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ORIGINAL ARTICLE

Dissociated Neural Representations of Pain Expressions of Different Races

F S [1,3,†], X H [1,2,†], S H [1,2]

[1]D P , [2]PKU-IDG/M G I B R , [3]G S M , P U , B C

A S H , D P , P U , 52 H R , B 100080, C . E : @ . .

[†]F.S. X.H. .

Abstract

T - - C C ( ) ( ) . I , (RS) , , , . W 128–188 (P2) 200–300 (N2) / . M , RS P2/N2 , C C . O fi .

Key words: EEG, , ,

Introduction

, (K A . 2012). E - (ERP) . R - 100 - , (.[illegible], N1 - - (I B 2009; K , I U 2003; K I 2007), . 2012; M 2013). F 170 , (MRI) (.[illegible], N170, S I 2013). , (.[illegible], W A 200 (P200) F 2005) (.[illegible], G . 2001), - - - (I U 2003; K fi - , . T - I 2007; I B 2009). (.[illegible], R . W 2003) fl - - - - , , fi

ﬂ ﬂ ﬂ , ,
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? A MRI ﬂ
- - /
(L . 2008) (C . 2008)
ﬂ ﬂ . ERP
ﬂ / / -
- , , fi -
(K I 2007).
O MRI
ERP
- - . MRI
, -
, - (-)
ﬂ ﬂ (X .
2009; A . 2013; S ﬂ . 2014). ERP
- (
-) ﬂ
/ 128–188 (P2) 200–300 (N2)
(S ﬂ H 2012; S ﬂ . 2013;
H H 2014). F , - -
, -
ﬂ /
(S . 2014) (A
. 2010).
T fi ﬂ -
- - ﬂﬂ
ﬂ
-ﬂ -ﬂ (J . 2002;
D . 2011). H , ﬂ
ﬂ - -
fi . B (B Y ﬂ1986) (H
. 2002) ﬂ
ﬂ
. T
ﬂ , , ,
., ﬂ ﬂ
(.ﬂ,) (ﬂ
H . (2002) ﬂﬂ
( ) ﬂ
). S ,
ﬂ
ﬂ -
ﬂ ﬂ ﬂ .ﬂ,
fi , , , -
ﬂ (I B 2009; K . 2012)

- - . T
2 ﬂ ﬂ ﬂ -
- . T fi 2
ﬂ ﬂ -
ﬂ -
. T ﬂﬂ -

ﬂ( )142(89).31( )-20.6((1995)T 14.4.4. ﬂ14 .3 -27)-2)14.9(, 42 (ﬂ-22.4(-)-9.8( )-19.3(14.4)-1754.9( )-3 4.4)3( )2 9.8(-14.9( )-224(8.6-15.TD 12.9( )-

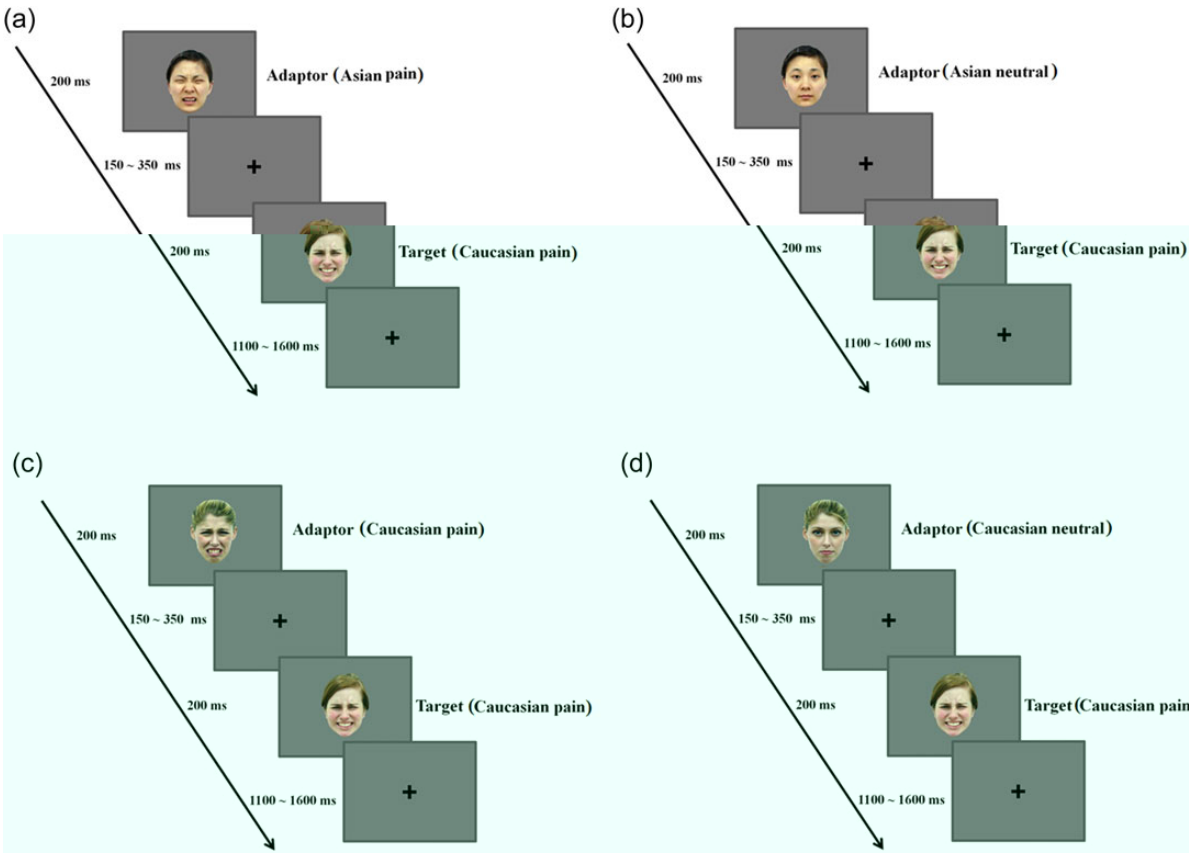


Figure 1. I EEG T fi
. A A C
. T
. O ,
C
. O , A . H

-
.
T RS
. C , -
RS
. W ERP C C -
-
, .

Materials and Methods

Participants

S C (8 , 19 27 , M = 21.56 , SD = 2.50) 16 C (8 , 17 27 , M = 21.06 , SD = 2.62) B C , . A C C . C 7 G , 4 A - , 2 I , 2 F , 1 S , - C 1 1 (= 6) . P , M - E I M (P 1992), fi 2 (C : 2.73 0.45; C : 2.85 0.46, $t_{30} = 0.72$, $P = 0.479$). A - , - fi E H I (O fi 1971), - - , . T , .

Stimuli and Procedure

S (S H 2012) 32 16 A (8) 32 16 C (8). T 2 , . R / , , - , A C (S H 2012).

E 200 fi 150 350 . A 200 fi 1100 1600 (F 1). E 3.8 4.7 120 . A - , - - . A

. O ,
1 2 . T 8 128 . A
. T
( )
( ) . T
P .
T ,
9- L (1 =
, 9 =)
(EEG) P ,
I R I
(IRI, D 1983) 5- (0 =
, 4 =). W
I A T (IAT, G . 1998)
, A C
. A 10 A 10 C (
) IAT. I
20 40 ,
A /
C /
. I 20 40
, A /
C /
. T IAT I . A
(G . 2003),
2
, D
. A D 0 ,
- , -
, D 0
-
-. A
,
9- L (1 = 9 =
A
C .

EEG Recording and Analysis

A N S EEG .
T EEG
62
.
E
. T
- 1.5
. T EEG fi
(0.1–100 H) 250 H .
T ERP fl
200
1000 . T
50 μV
. T
91 14
- 91 15
- . T
ERP 200-
.
W fi RS
ERP

. S fi ,
ERP F
1*a* *b*, ERP F
1*c* *d*. T , (. .,)
2 RS
-
2 . S -
F 1
C
RS -
fi . A , RS
“ ”
ERP F 1*a* *b* -
ERP F 1*c* *d*. H , -
, RS
ERP
F 1*c* *d* “ ” ERP
F 1*a* *b*.
M N1, P2, N2
(F , F3, F4) (C , C3,
C4) . M P3 N170
/ (C , C3, C4, P , P3, P4) -
(P7 P8) , . R -
(ANOVA) ERP ,
(RT), A R (- .
-), A E (.), T R
(- . -) - , E -
(C . C) -
. ANOVA ERP
(. , C3 C4)
- , , H (
). H ,
H fi ,
R . W
ERP ,
fi fi ($F < 1$). O - (
-)
( )
.

Results

Behavioral Performances

T 1 RT
. ANOVA RT (
- -
ANOVA) fi ($P > 0.1$). P -
(6.39 1.15 . 1.78 0.94, $F_{1,30} = 422.92$,
$P < 0.001$)
(4.44 1.96
. 1.77 0.97, $F_{1,30} = 79.23$, $P < 0.001$). R
A C
($P > 0.1$). O - t- IAT D
D fi 0 C -
(0.51 0.28, $t_{15} = 7.29$, $P < 0.001$)
C (0.18 0.41, $t_{15} = 1.79$, $P = 0.094$). I -
t- fi D C -
C ($t_{30} = 2.65$, $P < 0.05$).
T , C
- ,
C . I t-
IRI C C
(T 2, $P > 0.2$).

ERPs to Adaptor Faces

ERP
84–124 (N1) fl 128–188 (P2)
– ,
200–300 (N2)
420–

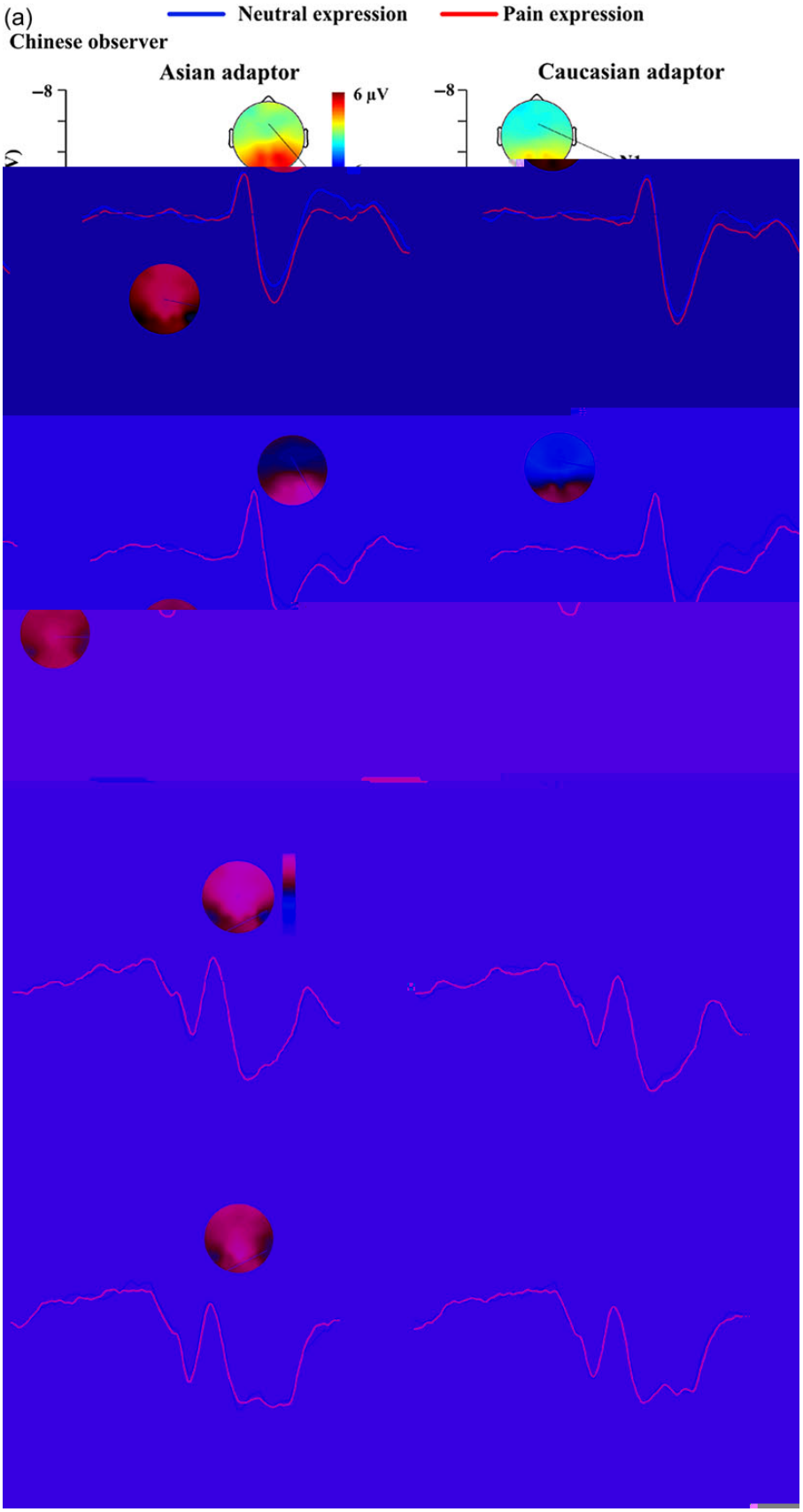


Figure 2. (*a*) I ERP (C). M P2/N2 - -. (*b*) I ERP (P8). T N170 . ERP C C , .

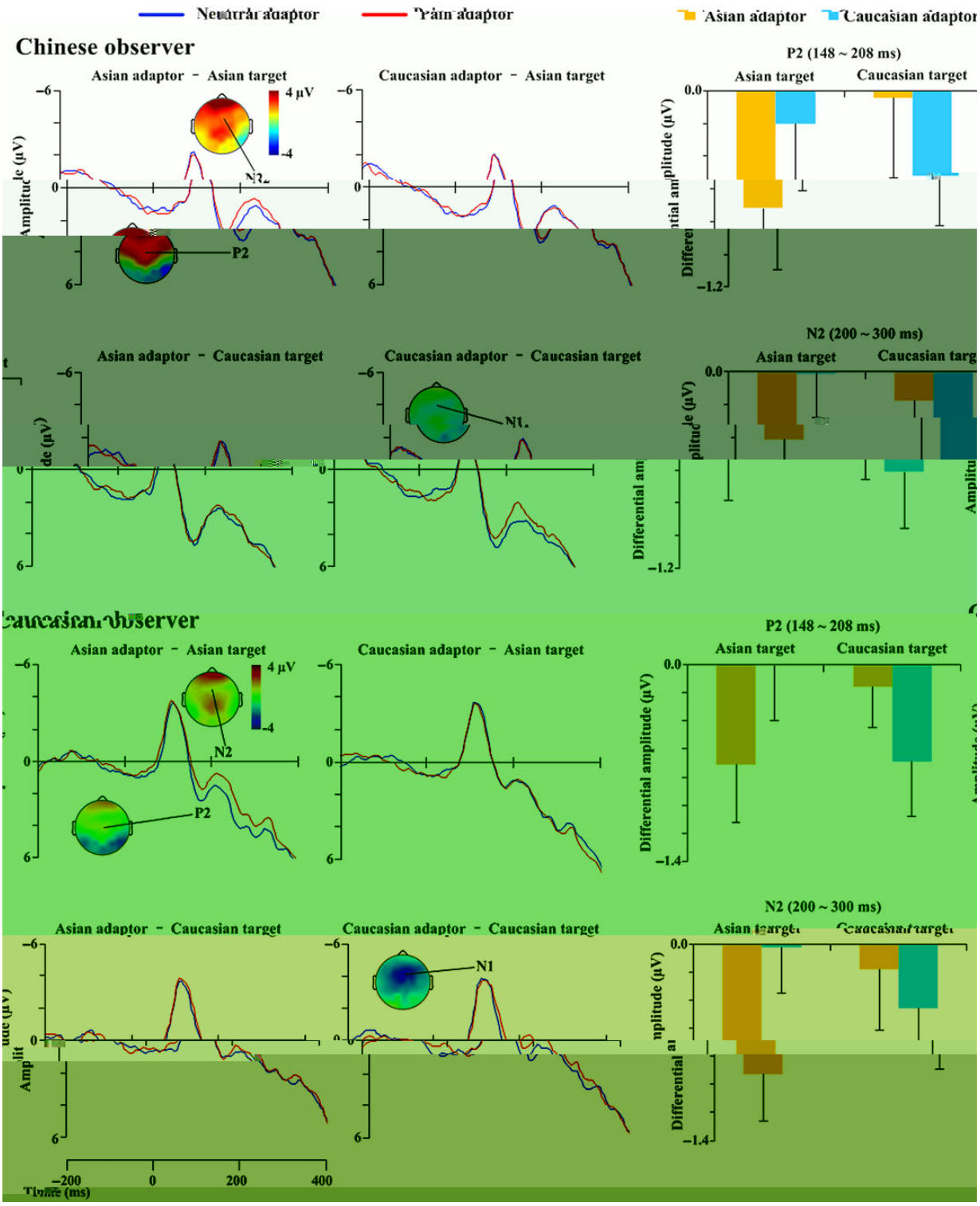
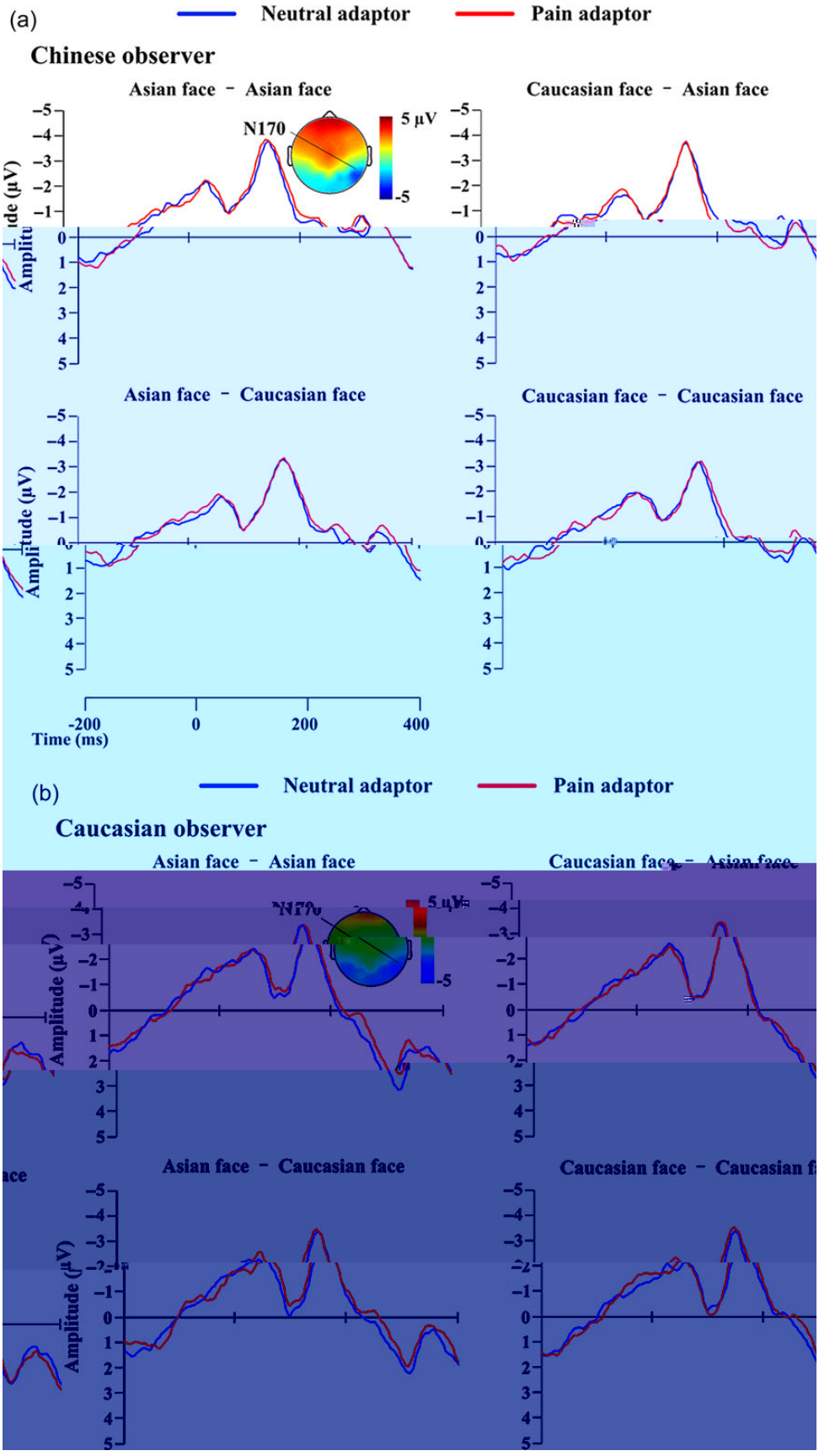


Figure 3. M - RS P2 N2 . ERP C A C . ERP - . T P2/N2 . O , P2/N2 C C .

ANOVA N2 fi . M , T R ($F_{1,30} > 29.31$, $P < 0.001$), - ($F_{1,30} > 4.99$, $P < 0.05$), - N2 - - RS N2 . T RS


(a)
Neutral adaptor
Pain adaptor
Chinese observer
Asian face – Asian face
Caucasian face – Asian face
Asian face – Caucasian face
Caucasian face – Caucasian face
N170
5 μV
-5
Amplitude (μV)
Time (ms)
-200
0
200
400
(b)
Neutral adaptor
Pain adaptor
Caucasian observer
Asian face – Asian face
Caucasian face – Asian face
Asian face – Caucasian face
Caucasian face – Caucasian face
Amplitude (μV)

fi fi A
E A R T R ($F_{1,30} > 4.43$, $P < 0.05$).
S , RS N2 -
fi fi - ($F_{1,30} = 2.53$–
3.49, $P = 0.071$–0.122) - ($F_{1,30} < 1$,
$P > 0.6$). I , RS N2 -
fi fi - ($F_{1,30} > 4.65$,
$P < 0.05$) - ($F_{1,30} < 1$, $P > 0.4$, F 2).
T , P2 N2
- RS

. S S T 4 .
O - P3
- ($F_{1,30} > 15.14$, $P < 0.001$). ANOVA N170 -
fi T R ($F_{1,30} =$
10.50, $P < 0.005$), - N170 -
- (F 4). N fi
N170 P3 ($P > 0.05$).
ANOVA P2/N2/P3/N170
fi E -
($P > 0.05$), -
, ,
, RS ERP C -
C . W
P2/N2 RS -
' 6( )-14.1( )-11.5.7(.1(-10.1( )-14.3.1( )-11IA( )-309T1( )-11D8( )316. ( )-51.7( )-1 20.0771-334184T
7).> -211 .3(9)-26( )221

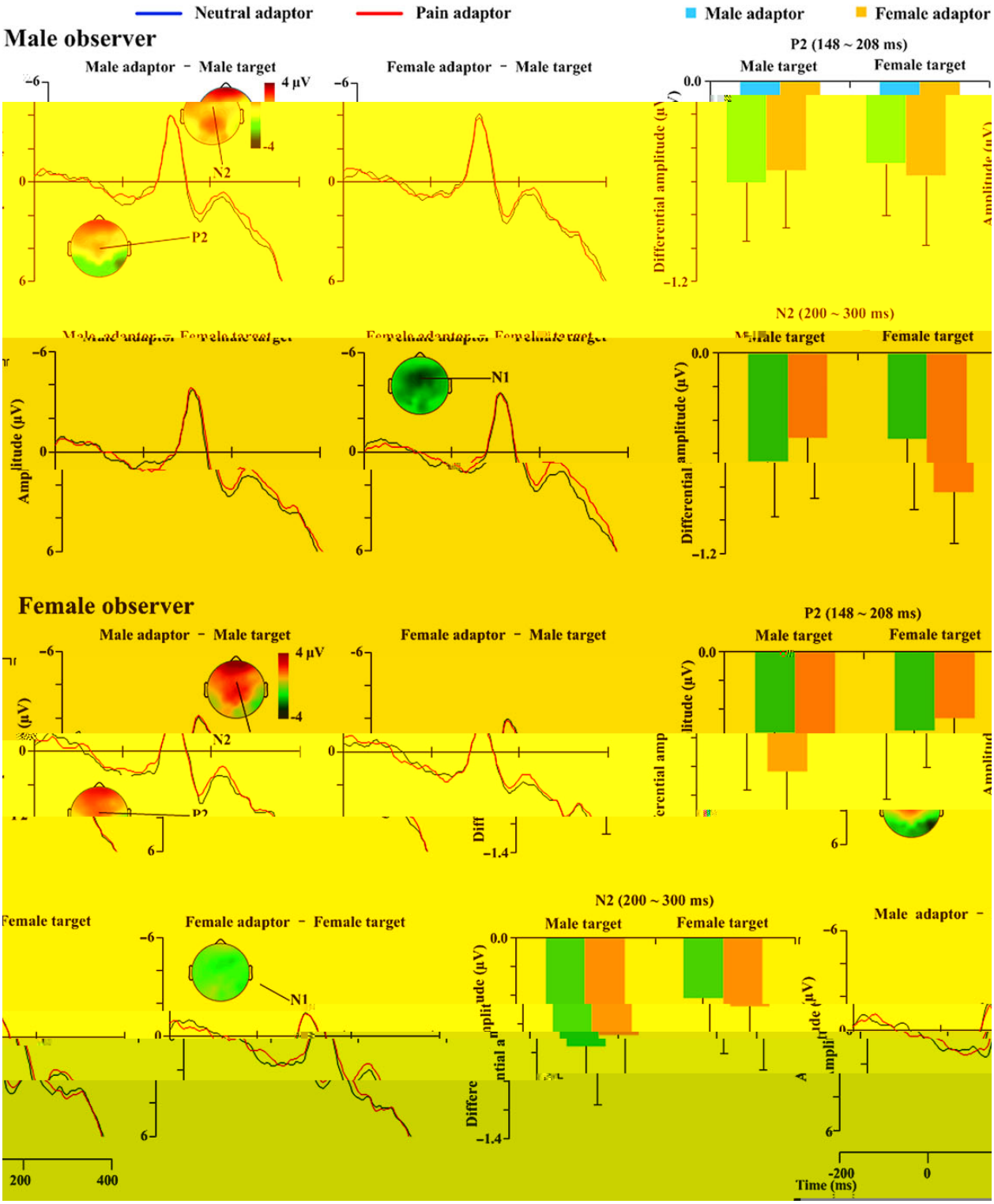


Figure 5. P2/N2 . ERP C ( ) . ERP -
. T P2/N2 . O , P2/N2 , .

S P2 2012). T MRI fi -
(S H (S . 2007;

S . 2014)

(X . 2009; A . 2013; S . 2014). S P2

P2 . H , / P2 .

S P2 . F MRI

P . I (V E 1992; V . 2010) (S H 2012). R P2 (S . 2013).

T fi M ERP / N1, P2, N2, P3 , B W (I B 2009; K . 2012). M P2/N2 -

(I B 2009). S , (S H 2012) P2 C . H , RS / P2 N2 . T N1 (, I U 2003; D B 2007) fl , P300 (I U 2005; W -J I 2006) fl (I B 2009). T N170 (V . 2010). O fi RS P2/N2 .

H ? F , .

B C 3 (K . 2005). B 6 (K . 2007). A K E C 3 9 C A (S . 2005). T fi

. D . A fl (O W 2003) (R 2000), fi , . T , . F , , . A fl (V . 2008; M S 2008). MRI 2 . F , E . (2011) fi RS (EBA) (FBA) . M , EBA FBA. T fi 2 . H , 2 2 ( ), . A , 2 , , . H , ( ) 2 . O , 2 2 . I , 2

. I ERP fi ,

2

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2 -

-

, RS -

2 - (

) . N , fi

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(., P2 -

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- - -

. I , -

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. R , fi -

, RS

2 - , RS

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O -

. A

C C

C C -

- EEG T

RS

. R ERP MRI

(.,)

(R . 2001; S . 2006; S . 2011; G . 2014). T ERP -

(., N170)

RS . T ,

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- . T

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I , ERP

RS

. O fi

- -

fi

. F fi -

- - -

- (X .

2009; A . 2010; S H 2012; A .

2013; S . 2014; S . 2014)

- (J . 2002; D

. 2011). O fi

, , fi (. ., RS

2 - -

-) . R -

-

(.,) - - .

Supplementary Material

S : :// . .

. .

Funding

T N N S F - C (P 31470986, 31421003, 91332125 81161120539) M E C (P 20130001110049).

Notes

Conflict of Interest: N .

References

A A, S A, A SM. 2010. R - . C B . 20:1018–1022.

A RT, M E, A A, S V, C V, A SM. 2013. T : - . H B M . 34:3168–3181.

B V, Y A. 1986. U . B J P . 77:305–327.

C JY, I T, G HL, N J, B M, A E, A N. 2008. C fi . J C N . 20:2167–2174.

D MH. 1983. T - . J P . 51:167–184.

D CL, B BD. 2007. E - . S C A N . 2:189–198.

D BB, M CF, W SE, P KM. 2011. R : - P . 152:1001–1006.

E MP, L RP, H RN, R JB, P L, C AJ. 2011. C “ - ” . J N . 31:5635–5642.

G AMV, L AM, S HS, L VAF, L AR. 2014. E . S C A N . 9: 610–614.

G AJ, G JDE, C JY, E JL. 2001. D - - . N N . 4:845–850.

G SJ, C CC, M A. 2012. R - : fi . C N . 3:227–237.

G A, M G D, S J. 1998. M : . J P S P . 74:1464–1480.

G A, N B, B M. 2003. U I A T : I. - . J P S P . 85:197–216.

G -S K, H R, M A. 2006. R : - fi . T C S . 10:14–23.

H JV, H EA, G MI. 2002. H . B P . 51:59–67.
H RN, R A, R E, V P, R MD. 2004. T - N I . 21:1674–1689.
H S, H S. 2014. S : / fi - . S N . 9:639–649.
I TA, B BD. 2009. T . T C S . 13:524–531.
I TA, U GR. 2003. R : - . J P S P . 85:616–626.
I TA, U GR. 2005. T fl : ERP - . C A B N . 5:21–36.
J JD, S CH, J A, M L L, T J, T D. 2002. R K O. J. : - . J A S P . 32:1208–1223.
K DJ, Q PC, S AM, L K, G L, P O. 2007. T - : - P S . 18:1084–1089.
K DJ, Q PC, S AM, L K, G A, S M, G L, P O. 2005. T - - , , - . D S . 8:F31–F36.
K JT, B MR, P EA. 2012. T . N N . 15:940–948.
K JT, I TA. 2007. M : . J E S P . 43:738–752.
L KU, K HS, K KT, K YJ, K YS, S YW, L I. 2008. D - - . N . 19:1021–1025.
M JP, S MA. 2008. N fi . J N . 100:1923–1935.
M EK, L L, D R. 1991. A - . S . 254:1377–1379.
M P. 2013. T -. N B R . 37:1530–1536.
O fi RC. 1971. A – E I . N 9:97–113.
O JE, W J. 2003. I - . A J P S . 47:567–582.
P J. 1992. T : . J A R . 7:156–176.
R JA, B AA, G HL, H TF, W CL, T S, S JN. 2003. A MRI - . N N . 6:1323–1328.
R B, L P, S BH, K R, B D. 2013. S P N A S USA. 110: 16760–16765.
R MH. 2000. C fl . E R S . 23:1002–1034.
R P, M R, H U, G M, H T. 2001. F : D - . N . 32:747–757.
S MV, H Y, W AC, S M, K E, H R. 2007. T : - ' . C C . 17:230–237.
S S, P C, A AM, V VAG, D S S. 2005. R - . P S . 16:440–444.
S W. 1995. P , , : . S C . 8:31–46.
S HT, S J, C M, J M, W AI, H AO. 2006. S : . N . 17:365–369.
S KB, I TA. 2013. S - N170' . S C A N . 8:937–942.
S P, M F, C L, D 'A R. 2014. T ' - : - - . S C A N . 9:454–463.
S F, H S. 2012. M -. N I . 61:786–797.
S F, L Q, L H, F F, H S. 2014. T - - ' N I . 88:263–270.
S F, L Y, B, W, H S. 2013. O - ' - B P . 92:380–386.
S A, G JOS, H A, S BP, J L, F BA, P DC. 2011. S ? L - . S C A N . 6:434–441.
V T, E M. 1992. T . Q J E P A. 44:161–204.
V BE, K G, F E, V J, V R. 2008. S - . J N . 28: 10631–10640.
V L, R GA, C R. 2010. N - - . P N A S USA. 107:20081–20086.
W ME, F ST. 2005. C - . P S . 16:56–63.
W -J EC, I TA. 2006. A . S C . 24:580–606.
W ACDC. 2002. F , , - , B B S . 25:475–480.
X X, X, W X, H S. 2009. D ? R . J N . 29:8525–8529.