

# Neural Substrates Differentiating Global/Local Processing of Bilateral Visual Inputs

Shihui Han,<sup>1\*</sup> Yi Jiang,<sup>1</sup> and Hua Gu<sup>2</sup>

<sup>1</sup>Department of Psychology, Center for Brain and Cognitive Sciences, Peking University, Beijing, People's Republic of China

<sup>2</sup>Department of Radiology, Beijing Chaoyang Hospital, Beijing, People's Republic of China

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**Abstract:**

Global/local processing of bilateral visual inputs was investigated using functional magnetic resonance imaging (fMRI). The results showed that the left and right hemispheres of the visual cortex were differentially activated by global and local processing of bilateral visual inputs. The left hemisphere was more sensitive to global processing, while the right hemisphere was more sensitive to local processing. These findings suggest that the left and right hemispheres of the visual cortex have different functional roles in processing bilateral visual inputs.

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**Key words:** global/local processing; bilateral visual inputs; fMRI; visual cortex

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**INTRODUCTION**

Global/local processing of visual inputs is a fundamental cognitive function. The left and right hemispheres of the visual cortex have been shown to be differentially involved in global and local processing of visual inputs (e.g., 1989, 1990; 1988; 1977).

Global processing involves the integration of information across the entire visual field, while local processing involves the analysis of individual features within the visual field (Egeton, 1997, 1999; 2000).

Consequently, the left hemisphere is more sensitive to global processing, while the right hemisphere is more sensitive to local processing (Egeton, 1997, 1999; 2000).

\*Correspondence to: Shihui Han, D., D., Department of Psychology, Peking University, Beijing 100871, China. E-mail: shihuihan@pku.edu.cn  
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1998 . E , 1997 ; ( F )  
 2001 . 2002 . F 80 120 ( 1 )  
 240 320 ( 2 )  
 1993 . C E E  
 2002 . F , 1996 ;  
 2002 . B I  
 , 1997 , I  
 . C  
 , 1999 ; , 2002 .  
 . G  
 . E  
 2000 1  
 . E E  
 2000 E E  
 E F E  
 ( F ) F F A/E A/

1998 . E , 1997 ; ( F )  
 2001 . 2002 . F 80 120 ( 1 )  
 240 320 ( 2 )  
 1993 . C E E  
 2002 . F , 1996 ;  
 2002 . B I  
 , 1997 , I  
 . C  
 , 1999 ; , 2002 .  
 . G  
 . E  
 2000 1  
 . E E  
 2000 E E  
 E F E  
 ( F ) F F A/E A/

**SUBJECTS AND METHODS**

**Participants**

21.2 ; 20 24 ( 2 , 8 )  
 . A D

**Stimuli and Procedure**

CD  
 7 × 7 F 1.  
 (A, E)  
 A/ , E/A, E/ , /A, /E). A  
 F E  
 A F A/E A/

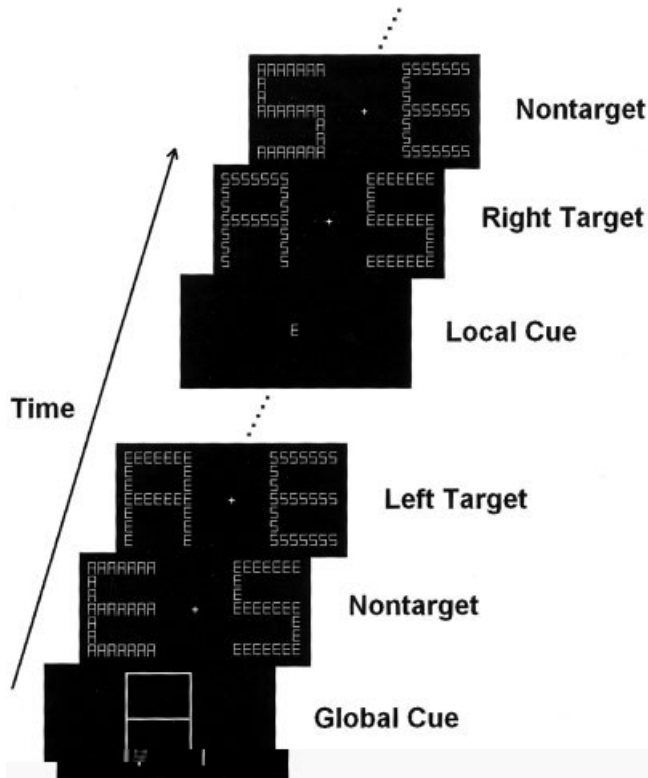


Figure 1.

Illustrations of the stimuli and procedure used in the current study.

( . . . / . . : E/A, E/ , /A, . /E) . . . . .

B . . . . . F . . . . . F, . . . . .

. A . . . . . 270 . . . . .

3.0 . . . . . 4.3 . . . . .

0.32 . . . . .

A . . . . . 0.50 . . . . .

E . . . . .

. . . . . 2.5 . . . . .

. . . . . 300 . . . . . 300 500

( I ) . . . . .

. E . . . . .

. . . . . ( . . . . . )

( A, E, . . . . . ) . . . . . A . . . . . ( F

1,000 . A 30 . . . . . 64 . . . . . F)

. . . . . E . . . . . 2 . . . . .

43 (30 . . . . . ), . . . . . F F . . . . .

. . . . . 14% . . . . .

(96.1 . . . . . 62.2%, = 8.99,  $P < 0.001$ )

**fMRI Image Acquisition and Analysis**

B . . . . . 1.5- GE . . . . .

B C . . . . .

F . . . . .

(64 × 64 × 15 . . . . . 3.75 × 3.75 × 7- . . . . .

= 2,000 . . . . . E = 40 . . . . . F . . . . .

= 240 . . . . . = 90 ). A . . . . .

3-D 1- . . . . . ( . . . . .

256 × 256 × 84 . . . . . 0.938 × 0.938 × 2.0- . . . . .

= 585 . . . . . E = . . . . . ). . . . .

99 ( . . . . . D . . . . . C . . . . .

, ) . . . . . F . . . . .

. . . . .

A . . . . . 2 × 2 × 2 . . . . .

I . . . . . ( I ) . . . . .

, 1998 . . . . .

F . . . . . ( F ) . . . . .

G . . . . . 8 . . . . . C . . . . .

/ . . . . .

. . . . .

. A . . . . .

P . . . . . 0.001 . . . . .

P . . . . . 0.01 . . . . .

I . . . . . ( I ) . . . . .

( . . . . . :// . . . . .

/I . . . . . / . . . . . ) . . . . .

**RESULTS**

A . . . . . ( F . . . . .

F) . . . . .

F F . . . . .

(96.1 . . . . . 62.2%, = 8.99,  $P < 0.001$ )

**TABLE I. Brain areas activated by global/local processing of bilateral visual inputs\***

| C | BA | x   | y   | z   | T    |
|---|----|-----|-----|-----|------|
| G | 21 | -44 | -2  | -18 | 4.71 |
|   | 41 | -40 | -18 | 2   | 3.94 |
|   | 41 | -52 | -16 | 12  | 3.87 |
|   | 36 | 32  | -24 | -14 | 3.99 |
|   | 36 | 24  | -40 | -8  | 3.34 |
|   | 36 | 28  | -36 | -18 | 3.29 |
|   | 7  | -14 | -74 | 32  | 3.83 |
|   | 7  | -30 | -62 | 48  | 3.55 |
|   | 7  | 8   | -72 | 50  | 4.03 |
|   | 7  | 22  | -78 | 38  | 3.96 |
|   | 7  | 24  | -64 | 58  | 4.04 |

\*A  $P < 0.01$ . BA, B

(762 .867 / = 3.02,  $P < 0.014$ ). F (1.9 .3.0%, = 1.34,  $P > 0.2$ ). B

B 21 41 (F .2 ). A F 36 (F .2 ). B 1996; , 2002 ; , 2001 B 7 (F .3).

**DISCUSSION**

E , 2000; , 1999 ; , 1998 . , 2002 B E

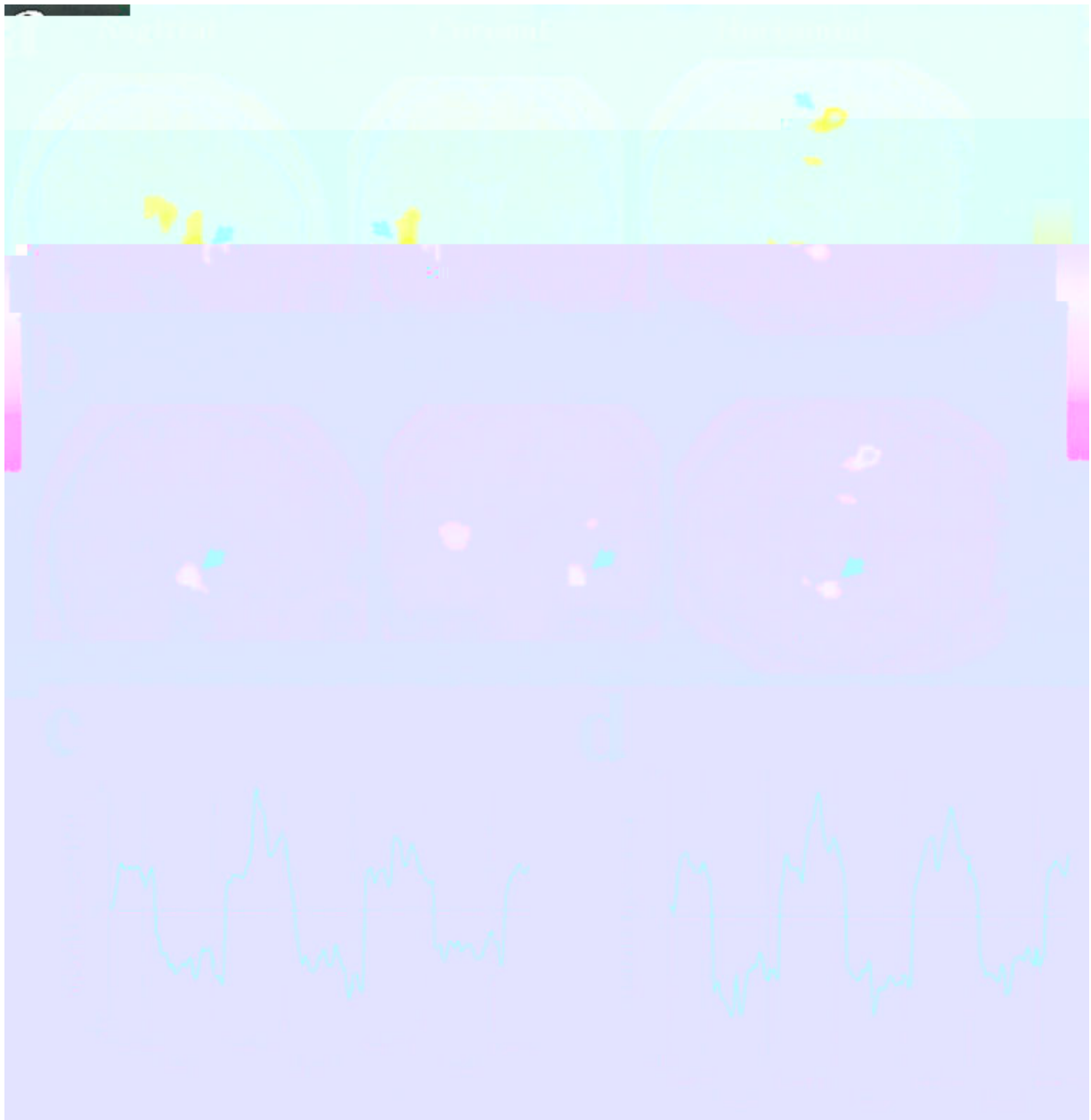
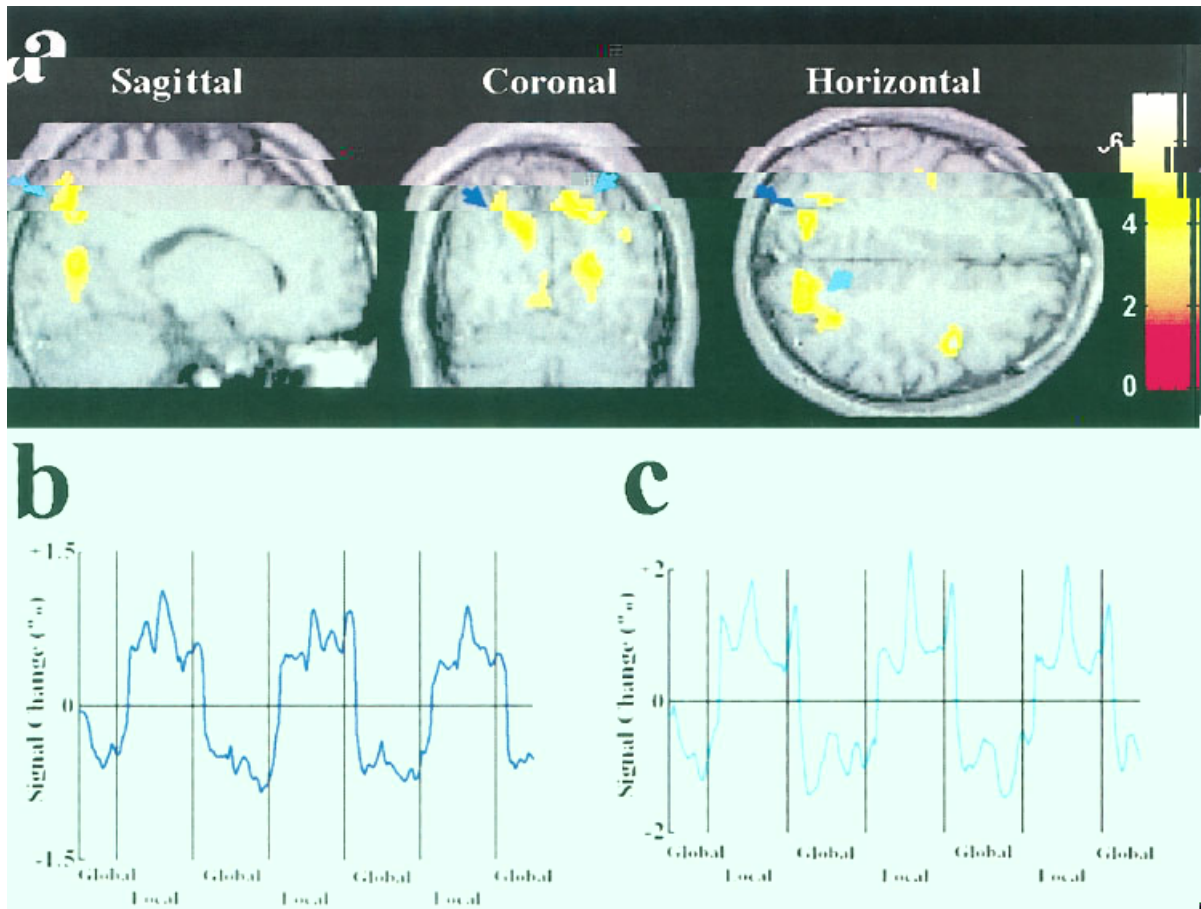


Figure 2.



**Figure 3.**

Brain areas activated by attention to the local level of bilateral compound stimuli. The results of the group analysis from 10 subjects were plotted on MR images of a representative subject. Threshold for activation of all clusters was  $P < 0.01$  (corrected). The color bar indicates the scale of z values. **a:** Activations in the left superior parietal cortex (indicated by blue arrows) and the right superior parietal cortex (indicated by green arrows). **b:** The time

courses of the signal change in the left superior parietal cortex as a function of global/local attention, averaged across the 10 subjects. The mean image values obtained from the average of the six scans were used as baseline. **c:** The time courses of the signal change in the right superior parietal cortex as a function of global/local attention, averaged across the 10 subjects. The time courses were averaged from raw fMRI signals.

... F ... / ... ( F ) ... 1986; ... 1987, ... F ... 1998; ... , 1982 . ... F , ... E ... F ... , 2001 . E

... F , ... F ... F ... / ... F ... , 1999 ; ... , 1999 . ... E ...

A . . . . ., 2003; . . . . ., 2001 ; . . . . ., 2002 ;  
. . . . ., 2003 . . . . .

.A . . . . ., . . . . .

, 2003 , . . . . .

.G . . . . ., . . . . . -

F . . . . ., . . . . .

, 2002; . . . . ., 2001 ;

I . . . . .

I . . . . .

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A . . . . . CF, B . . . . . C., CB . . . . . 13:342(2003):387-402. . . . . -

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 A: I  
 A, A, A CF, A (2003):  
 I 23:333 346.  
 C, (1990): C  
 E, C 16:471 483.  
 C, (1989): A  
 27:471 483.  
 A, F, B E, (1997):  
 : E  
 8:1685 1689.  
 A, D F, A A (2001): E  
 C  
 112:1980 1998  
 D (1977): F  
 C 9:353 383.

A, A, A (1998): E  
 C B 6:321 334.  
 C, (1988): E  
 8:757 3769.  
 C, E (1993):  
 E 19:471 487.  
 B (2001): F B, A, D A,  
 A A  
 98:2077 2082.  
 (1982):  
 ? E 8:253 272.  
 G, (1987): 16:89 101.  
 G, A, G (1986):  
 15:259 279.  
 (1998): C  
 (2003): C  
 C C 13:90 99.