

The neural signature of spatial frequency-based information integration in scene perception

Tonglin Mu · Sheng Li

Department of Psychology, Beijing Normal University, Beijing, China

Abstract

Scene perception is a complex process that involves the integration of information from different spatial frequencies. The present study investigated the neural signature of spatial frequency-based information integration in scene perception. We used functional magnetic resonance imaging (fMRI) to measure brain activity in response to scenes with different spatial frequency components. The results showed that the integration of information from different spatial frequencies is associated with increased activity in the fusiform gyrus and the hippocampus. These findings suggest that the fusiform gyrus and the hippocampus play a role in the integration of information from different spatial frequencies in scene perception. The fusiform gyrus is known to be involved in object recognition and the hippocampus is known to be involved in memory. The present study provides evidence that these two brain regions are also involved in the integration of information from different spatial frequencies in scene perception. This finding has important implications for our understanding of the neural basis of scene perception and the role of the fusiform gyrus and the hippocampus in this process.

Keywords

scene perception; spatial frequency; functional magnetic resonance imaging

Introduction

Scene perception is a complex process that involves the integration of information from different spatial frequencies. The present study investigated the neural signature of spatial frequency-based information integration in scene perception. We used functional magnetic resonance imaging (fMRI) to measure brain activity in response to scenes with different spatial frequency components. The results showed that the integration of information from different spatial frequencies is associated with increased activity in the fusiform gyrus and the hippocampus. These findings suggest that the fusiform gyrus and the hippocampus play a role in the integration of information from different spatial frequencies in scene perception. The fusiform gyrus is known to be involved in object recognition and the hippocampus is known to be involved in memory. The present study provides evidence that these two brain regions are also involved in the integration of information from different spatial frequencies in scene perception. This finding has important implications for our understanding of the neural basis of scene perception and the role of the fusiform gyrus and the hippocampus in this process.

Mu, T. (✉), mtl@bnu.edu.cn

Li, S., lisheng@bnu.edu.cn

Key words: scene perception; spatial frequency; functional magnetic resonance imaging

Key words: scene perception; spatial frequency; functional magnetic resonance imaging

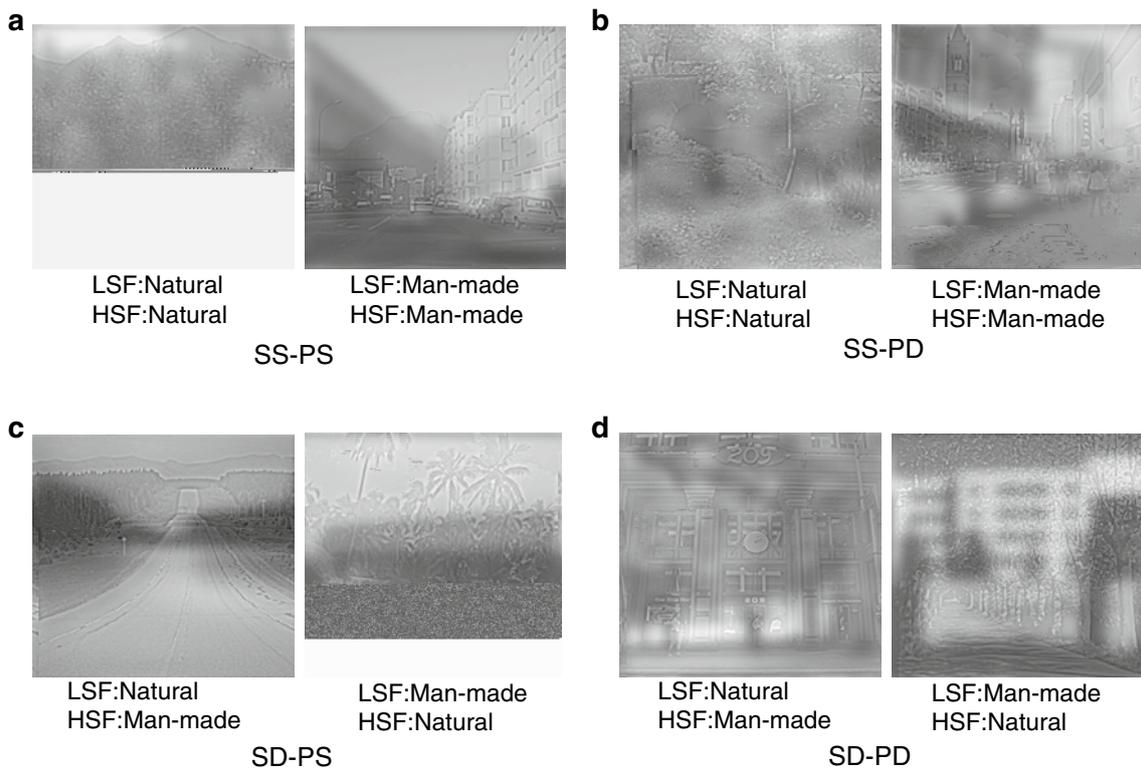


Fig. 1E Comparison of LSF and HSF images for natural and man-made scenes under different conditions (SS-PS, SS-PD, SD-PS, SD-PD). **a** SS-PS, **b** SS-PD, **c** SD-PS, **d** SD-PD

Comparison of LSF and HSF images for natural and man-made scenes under different conditions (SS-PS, SS-PD, SD-PS, SD-PD). **a** SS-PS, **b** SS-PD, **c** SD-PS, **d** SD-PD

The results of the experiments are shown in Fig. 1E. The images are arranged in a 2x2 grid. The top row (a, b) shows SS-PS and SS-PD conditions, and the bottom row (c, d) shows SD-PS and SD-PD conditions. The left column (a, c) shows natural scenes, and the right column (b, d) shows man-made scenes. Each image is labeled with its LSF and HSF components. For example, in (a), the left image is labeled 'LSF:Natural' and 'HSF:Natural', and the right image is labeled 'LSF:Man-made' and 'HSF:Man-made'. The labels for (c) and (d) are swapped compared to (a) and (b). The images show the effect of different processing methods on the LSF and HSF components of natural and man-made scenes.

The results of the experiments are shown in Fig. 1E. The images are arranged in a 2x2 grid. The top row (a, b) shows SS-PS and SS-PD conditions, and the bottom row (c, d) shows SD-PS and SD-PD conditions. The left column (a, c) shows natural scenes, and the right column (b, d) shows man-made scenes. Each image is labeled with its LSF and HSF components. For example, in (a), the left image is labeled 'LSF:Natural' and 'HSF:Natural', and the right image is labeled 'LSF:Man-made' and 'HSF:Man-made'. The labels for (c) and (d) are swapped compared to (a) and (b). The images show the effect of different processing methods on the LSF and HSF components of natural and man-made scenes.

Fig. 2

a **b** **c** **d**

Error bars

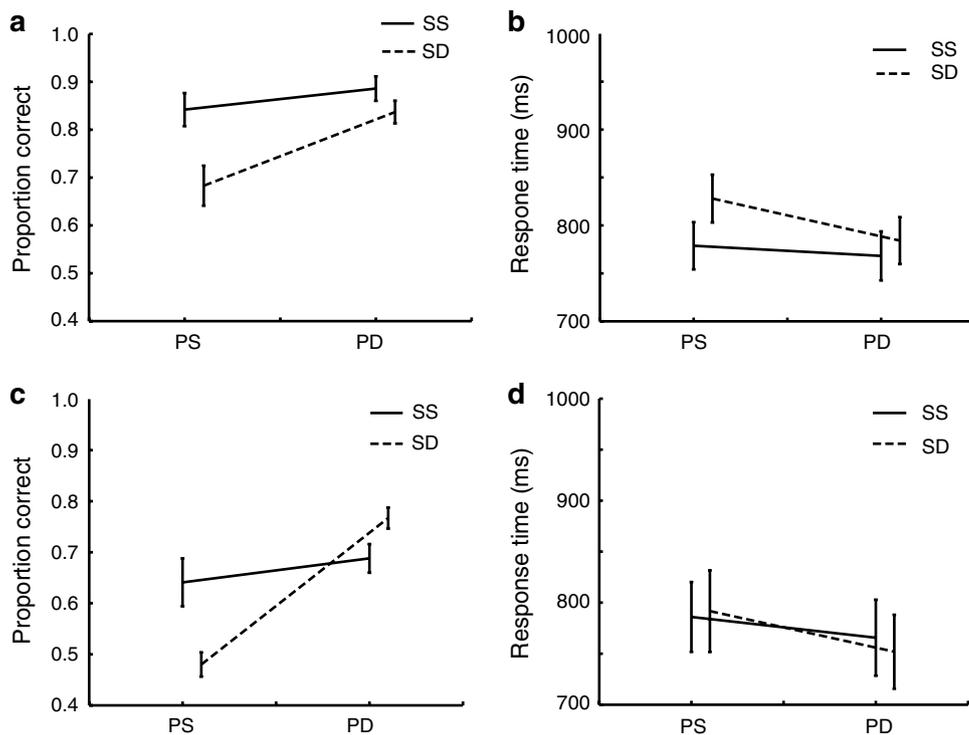


Table 1

Mean and standard error of the mean (SEM) for the proportion correct and response time (ms) for the SS and SD conditions in the PS and PD exposure levels.

Exposure	Condition	Proportion correct		Response time (ms)	
		Mean (SEM)	% (± %)	Mean (SEM)	% (± %)
Long exposure	SS	0.85 (0.02)	85 (± 2)	780 (15)	78 (± 1.5)
	SD	0.68 (0.03)	68 (± 3)	830 (20)	83 (± 2)
	SS	0.90 (0.02)	90 (± 2)	770 (15)	77 (± 1.5)
	SD	0.83 (0.03)	83 (± 3)	790 (20)	79 (± 2)
Short exposure	SS	0.65 (0.04)	65 (± 4)	790 (25)	79 (± 2.5)
	SD	0.48 (0.02)	48 (± 2)	790 (20)	79 (± 2)
	SS	0.70 (0.03)	70 (± 3)	760 (15)	76 (± 1.5)
	SD	0.78 (0.04)	78 (± 4)	750 (20)	75 (± 2)

... () ...

... () ...

... $F(1, 15) = 10.2, p < 0.01$...

... $F(1, 15) = 10.2, p < 0.01$...

... $F(1, 15) = 10.2, p < 0.01$...

... $F(1, 15) = 10.2, p < 0.01$...

... $F(1, 15) = 10.2, p < 0.01$...

... $F(1, 15) = 10.2, p < 0.01$...

... $F(1, 15) = 10.2, p < 0.01$...

... $F(1, 15) = 10.2, p < 0.01$...

... $F(1, 15) = 10.2, p < 0.01$...

... H ...

... EE ...

... EE ...

... E ...

Experiment 2

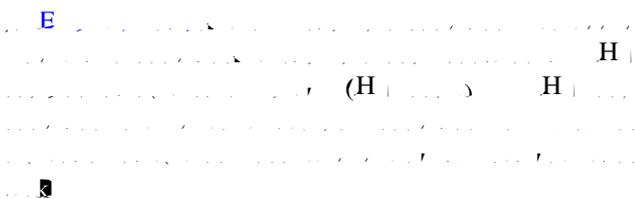
M...

Observers

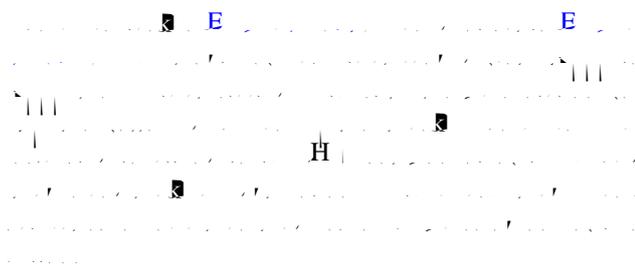
E ... () ...

... ± ...

Stimuli



Design



EEG recording and analysis

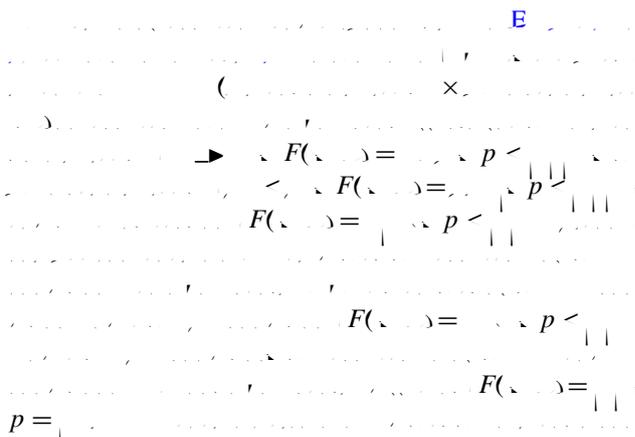
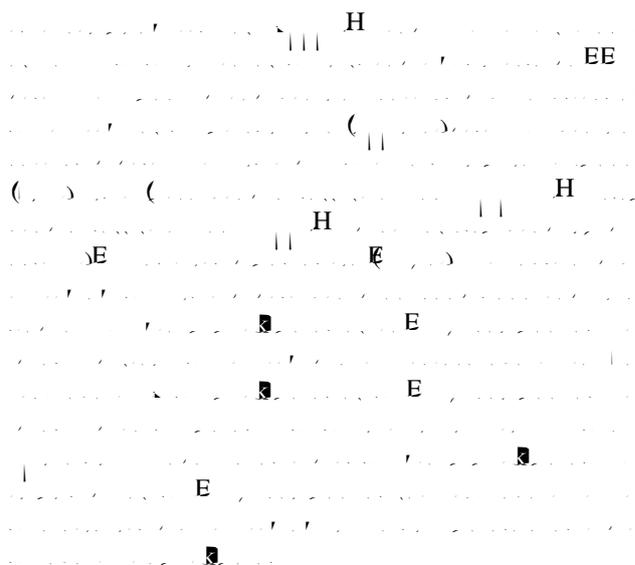
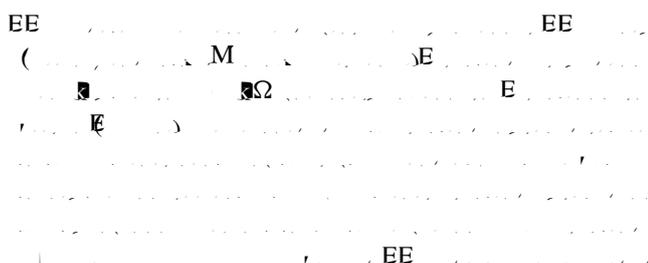


Table 2

(±E M)	% (± %)	% (± %)	% (± %)	% (± %)
(±E M)	(±)	(±)	(±)	(±)

Fig. 3

Fig. 3 shows the proportion correct and response time for the three conditions: SS, SD, and HSF_Only. Error bars represent standard error.

