

Neural Substrates Differentiating Global/Local Processing of Bilateral Visual Inputs

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Abstract:

Global/local processing of bilateral visual inputs is a fundamental cognitive function. The neural substrates of this function are not well understood. In this study, we used functional magnetic resonance imaging (fMRI) to investigate the neural substrates of global/local processing of bilateral visual inputs. The results showed that the left fusiform gyrus was more active during global processing, while the right fusiform gyrus was more active during local processing. These findings suggest that the fusiform gyrus plays a role in the processing of bilateral visual inputs, and that the left and right fusiform gyri are specialized for different types of processing.

Key words:

global/local processing; bilateral visual inputs; fMRI; fusiform gyrus

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INTRODUCTION

Global/local processing of bilateral visual inputs is a fundamental cognitive function. The neural substrates of this function are not well understood. In this study, we used functional magnetic resonance imaging (fMRI) to investigate the neural substrates of global/local processing of bilateral visual inputs. The results showed that the left fusiform gyrus was more active during global processing, while the right fusiform gyrus was more active during local processing. These findings suggest that the fusiform gyrus plays a role in the processing of bilateral visual inputs, and that the left and right fusiform gyri are specialized for different types of processing.

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

SUBJECTS AND METHODS

Participants

. C (2 , 8)
 F , 1999 ; F F , 2002 . ; 21.2 ; 20 24)
 . A
 . G D

Stimuli and Procedure

. 2000 1 . E CD
 F 1.
 . 2000 E E (A, E)
 A/ , E/A, E/ , /A, /E). A (. , / : A/E,
 E F A F F, F
 (F) F F A/E A/

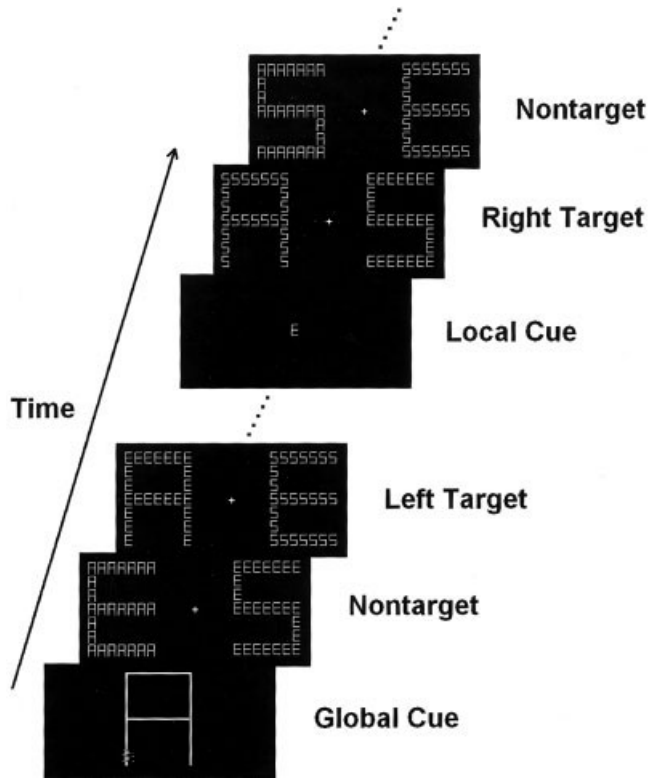


Figure 1.

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

(. . , / : E/A, E/ , /A, /E) -
 F F,
 B
 . A 270 ,
 3.0 4.3
 0.32
 A
 E
 300 2.5 . -
 (t r) 300 500
 . E
 (A, E,).
 1,000 . A 30 . E , 64 . F)
 43 (30), 2
 14%

fMRI Image Acquisition and Analysis

B 1.5- GE
 B C I
 . F
 (64 × 64 × 15 = 2,000 , 3.75 × 3.75 × 7-
 = 240 , = 90). A , E = 40 , F
 3-D 1-
 256 × 256 × 84 = 585 , E = (.
 99 (D C . F -
 ,) . F -
 . A 2 × 2 × 2 3
 I (r)
 , 1998 -
 . F (F I)
 G 8 . C
 / .
 . A
 P 0.001
 P 0.01
 I (r)
 (/ :// . - . .
 . / / .) .
RESULTS
 (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	
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%, F² , I -
 = 1.34, $P > 0.2$).
 B

I.
 , I
 B 21 41 (F . 2). A
 . F ,
 B
 36 (F . 2). , , 1996; F² , , 2002 ; , 2001 F ,
 B 7
 (F . 3). /

DISCUSSION

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 ,
 ,
 E , 2000; F² , 1999 ; ,
 F² , ; , 1998 . F² , 2002
 I
 ,
 ,
 B
 /
 E ,
 -

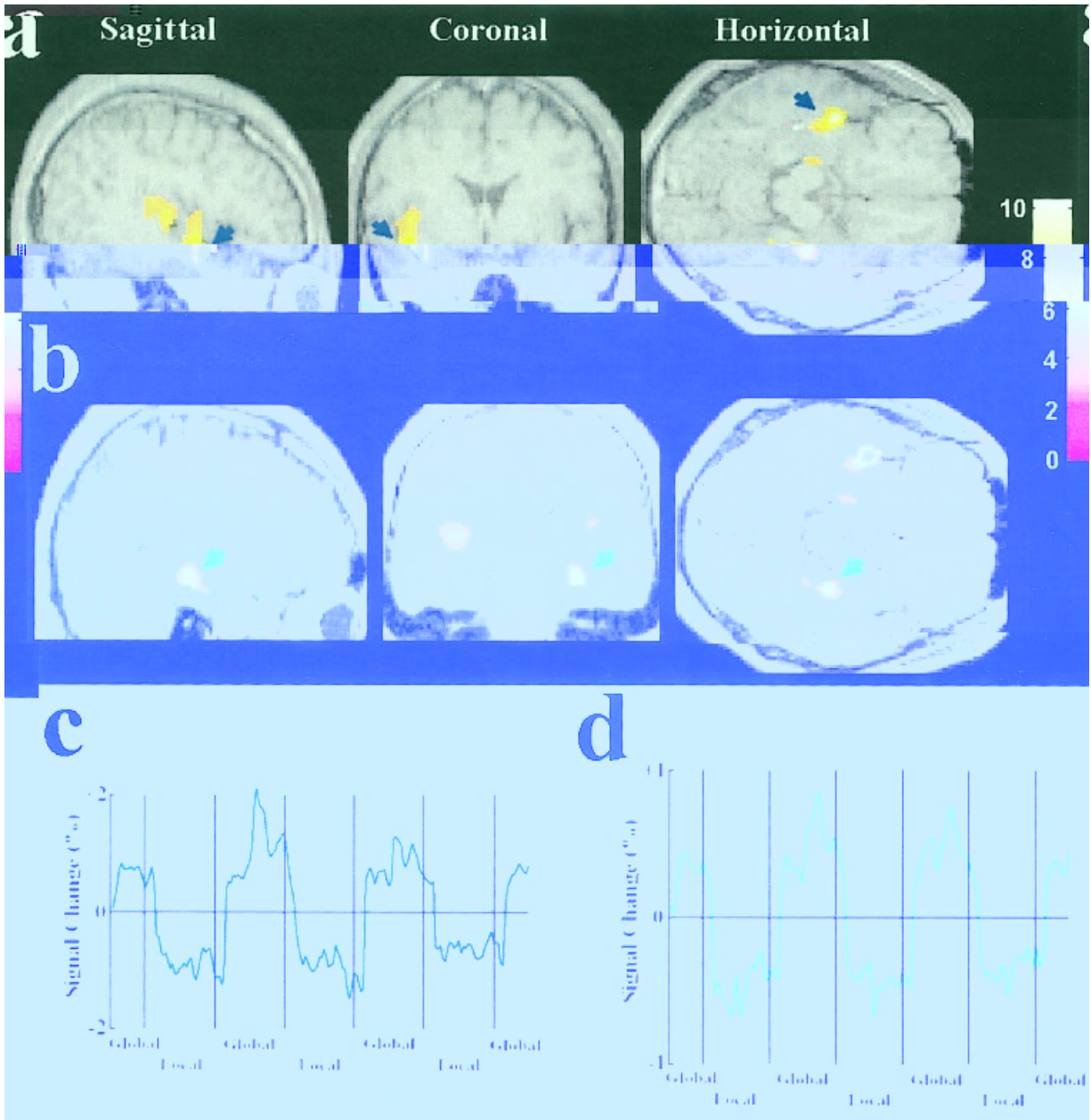


Figure 2.

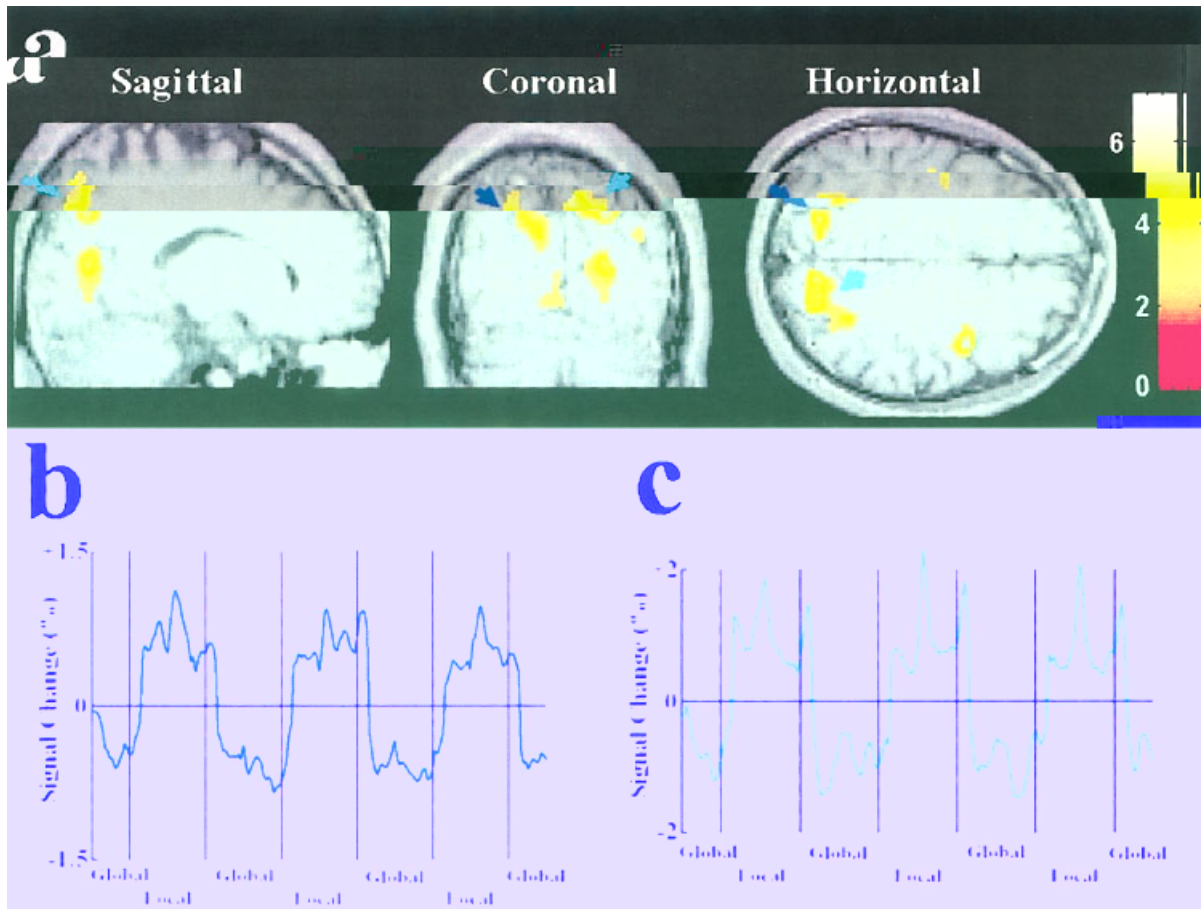


Figure 3.

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) F , . F , F 1987 , / , 1986; / F , F 1998; , 1982 . , F r , F , . E F , 1999 . F , E , 2001 . E

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

.A ,

, , 2003 ,

.G , , -

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-

F ,

H H , 2002; H , 2001 ;

I B, C (1999): .C , A , A, A (1998): E -
 A: I . / - .C B 6:321 334. -
 , I⁺ . () . (1988): E -
 A, A , A CF, A , (2003): -
 I : 8:757 3769. -
 I . 23:333 346. C, E , , . (1993): -
 , I C, (1990): C -
 : E I⁺ I⁺ 19:471 487. -
 : , I⁺ , F B, A , , D A , -
 E C 16:471 483. B (2001): A A -
 , C, (1989): A 98:2077 2082. -
 : (1982): : 8:253 272. -
 27:471 483. ? E I⁺ (1987): -
 A, , F , B , E, (1997): G , 16:89 101. -
 I⁺ : E - G , A, G , (1986): -
 I . 8:1685 1689. A (2001): E -
 A, D F, A - , I⁺ A (2001): E -
 : 15:259 279. -
 .C (1998): C -
 112:1980 1998 : (2003): C : -
 D (1977): F : .C C 13:90 99. -
 .C 9:353 383. .C C 13:90 99.