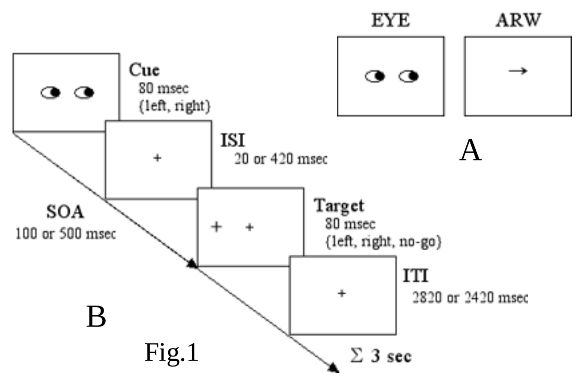

Fig.1

References
[1] Driver J et al., *Visual Cognition*, 6, 509-540 , 1999
[2] Friesen CK, & Kingstone A, *Psychonomic Bulletin & Review*, 5, 490-495, 1998
[3] Kato C et al., *Neuroscience Letters*, 1314, 5-8, 2001
[4] Langton SRH, & Bruce V, *Visual Cognition*, 6, 541-567, 1999

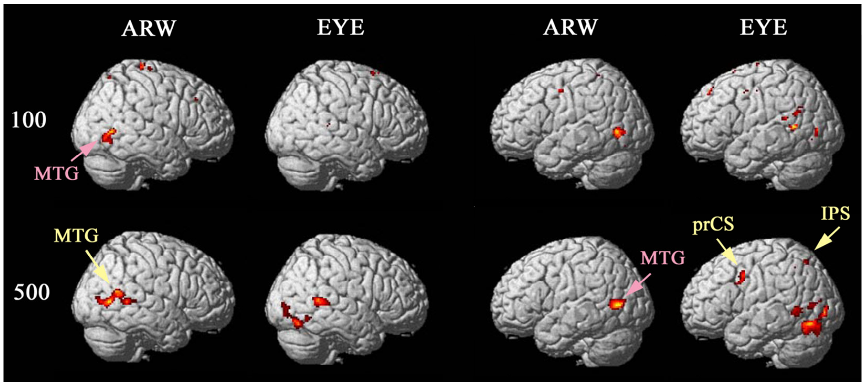

Fig.2