Chapter 13

The Present Visual Equipment System and Its Application in fMRI

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ABSTRACT

The visual system is the part of the central nervous system that gives organisms the ability to process visual details and enables the formation of several non-image photo response functions. It detects and explains information from visible by the light to build a representation of the surrounding environment. One reason why the visual system is so important is that it enables us to perceive information at a distance. We need not be in immediate contact with a stimulus to process it. We must experiment with visual equipment to understand how we process visual information. This article summarizes current visual system equipment and how this equipment can be used to determine how the visual system functions.

INTRODUCTION

The presentation of high-quality visual stimuli to a subject undergoing functional fMRI is very important but has been difficult to achieve. Currently, brain functional activation studies, either for basic research or pre-operative brain mapping, are becoming increasingly common (Fox, Lancaster, Parsons, Xiong, & Zamarripa, 2017). DOI: 10.4018/978-1-5225-0925-7.ch013

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1997). Visual stimuli are very important and are the most commonly used stimuli for brain functional activation. For conventional positron emission tomography (PET), computed tomography (CT), single-photon emission tomography (SPECT), and other modalities, the presentation of visual stimuli poses some logistical problems because conventional video monitors can be used, and the scanner typically does not encroach on the subject’s field of view. MRI scanners and three-dimensional PET scanners bores are longer, so restrict the patient’s view.

There are significant conditional logistical problems involved in MRI. Every device placed within the MR scanning suite must be free of radiofrequency (RF) emissions so as not to degrade the quality of the MRI data that are acquired. Thus, devices must be properly functional in the elevated magnetic field and non-magnetic so they are not drawn into the magnet bore. Moreover, devices placed within the bore must be small enough to accommodate the patient but also non-metallic so as not to distort the magnetic or RF fields and the resultant image. However, the viewing surface should be placed as close to the subject as possible to maximize the viewing angle. Finally, the stimulus presentation system should be compatible with a wide range of input devices (computers, videos, etc.) (Roby, Gao, & Fox, 2000).

FMRI equipment creates images that are both projected onto a mirror inside by refraction and projected directly to the eye through the optical fiber. In addition, some types of visual equipment primarily focus on the central visual field and use high-speed visual stimulation systems (Richlan et al., 2013). However, more attention has recently been placed on peripheral vision, and consequently, peripheral vision visual equipment has been developed (Wu et al., 2013; Yan, Jin, He, & Wu, 2011).

MAIN FOCUS OF THE CHAPTER


This method consists of passing light through a pattern of holes onto a screen (Hajnal et al., 1994). Pattern-flash systems activate the visual system, whereas complex visual stimuli (e.g., words, objects, moving patterns) can be used to induce activation in a wider range of brain areas.

The most common way to present complex stimuli is through the video projection of a computer-generated image. Systems designed for presenting relaxation videos are commercially available (e.g., MSI, MR Resources, and Magnetic Resonance Technology) and have been adapted for fMRI brain activation research (Cohen, Noll, & Schneider, 1993; Glover, Lemieux, Drangova, & Pauly, 1996; Lewin et al., 1996). In some commercial systems, the screen is normally placed at the subject’s feet, and
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