B>DAD<>86A +HN8=DAD<N MMM (2017) MMM-MMM

CDCI:CIH A>HIH 6K6>A67A: 6I -8>:C8:D>G:8I

B>DAD<>86A +HN8=DAD<N

?DJGC6A =DB:E6<:: LLL.:AH:K>:G.8DB

(:CI6A >B6<:GN D; ;68: :C=6C8:H ;68:-H:CH>I>K: :K:CI-G:A6I:9 EDI:CI>6AH ID 6B7><JDJH K>HJ6A HI>BJA>

'>C<M> 'J[6,U,V], C=6C<M>C 3=6C<[8], '>6C< '>[6,U,V,UU]

3Ю92ℷI5S)(t68:

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A , . $C ' $) ! *

Keywords:
0>HJ6A B:CI6A >B6<:GN
.DE:9DLC BD9JA6I>DC
!68:
0:GI:M EDH>I>K: EDI:CI>6A
+2
)170
K:CI-G:A6I:9 EDI:CI>6AH

AB - . , AC .

0>HJ6A B:CI6A >B6<:GN ;DGBH B:CI6A G:EG:H:CI6I>DCH D; K>HJ6A D7?:8IH L=:C 8DGG:HEDC9:CI HI>BJA> 6G: 67H:CI 6C9 H=6G:H HDB: 8=6G68I:GH L>I= K>HJ6A E:G8:EI>DC. BDI= I=: K:GI:M-EDH>I>K:-EDI:CI>6A (0++) 6C9)170 8DBEDC:CIH D; :K:CI-G:A6I:9 EDI:CI>6AH (,+H) ID K>HJ6A HI>BJA> =6K: 6 G:B6G@67A: EG:;:G:C8: ID ;68:H. .=>H HIJ9N >CK:HI><6I:9 L=:I=:G K>HJ6A B:CI6A >B6<:GN BD9JA6I:H I=: ;68:-H:CH>I>K: 0++ 6C9/DG)170 8DBEDC:CIH. .=: G:HJAIH H=DL:9 I=6I L>I= H><C>;>86CIAN A6G<:G 6BEA>IJ9:H JC9:G I=: ;68:->B6<:GN 8DC9>I>DC I=6C I=: =DJH:->B6<:GN 8DC9>I>DC, I=: 0++ 6C9 +2 G:HEDCH:K, 7JI CDI I=:)170 8DBEDC:CI, L:G: :A>8>I:9 7N E=6H:-G6C9DB>O:9 6B7><JDJH HI>BJA>. .=JH, I=: 7G6>C HJ7HIG6I:H JC9:GAN>C< 0++ 6G: CDI 8DBEA:I:AN >9:CI>86A ID I=DH: JC9:GAN>C<)170, 6C9 I=: 0++/+2 B6C>;:HI6I>DC D; I=: 86I:<DGN H:A:8I>K>IN >C >B6<:GN EGD767AN G:S:8IH 6C >CI:<G6I>DC D;

290 (6C92<398.087 Tb E.BT./F3 8 Tf28176.290 (6C92<37.427.220181 TCT./F2 7.2 208.2.52.290 (6C92<39HC:87 Tb E.BT./F3 8 T

E6G69><BH, HJEEDGI>C< I=: K>:L I=6I K>HJ6A B:CI6A >B6<:GN 6C9 E:G8:EI>DC H=6G: HDB: 8DBBDC C:JG6A HJ7HIG6I:H. !DG :M6BEA:, :K:C L=:C I=: K>HJ6A H:CHDGN >CEJI D; 6 ;68: >B6<: >H 67H:CI, >B6<:GN 86C >C9J8: B6G@:9 68I>K6I>DC D; I=: !!A (:.<., D7H:GK:GH 6G: >CHIGJ8I:9 ID >B6<>C: 6 ;68: L>I= I=:>G :N:H 8ADH:9), I=DJ<= I=: >B6<:GN->C9J8:9 68I>K6I>DC >H L:6@:G I=6C I=6I >C9J8:9 7N 6 ;68: E=DID<G6E= (*'CG6K:C & &6CL>H=:G, 2000). AAHD, >C 7DI= =:6AI=N >C9>K>9J6AH ('> :I 6A., 2010;) :HIDG :I 6A., 2013) 6C9 E6I>:CIH L>I= EGDHDE6<CDH>6 (,><=6GI :I 6A., 2010), L=:C I=: K>HJ6A >CEJI >H G6C9DB CD>H:, I=: !!A 7:8DB:H 68I>K6I:9 6H ADC< 6H 6C >AAJHDGN ;68: >H G:EDGI:9. .=: #69?>@=6C>, &K:G6<6,)6>@ 6C9 A=A;DGH B6<C:ID:C8:E=6AD<G6E=>8 ((") HIJ9N (2009) =6H ;JGI=:G H=DLC I=6I L=:C I=: K>HJ6A HI>BJAJH 8DCI6>C>C< HDB: H8=:B6I>8 8AJ:H D; 6 ;68: (:.<., I=: E6II:GC D; DC: BDJI= 6C9 ILD :N:H) 6G: >C8>9:CI6AAN E:G8:>K:9 6H 6 ;68:, I=: (165 G:HEDCH: D88JGH 7DI= L>I= 6 H>B>A6G 6BEA>IJ9: ID I=6I :A>8>I:9 7N 6 G:6A ;68: HI>BJAJH 6C9 L>I= 6C 68I>K6I>DC HDJG8: >C I=: K:CIG6A !!A. AAA I=:H: G:EDGIH HJ<<:HI I=6I I=: !!A >H 6C >CI:G;68: I=6I >H >CKDAK:9 >C ;JC8I>DC6A >CI:<G6I>DC 7:IL::C I=: IDE-9DLC >B6<:GN EGD8:HH 6C9 I=: 7DIIDB-JE H:CHDGN EGD8:HH. $I >H >BEDGI6CI ID :HI67A>H= 6 C:JGDE=NH>DAD<>86A BD9:A D; I=: IDE-9DLC BD9JA6I>DC< :;;:8I D; K>HJ6A B:CI6A >B6<:GN D; ;68:H.

)JB:GDJH :A:8IGD-:C8:E=6AD<G6E=>8 (") HIJ9>:H =6K: H=DLC I=6I 7DI= I=: K:GI:M EDH>I>K: EDI:CI>6A (0++) 8DBEDC:CI 6C9 I=:)170 8DBEDC:CI D; :K:CI-G:A6I:9 EDI:CI>6AH (,+H) 6G: B6G@:9AN ;68: H:CH>I>K:: 7DI= 0++ 6C9)170 6G: :C=6C8:9 L=:C :A>8>I>C< HI>BJA> 6G: ;68:->A>@: D7?:8IH 8DBE6G:9 ID CDC-;68: D7?:8IH (:.<. 86GH, 6C>B6AH, A:6K:H, SDL:GH, BJH=GDDBH, IDDAH, H=D:H, GD69 H><CH DG LDG9H) (;DG 0++, H:: BöIO:A, -8=JAO:, & -ID9>:8@, 1995; $I>:G & .6NADG, 2004; %:TG:NH, 1996; %:TG:NH & .J@B68=>, 1992; +GDK:G7>D & "6AA>, 2016; ,DHH>DC & %68FJ:H, 2008; ,DHH>DC, %DN8:, CDIIG:AA, & .6GG, 2003; ;DG)170, H:: B:CI>C, AAA>HDC, +J8:, +:G:O, & (8C6GI=N, 1996; D: #66C, +6H86A>H, & %D=CHDC, 2002; >B:G, 2000; $I>:G & .6NADG, 2004; +GDK:G7>D & "6AA>, 2016; ,DHH>DC & %68FJ:H, 2008; ,DHH>DC :I 6A., 2000 .6NADG, (8C6GI=N, -6A>76, & D:<>DK6CC>, 1999 ; ;DG 6 G:8:CI G:K>:L H:: ,DHH>DC, 2014). $I >H D; >CI:G:HI ID @CDL L=:I=:G I=:H: ILD ;68:-H:CH>I>K: ,+ 8DBEDC:CIH ()170, 0++) 6G: H:CH>I>K: ID ;68: B:CI6A >B6<:GN L=:C 6CN ;68: ;:6IJG:H >C :A>8>I>C< HI>BJA> 6G: 8DBEA:I:AN :A>B>C6I:9.

.=: ;68:-G:HEDCH>K:)170 8DBEDC:CI B6>CAN D88JGH 6I D88>E>ID-I:BEDG6A G:8DG9>C< H>I:H DC I=: H86AE, L>I= I=: 6BEA>IJ9: E:6@ C:6G 170 BH ;DAADL>C< I=: DCH:I D; 6 ;68: HI>BJAJH 6C9 B6C>;:HIH I=: :6GAN HI6<: D; EGD8:HH>C< ;68: HIGJ8IJG6A >C;DGB6I>DC (B:CI>C :I 6A., 1996; ,DHH>DC :I 6A., 2000). $CI:G:HI>C<AN,)170 86C 7: :A>8>I:9 7N CDC-;68: CD>H: >B6<:H :>I=:G 9JG>C< I=: B6>CI:C6C8: D; I=: LDG@>C< B:BDGN D; 6 G:6A ;68: >B6<: (-G::C>K6H6C, &6IO, & %=6, 2007) DG L=:C 6 CD>H: >B6<: >H IG:6I:9 6H 6 =JB6C ;68: L>I= 6 <:C9:G (1>A9 & BJH:N, 2004). (DG:DK:G,)170 86C :K:C 7: :A>8>I:9 7N H>BEA: H8=:B6I>8 DG A>C: 9G6L>C<H >CI:GEG:I:9 6H ;68:H DG :N:H (B:CI>C & "DAA6C9, 2002; B:CI>C :I 6A., 2002). #DL:K:G, >I >H CDI 8A:6G L=:I=:G IDE-9DLC >B6<:GN 86C HI>AA 6;;:8I)170 L=:C 6CN 7DIIDB-JE ;68:->C<C6A >CEJIH 6G: HJ7HI6CI>6AAN A>B>I:9 DG :K:C 8DBEA:I:AN :A>B>C6I:9.

.=: 0++ :B:G<:H 6I ;GDCID-8:CIG6A G:8DG9>C< H>I:H DC I=: H86AE L>I= I=: E:6@ 6BEA>IJ9: 7:IL::C 160 6C9 200 BH ;DAADL>C< I=: DCH:I D; 6 ;68: HI>BJAJH 6C9 B6N 6AHD G:EG:H:CI I=: HI6<: D; HIGJ8IJG6A :C8D9>C< D; 6 ;68:, 7:86JH: >I 7:8DB:H 9:A6N:9 DG HDB:I>B:H 6II:CJ6I:9 >; I=: ;68: HI>BJAJH >H 9>HGJEI:9 7N 6C >CK:GH>DC, H8G6B7A:, DG B6H@>C< IG:6IB:CI ("!:DG<:, K6CH, !>DG>, D6K>9DT, & ,:C6JAI, 1996; %:TG:NH, 1989; %DN8: & ,DHH>DC, 2005; %:B:A :I 6A., 2003). $I >H CDI 8A:6G L=:I=:G 0++ 86C 7: JH:9 ;DG HIJ9N>C< L=:I=:G 6 EG:;:G:C8: ID ;68: 6AHD D88JGH >C B:CI6A >B6<:GN.

-DB: EG:K>DJH HIJ9>:H =6K: HJ<<:HI:9 I=6I 0++ 6C9)170 G:S:8I >9:CI>86A 7G6>C EGD8:HH:H >C ;68: E:G8:EI>DC ($I>:G & .6NADG, 2002; %DN8: & ,DHH>DC, 2005; %:B:A :I 6A., 2003; ,DHH>DC & %68FJ:H, 2008; ,DHH>DC, C6BE6C:AA6 :I 6A., 1999; ,DHH>DC, D:AK:CC: :I 6A., 1999; ,DHH>DC :I 6A., 2003). +6GI>8JA6GAN, I=: 8=6C<>C< E6II:GC D; 6BEA>IJ9: D; 0++ 6C9 I=6I D;)170 6G: =><=AN 8DGG:A6I:9 68GDHH 9>;;:G:CI G:;:G:C8: H>I:H (%DN8: & ,DHH>DC, 2005), 6C9 I=:>G A6I:C8>:H 6AHD 8=6C<: HNC8=GDCDJHAN :>I=:G L>I= 699>I>DC D; CD>H: ID ;68: E>8IJG:H (%:B:A :I 6A., 2003) DG L>I= >CK:GH>DC DG 8DCIG6HI G:K:GH6A D; ;68: E>8IJG:H ($I>:G & .6NADG, 2002). -DB: HIJ9>:H =6K: 6AHD HJ<<:HI:9 I=6I 7DI= 0++ 6C9)170 LDJA9 7: DG><>C6I:9 ;GDB 7DI= ;JH>;DGB <NGJH G:<>DCH 6C9 A6I:G6A >C;:G>DG D88>E>I6A 8DGI:M (,DHH>DC, C6BE6C:AA6 :I 6A., 1999; ,DHH>DC :I 6A., 2003). #DL:K:G, H:K:G6A A>C:H D; HIJ9>:H =6K: 6AHD HJ<<:HI:9 I=6I 0++ 6C9)170 6G: 76H:9 DC 9>;;:G:CI 7G6>C B:8=6C>HBH ($I>:G & .6NADG, 2004 BöIO:A :I 6A., 1995; ":DG<: :I 6A., 1996; .6NADG :I 6A., 1999; -66K:9G6 :I 6A., 2012): (1) I=: 0++ <:C:G6IDG >CKDAK:H 6 A6G<:G C:ILDG@ >C8AJ9>C< 7DI= >C;:G>D-I:BEDG6A 8DGI:M 6C9 I=: HJE:G>DG I:BEDG6A HJA8JH, 7JI I=:)170 <:C:G6IDG >H 8DCRC:9 ID I=: E6G6=>EED86BE6A EA68: 6G:6 (++A) 6C9 !!A (":DG<: :I 6A., 1996); (2) I=: =>EED86BEJH B6N 7: 6CDI=:G DG><>C D; 0++, >C9>86I>C< I=6I 0++ >H 6AHD 6HHD8>6I:9 L>I= B:BDGN-G:A6I:9 EGD8:HH (BöIO:A :I 6A., 1995); (3) 6 HI:69N 6<:-G:A6I:9 8=6C<: D;)170 >H D7H:GK:9 6C9 0++ >H 67H:CI >C NDJC< 8=>A9G:C, >C9>86I>C< 6 9:K:ADEB:CI6A 9>;;:G:C8: 7:IL::C)170 6C9 0++ (.6NADG :I 6A., 1999); (4) 8D<C>I>K: 9:8A>C: 6;;:8IH I=: 0++ 6C9)170 >C I=: DEEDH>I: 9>G:8I>DC (-66K:9G6 :I 6A., 2012); (5) I=: ;68:->DG>:CI6I>DC >CK:GH>DC :;;:8I >H G:A>67A: DC I=: 6BEA>IJ9: D;)170, 7JI CDI DC I=: 6BEA>IJ9: D; 0++ ($I>:G & .6NADG, 2004).

.=>H HIJ9N 6>B:9 ID >CK:HI><6I: L=:I=:G >CHIGJ8I>DC->C9J8:9 B:CI6A >B6<:GN D; ;68:H 86C IDE-9DLC BD9JA6I: I=: ILD ;68:-H:CH>I>K: ,+ 8DBEDC:CIH, 0++ 6C9)170, L=:C I=: ,+-:A>8>I>C< HI>BJA> 6G: 8DBEA:I:AN 6B7><JDJH E>8IJG:H I=6I =6K: CD E=NH>86A ;:6IJG:H D; ;68:H. .=: 8DCIGDAA>C< 8DC9>I>DC ;DG ;68:->B6<:GN L6H B:CI6A >B6<:GN D; =DJH:H.

2. Methods

2.1. Participants

->MI::C JC>K:GH>IN HIJ9:CIH (8 B6A:H 6C9 8 ;:B6A:H, 6<:9 7:IL::C 20 6C9 28 N:6GH L>I= I=: B:6C D; 22.9 ± 2.0 N:6GH) E6GI>8>E6I:9 >C I=>H HIJ9N. .=:N L:G: G><=I =6C9:9 6C9 =69 :>I=:G CDGB6A DG 8DGG:8I-ID-CDGB6A K>H>DC. .=:H: E6GI>8>E6CIH <6K: I=:>G >C;DGB:9 8DCH:CI 7:;DG: I=: :ME:G>B:CI 6C9 L:G: E6>9 6 BD9:HI HI>E:C9 ;DG I=:>G E6GI>8>E6I>DC. .=: :ME:G>B:CI6A EGD8:9JG:H L:G: 6EEGDK:9 7N I=: CDBB>II:: ;DG +GDI:8I>C< #JB6C 6C9 AC>B6A -J7?:8IH D; I=: D:E6GIB:CI D; +HN8=DAD<N 6I +:@>C< /C>K:GH>IN.

2.2. Stimuli

.:C <G6NH86A: E>8IJG:H D; ;68:H (5 ;:B6A:H 6C9 5 B6A:H) 6C9 10 <G6NH86A: E>8IJG:H D; =DJH:H (5 ILD-SDDG DC:H 6C9 5 I=G::-SDDG DC:H) L>I= 76A6C8:9 E=NH>86A 6IIG>7JI:H D; 7G><=IC:HH 6C9 8DCIG6HI L:G: JH:9 6H I=: DG><>C6A E>8IJG:H. .=: =6>G 6C9 :6GH D; ;68: E>8IJG:H L:G: G:BDK:9. .=:

=DJH:H L:G: EA68:9 >CID 6 ;68:-H=6E: 8DCIDJG ID G:9J8: I=: E=NH>86A >C-I:GHI>BJAJH K6G>6C8:. .=:H: DG><>C6A E>8IJG:H L:G: IG6CH;:GG:9 ID 8DBEA:I:AN 6B7><JDJH R<JG:H JH>C< I=: E=6H: G6C9DB>O6I>DC B:I=D9H D; (A. 'AB 7.0, A:69>C< ID I=6I 6AA I=: E>M:AH D; 6 E>8IJG: L:G: H:A:8I:9 6C9 I=:>G E=6H:H L:G: G6C9DBAN G:9>HIG>7JI:9 ID ;DGB 6 C:L R<JG:. .D 6KD>9 EDI:CI>6A :;;:8IH D; 8DCI:CI D; DG><>C6A E>8IJG:H, I=:H: 6B7><JDJH R<JG:H L:G: 8A6HH>R:9 >CID ILD 86I:<DG>:H 688DG9>C< ID I=:>G DG><>C6A 8DCI:CI: I=: 6B7><JDJH R<JG:H ;GDB ;68: E>8IJG:H 6C9 I=DH: ;GDB =DJH: E>8IJG:H. 68= DG><>C6A E>8IJG: L6H EGD8:HH:9 ;DG 15 I>B:H. .=JH, >C ID-I6A 150 8DBEA:I:AN 6B7><JDJH R<JG:H L:G: B69: ;GDB ;68: E>8IJG:H 6C9 150 8DBEA:I:AN 6B7><JDJH R<JG:H L:G: B69: ;GDB =DJH: E>8IJG:H. A;-I:G I=: E=6H:-G6C9DB>O6I>DC B6C>EJA6I>DC, I=:H: 6B7><JDJH R<JG:H =69 C:>I=:G G:8D<C>O67A: ;68: D7?:8IH CDG G:8D<C>O67A: =DJH: D7?:8IH. .=: I=>G9 86I:<DGN D; HI>BJA> L:G: 150 "6JHH>6C CD>H: HI>BJA>, L=DH: 7G><=I-C:HH L6H B6I8=:9 ID I=6I D; 8DBEA:I:AN 6B7><JDJH R<JG:H.

$C 699>I>DC ID I=: 8DBEA:I:AN 6B7><JDJH R<JG:H, E>8IJG:H 8DCI6>C>C< :>I=:G 6 G:6A ;68: DG 6 G:6A =DJH: L:G: 6AHD JH:9. (DG: HE:8>;>86AAN, 50 ;68: E>8IJG:H 6C9 50 =DJH: E>8IJG:H (10 DG><>C6A ;68: E>8IJG:H 6C9 10 DG><>C6A =DJH: E>8IJG:H :68= HJ7B>II:9 ID I=: EGD8:HH>C< 9:H8G>7:9 7:ADL 5 I>B:H) L:G: EGD8:HH:9 >CID =6A;-6B7><JDJH E>8IJG:H, >C L=>8= :>I=:G 6 ;68: DG 6 =DJH: 8DJA9 7: :6H>AN D7H:GK:9. .=: =6A;-6B7><JDJH E>8IJG:H L:G: EGD9J8:9 7N G6C9DBAN H:A:8I>C< 50% D; I=: E>M:AH D; I=: DG><>C6A E>8IJG:H 6C9 G6C9DB>O>C< I=: E=6H:H D; I=: E>M:AH. $C I=>H L6N, 50 =6A;-6B7><JDJH ;68: E>8IJG:H 6C9 50 =6A;-6B7><JDJH =DJH: E>8IJG:H L:G: D7I6>C:9. $C :68= 8DC9>I>DC L>I= :>I=:G I=: ;68:-E>8IJG: DG><>C DG I=: =DJH:-E>8IJG: DG><>C, 50 DG><>C6A (8A:6G) E>8IJG:H 6C9 50 =6A;-6B7><JDJH E>8IJG:H L:G: JH:9 (!><. 1).

2.3. Procedures

DJG>C< I=: :ME:G>B:CI, E6GI>8>E6CIH H6I >C 6 9>BAN-A>I 6C9 HDJC9-6I-I:CJ6I:9 GDDB (($-=>:A9:9 AJ9>DB>IG>8 M6B>C6I>DC A8DJHI>8 -J>I:), L>I= 6 9>HI6C8: D; 75 8B 6L6N ;GDB 6 15->C. 8DBEJI:G H8G::C (G:HDAJ-I>DC, 1024 × 768 E>M:AH; G:;G:H= G6I:, 60 #O) I=6I EG:H:CI:9 I=: K>HJ6A HI>BJA> (K>HJ6A 6C<A:, 10.5° × 7.9°). .=:G: L:G: ILD 7AD8@H (;68:->B-6<:GN 7AD8@, =DJH:->B6<:GN 7AD8@) D; 550 G6C9DBAN DG9:G:9 IG>6AH, >C-8AJ9>C< >C :68= 7AD8@ 150 EG:H:CI6I>DCH D; 6B7><JDJH R<JG:H ;GDB ;68: E>8IJG:H, 150 EG:H:CI6I>DCH D; 6B7><JDJH R<JG:H ;GDB =DJH: E>8IJG:H, 150 EG:H:CI6I>DCH D; "6JHH>6C CD>H: >B6<:H, 6C9 :>I=:G 100 EG:H:CI6I>DCH D; G:6A-;68: E>8IJG:H (50 8A:6G 6C9 50 =6A;-6B7><JDJH DC:H, DCAN >C I=: ;68:->B6<:GN 7AD8@) DG 100 EG:H:CI6I>DCH D; G:6A-=DJH: E>8IJG:H (50 8A:6G 6C9 50 =6A;-6B7><JDJH DC:H, DCAN >C I=: =DJH:->B6<:GN 7AD8@). .=: DG9:G D; I=: 2 7AD8@H L6H 8DJCI:G76A6C8:9 68GDHH E6GI>8>E6CIH. 68= 7AD8@ L6H 9>K>9:9 >CID 5 H:HH>DCH 6C9 E6GI>8>E6CIH =69 6 H=DGI G:HI 7:IL::C H:HH>DCH.

$C 6 IG>6A, 6 RM6I>DC 8GDHH L6H EG:H:CI:9 ;DG 6 9JG6I>DC G6C9DBAN 7:IL::C 800 6C9 1000 BH, ;DAADL:9 7N 6C 800-BH EG:H:CI6I>DC D; 6 HI>BJAJH, 6C9 I=:C E6GI>8>E6CIH G:HEDC9:9 ID I=>H HI>BJAJH 7N EG:HH>C< D; I=: ILD 7JIIDCH D; 6 ?DNHI>8@ (!><. 1). B:;DG: :68= 7AD8@, E6GI>8>E6CIH L:G: >CHIGJ8I:9 ID >B6<>C: :>I=:G 6 ;68: DG 6 =DJH: (>C I=: ;68:->B6<:GN 7AD8@) DG 6 =DJH: (>C =DJH:->B6<:GN 7AD8@). .=: >CHIGJ8I>DC ;DG I=: ;68:->B6<:GN 7AD8@ L6H I=6I "1: 6G: <D>C< ID H=DL NDJ 6 CJB7:G D; ;68: E>8IJG:H. -DB: D; I=:B 6G: 8A:6G, 7JI HDB: 6G: 6B7><JDJH. 2DJG I6H@ >H ID ?J9<: I=: <:C9:G 6C9 EG:HH I=: 8DGG:HEDC9>C< 7JIIDCH. .=: I6H@ >C HDB: IG>6AH B6N 7: 8=6AA:C<>C< 6C9 NDJ B><=I RC9 HDB: R<JG:H IDD 6B7><JDJH ID I:AA I=: <:C9:G. 2DJ ?JHI >B6<>C: 6 ;68: ;GDB 6C 6B7><JDJH R<JG: 6C9 IGN NDJG 7:HI ID 9:I:GB>C: I=: <:C9:G." .=: >CHIGJ8I>DC ;DG I=: =DJH:->B6<:GN 7AD8@ L6H H>B>A6G, :M-8:EI I=6I I=: E6GI>8>E6CIH' I6H@ L6H ID ?J9<: L=:I=:G I=: >B6<:9

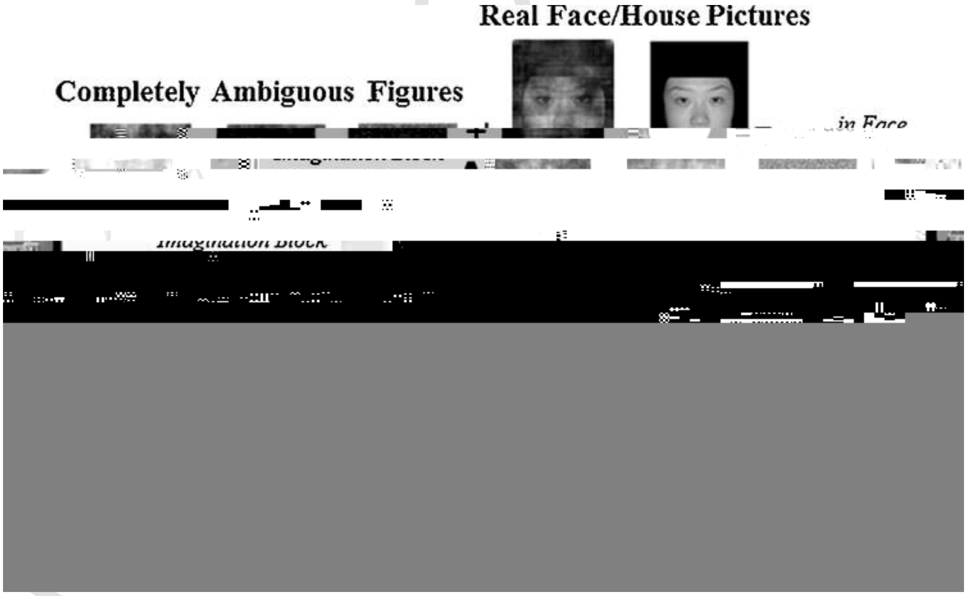

Fig. 1. ->BJA> 6C9 +GD8:9JG:H. .=: JEE:G E6C:A (A): M6BEA:H D; I=: :ME:G>B:CI6A HI>BJA>. CDBEA:I:AN 6B7><JDJH R<JG: HI>BJA> L:G: JH:9 >C 7DI= I=: ;68:->B6<:GN 6C9 =DJH:->B6<:GN 7AD8@H. CDGG:HEDC9>C< G:6A ;68:/=DJH: E>8IJG:H L:G: JH:9 >C I=: ;68:->B6<:GN 7AD8@ 6C9 I=: =DJH:->B6<:GN 7AD8@H. .=: ADL:G E6C:A (B): ME:G>B:CI6A EGD8:9JG:H. DJG>C< HI>BJAJH EG:H:C-I6I>DC, E6GI>8>E6CIH L:G: >CHIGJ8I:9 ID >B6<>C: :>I=:G 6 ;68: DG 6 =DJH:, 6C9 I=:C B6@: 2-6AI:GC6I>K:-;DG8:9-8=D>8: G:HEDCH:H (B6A:/;:B6A:, ILD/I=G:: SDDGH).

=DJH:H =69 :>I=:G 2 DG 3 SDDGH. $C I=>H L6N, E6GI>8>E6CIH E:G;DGB:9 I=: 2-6AI:GC6I>K:-;DG8:9-8=D>8: (2A!C) <:C9:G-?J9<B:CI I6H@ (;DG I=: ;68:->B6<:GN 7AD8@) DG SDDG-?J9<B:CI I6H@ (;DG I=: =DJH:->B6<:GN 7AD8@) CDI DCAN ;DG 8DBEA:I:AN 6B7><JDJH R<JG:H, 7JI 6AHD ;DG G:6A ;68:H >C I=: ;68:->B6<:GN 7AD8@ 6C9 ;DG G:6A =DJH:H >C I=: =DJH:->B6<:GN 7AD8@. .D 6KD>9 >CI:G;:G:C8:H ;GDB E6GI>8>E6CIH' 68I>DCH, E6GI>8>E6CIH L:G: >CHIGJ8I:9 ID EG:HH I=: 7JIIDC DCAN 6;I:G I=: K>HJ6A HI>BJAJH I:GB>C6I:9.

B:;DG: I=: ;DGB6A I:HI>C<, E6GI>8>E6CIH G:8:>K:9 6 IG6>C>C< ID :CHJG: I=6I I=:N =69 ;JAAN JC9:GHIDD9 I=: EGD8:9JG: 6C9 E:G;DGB:9 I=: I6H@ 8DGG:8IAN. .=: EJGEDH: D; I=>H HIJ9N L6H ;JAAN :MEA6>C:9 ID >C9>K>9J6A E6GI>8>E6CIH DCAN 6I I=: :C9 D; I=: :ME:G>B:CI.

2.4. EEG recordings

-86AE :A:8IGD-:C8:E=6AD<G6E=>8 68I>K>IN L6H G:8DG9:9 JH>C< 6 64-8=6CC:A):JGD-86C -NCABEH HNHI:B (CDBEJB:9>8H '>B>I:9, 0>8ID-G>6, AJHIG6A>6) L>I= I=: G:;:G:C8: :A:8IGD9: EA68:9 DC I=: CDH: I>E. .LD K:GI>86A 6C9 =DG>0DCI6A * " H>I:H L:G: JH:9 ID BDC>IDG :N: BDK:B:CIH 6C9 :N: 7A>C@H, EA68:9 HJE:G>DG 6C9 >C;:G>DG ID I=: A:;I :N: 6C9 6AHD 6I I=: DJI:G 86CI=> D; I=: ILD :N:H. A:8IGD9: >BE:96C8: L6H @:EI 7:ADL 5 @Ω. " H><C6AH L:G: EGD8:HH:9 6I DC-A>C: 76C9-E6HH ;GDB 0.05 ID 100 #0 6C9 9><>I>0:9 L>I= 6 H6BEA: G6I: D; 1000 #0. D6I6 6K:G6<: L6H E:G;DGB:9 6;I:G HDGI>C< 7N HI>BJAJH INE: (6B7><JDJH R<JG:H ;GDB ;68:H, 6B7><JDJH R<JG:H ;GDB =DJH:H, "6JHH>6C CD>H:, G:6A ;68:/=DJH: E>8IJG:H) 6C9 >B6<:GN 86I:<DGN (;68: 7AD8@, =DJH: 7AD8@). " 6C9 * " L:G: :ED8=:9 ;GDB 200 BH 7:;DG: (H:GK:9 6H 76H:A>C: ;DG I=: 76H:A>C: 8DGG:8I>DC) 6C9 800 BH 6;I:G I=: HI>BJAJH DCH:I. ED8=H L>I= D8JA6G 6G-I>;68IH :M8::9>C< ± 100 μ0 L:G: G:?:8I:9, 6C9 I=:C I=: L6K:;DGB L6H DT-A>C: ADL-E6HH RAI:G:9 6I I=: 8JI-DT ;G:FJ:C8N D; 20 #0 (12 9B/D8-I6K:). '>C:6G 9:S:8I>DCH L:G: G:BDK:9 7:;DG: 6K:G6<>C<.

.=: E:6@ 6BEA>IJ9: 6C9 A6I:C8N D; I=:)170 8DBEDC:CI L:G: EGD8:HH:9 6I I=: D88>E>ID-I:BEDG6A H>I:H >C I=: G><=I =:B>HE=:G: (+6, +8, +*6, +*8) 6C9 A:;I =:B>HE=:G: (+5, +7, +*5, +*7) 9JG>C< I=: I>B: L>C-9DL D; 140–220 BH 6;I:G I=: HI>BJAJH DCH:I. .=: 0++ L6H EGD8:HH:9 6I I=: ;GDCID-8:CIG6A H>I:H D; !C0 6C9 C0 140–220 BH 6;I:G I=: HI>BJAJH DC-H:I; I=: D88>E>ID-I:BEDG6A +2 8DBEDC:CI L6H EGD8:HH:9 6I I=: H>I:H >C I=: G><=I =:B>HE=:G: (+6, +8, +*6, +*8) 6C9 A:;I =:B>HE=:G: (+5, +7, +*5, +*7) 9JG>C< I=: I>B: L>C9DL D; 200–260 BH 6;I:G I=: HI>BJAJH DCH:I. $C I=: E:6@-ID-E:6@ B:6HJG:B:CI D; 0++, ;GDCI6A)1 (I=: C:<6I>K: E:6@ 6GDJC9 100–120 BH 6;I:G I=: HI>BJAJH DCH:I) L6H EGD8:HH:9 6I I=: :A:8IGD9: H>I:H D; !C0 6C9 C0 9JG>C< I=: I>B: L>C9DL D; 70–150 BH 6;-I:G I=: HI>BJAJH DCH:I, 6C9 I=:)1-0++ E:6@-ID-E:6@ 6BEA>IJ9: L6H D7-I6>C:9 7N HJ7IG68I>C< I=: 76H:A>C:-ID-E:6@ 6BEA>IJ9: D; ;GDCI6A)1 ;GDB I=: 76H:A>C:-ID-E:6@ 6BEA>IJ9: D; 0++.

3. Results

3.1. Behavioral testing

.=: G:HJAIH D; I=: 7:=6K>DG6A I:HI>C< H=DL:9 I=6I I=: B:6C 688J-G68N G6I: D; I=: 2A!C I6H@ ;DG G:8D<C>0>C< G:6A ;68: E>8IJG:H 6C9 G:6A =DJH: E>8IJG:H L:G: 67DK: 0.85 (;68:, 0.94 ± 0.01; =DJH:, 0.88 ± 0.02), >C9>86I>C< I=6I E6GI>8>E6CIH L:G: 67A: ID 8DC8:CIG6I: I=:>G 6II:CI>DC DC I=: HI>BJAJH, E:G;DGB I=: I6H@, 6C9 9>H8G>B>C6I: ;:6IJG:H D; I=: G:6A D7?:8IH (;68:H DG =DJH:H).

!DG I=: 8DBEA:I:AN 6B7><JDJH R<JG:H, >C I=: ;68:->B6<:GN I6H@ 6C9 >C I=: >C I=: =DJH:->B6<:GN I6H@ E6GI>8>E6CIH ?J9<:9 I=: R<JG:H 6H >I=:G B6A: DG ;:B6A: DG 6H ILD DG I=G:: SDDGH DCAN 6I G6C9DB. -I6I>HI>86AAN, >C I=: ;68:->B6<:GN I6H@, CD H><C>;>86CI 9>;;:G:C8:H L:G: ;DJC9 7:IL::C I=: EGD767>A>IN D; ?J9<>C< I=: 6B7><JDJH E>8IJG:H 6H >I=:G B6A: ;68:H (0.56 ± 0.03) DG ;:B6A: ;68:H (0.44 ± 0.03). $C I=: =DJH:->B6<:GN I6H@, CD H><C>;>86CI 9>;;:G:C8: L6H ;DJC9 7:IL::C I=: EGD767>A>IN D; ?J9<>C< I=: 6B7><JDJH E>8IJG:H 6H >I=:G ILD-SDDG =DJH:H (0.46 ± 0.03) DG I=G::-SDDG =DJH:H (0.54 ± 0.03).

3.2. ERP recordings

3.2.1. Amplitudes and latencies of ERPs to completely ambiguous figures

!><. 2 H=DLH I=: <GDJE <G6C9 6K:G6<: ,+ L6K:;DGBH >C9J8:9 7N :68= D; I=: 3 INE:H D; 6B7><JDJH HI>BJA> >C :>I=:G I=: ;68:->B6<:GN 8DC-9>I>DC DG I=: =DJH:->B6<:GN 8DC9>I>DC L>I= G:8DG9>C<H ;GDB I=: :A:8-IGD9: H>I:H D; C0 6C9 +8. CA:6GAN, I=: 6B7><JDJH HI>BJA> G:A>67AN :A>8>I:9 7DI= I=: 0++ 8DBEDC:CI (6I H>I: C0) 6C9 I=: +2 8DBEDC:CI (6I H>I: +8), 7JI CDI I=:)170 8DBEDC:CI (6AHD H:: 7:ADL).

.=: G:HJAIH D; G:8DG9>C<H 6I H>I: C0 H=DL:9 I=6I I=: 6BEA>IJ9: D; 0++ L6H A6G<:G JC9:G I=: ;68:->B6<:GN 8DC9>I>DC I=6C JC9:G I=: =DJH:->B6<:GN 8DC9>I>DC. .=: 6BEA>IJ9: 6C9 A6I:C8N D; 0++ L:G: HI6I>HI>86AAN 6C6ANO:9 JH>C< 6 G:E:6I:9-B:6HJG:H 6C6ANH:H D; K6G>6C8: (A)*0A) L>I= I=: ;DAADL>C< 3 K6G>67A:H: (1) >B6<:GN 86I:<DGN (;68: >B6<:GN, =DJH: >B6<:GN), (2) HI>BJAJH INE: (6B7><JDJH R<JG:H ;GDB ;68: E>8IJG:H, 6B7><JDJH R<JG:H ;GDB =DJH: E>8IJG:H, "6JHH>6C CD>H:), 6C9 (3) :A:8-IGD9: H>I: (!C0, C0). A I=G::-K6G>67A: L>I=>C-HJ7?:8I A)*0A H=DL:9 6 H><C>;>86CI B6>C :;;:8I D; >B6<:GN 86I:<DGN 4!(1,15) = 18.27, $p = 0.001$, $\eta p^2 = 0.555$, H><C>;>86CI B6>C :;;:8I D; HI>BJAJH INE: 4!(2,30) = 6.58, $p = 0.004$, $\eta p^2 = 0.315$, 6C9 H><C>;>86CI B6>C :;;:8I D; :A:8IGD9: H>I: 4!(1,15) = 4.87, $p = 0.043$, $\eta p^2 = 0.255$.)D H><C>;>-86CI >CI:G68I>DCH L:G: D7H:GK:9 (6AA $p > 0.05$). '-D +DHI =D8 6C6AN-H:H H=DL:9 I=6I I=: 6BEA>IJ9: D; 0++ L6H H><C>;>86CIAN A6G<:G JC9:G I=: ;68:->B6<:GN 8DC9>I>DC (2.95 ± 0.63 μ0) I=6C JC9:G I=: =DJH:->B6<:GN 8DC9>I>DC (1.80 ± 0.52 μ0) 4I(15) = 4.28, $p < 0.001$, CD=:C'H $d = 0.505$. .=JH, 6AI=DJ<=>9:CI>86A 6B7><JDJH HI>BJA> L:G: JH:9, >CIGD9J8>C< B:CI6A >B6<:GN D; ;68: A:9 ID HIGDC<:G 0++ I=6C >CIGD9J8>C< B:CI6A >B6<:GN D; =DJH:.

(DG:DK:G, I=: B:6C 0++ 6BEA>IJ9: ID I=: 6B7><JDJH HI>BJA> ;GDB ;68: E>8IJG:H (2.87 ± 0.64 μ0) L6H A6G<:G I=6C B:6C 0++ 6BEA>IJ9: ID "6JHH>6C CD>H: (1.74 ± 0.50 μ0) 4I(15) = 3.42, $p = 0.004$, CD=:C'H $d = 0.495$, 6C9 I=: B:6C 0++ 6BEA>IJ9: ID I=: 6B7><JDJH HI>B-JA> ;GDB =DJH: E>8IJG:H (2.51 ± 0.62 μ0) L6H A6G<:G I=6C B:6C 0++ 6B-EA>IJ9: ID "6JHH>6C CD>H: 4I(15) = 2.49, $p = 0.025$, CD=:C'H $d = 0.345$. AAHD, CD H><C>;>86CI 9>;;:G:C8: L6H ;DJC9 7:IL::C 0++ :A>8>I:9 7N 6B-7><JDJH HI>BJA> ;GDB ;68: E>8IJG:H 6C9 I=6I :A>8>I:9 7N 6B7><JDJH HI>B-JA> ;GDB =DJH: E>8IJG:H ($p = 0.27$). .=JH, I=: :;;:8I D; DG><>C6A E>8-IJG: 8DCI:CI 7:;DG: E=6H: G6C9DB>06I>DC L6H CDI H><C>;>86CI. .=: G:-HJAIH 6AHD H=DL:9 I=6I 0++ 6I I=: H>I: !C0 (2.68 ± 0.65 μ0) L6H A6G<:G I=6C I=6I 6I I=: H>I: !C0 (2.07 ± 0.49 μ0)

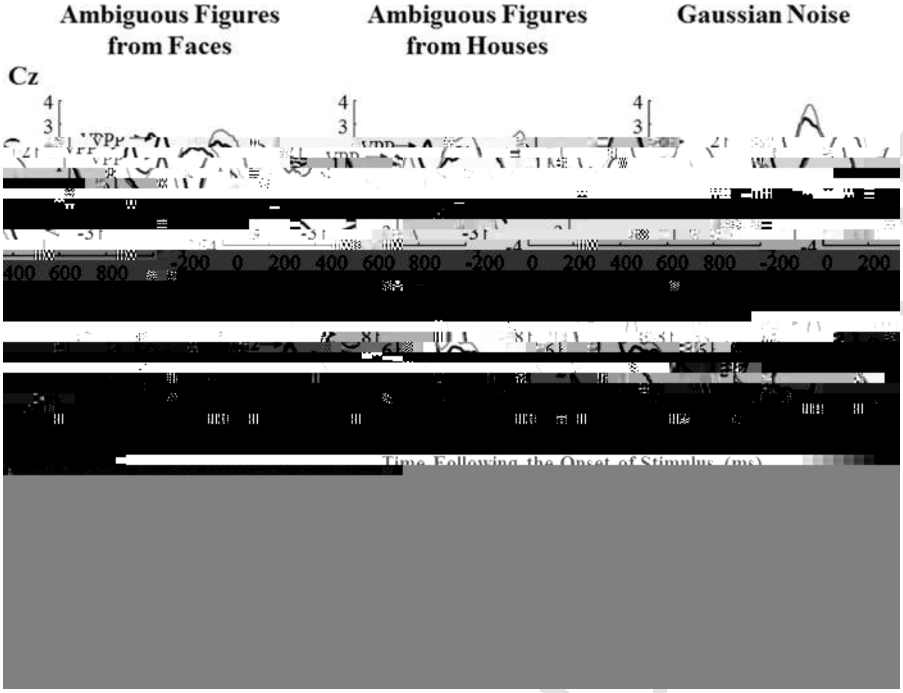

Fig. 2. 1 6K:;DGBH D; 0++ 6C9 +2. "GDJE <G6C9 6K:G6<: L6K:;DGBH 6I :A:8IGD9: H>I: CO (I=: JEE:G E6C:A) 6C9 +8 (I=: ADL:G E6C:A) JC9:G :>I=:G I=: ;68:->B6<:GN 8DC9>I>DC DG I=: =DJH:->B6<:GN 8DC9>I>DC. 0++ (I>B: L>C9DL: 140–220 BH) 6C9 +2 (I>B: L>C9DL: 200–260 BH) L:G: :C=6C8:9 JC9:G I=: ;68:->B6<:GN 8DC9>I>DC (96G@ A>C:) 8DBE6G:9 ID I=: =DJH:->B6<:GN 8DC9>I>DC (<G:N A>C:).

4I(15) = 2.27, $p = 0.043$, CD=:C’H $d = 0.275$. .=: 8DBE6G>HDCH >C 0++ 6BEA>IJ9:H 6G: H=DLC >C I=: JEE:G E6C:A D; !><. 3.

!DG I=: A6I:C8N D; 0++, C:>I=:G I=: B6>C :;;:8I ;DG :68= D; I=: 3 K6G>67A:H CDG I=: >CI:G68I>DCH 7:IL::C I=: K6G>67A:H L:G: H><C>;>86CI. .=: B:6C A6I:C8N D; 0++ L6H 191.4 ± 8.5 BH 6C9 191.4 ± 7.3 BH JC9:G I=: ;68:->B6<:GN 8DC9>I>DC 6C9 I=: =DJH:->B6<:GN 8DC9>I>DC, G:HE:8I>K:AN.

.=: 6BEA>IJ9: 6C9 A6I:C8N D; +2 L:G: 6C6ANO:9 6AHD JH>C< 6 G:E:6I:9-B:6HJG:H A)*0A L>I= I=: ;DAADL>C< 3 K6G>67A:H (1) >B6<:GN 86I:<DGN (;68: >B6<:GN, =DJH: >B6<:GN), (2) HI>BJAJH INE: (6B7><JDJH HI>BJA> ;GDB ;68: E>8IJG:H, 6B7><JDJH HI>BJA> ;GDB =DJH: E>8IJG:H, "6JHH>6C CD>H:), 6C9 (3) =:B>HE=:G: (A:;I, G><=I). "G::C=DJH:-":>HH:G A9?JHIB:CI L6H JH:9 ;DG K>DA6I>DC D; -E=:G>8>IN AHHJBEI>DC.

.=: ADL:G E6C:A D; !><. 2 H=DLH I=: 8DBE6G>HDCH D; <G6C9 6K:G6<: ,+ L6K:;DGBH JC9:G I=: ;68:->B6<:GN 8DC9>I>DC 6C9 I=DH: JC9:G I=: =DJH:->B6<:GN 8DC9>I>DC L>I= I=: G:8DG9>C<H 6I I=: :A:8IGD9: H>I: D; +8. !DG I=: +2 6BEA>IJ9:, 6 I=G::-K6G>67A: L>I=>C-HJ7?:8I A)*0A G:K:6A:9 6 H><C>;>86CI B6>C :;;:8I D; >B6<:GN 86I:<DGN 4!(1,15) = 4.58, $p = 0.049$, $\eta p^2 = 0.235$, H><C>;>86CI B6>C :;;:8I D; HI>BJAJH INE: 4!(2.30) = 35.19, $p < 0.001$, $\eta p^2 = 0.705$, 6C9 H><C>;>86CI B6>C :;;:8I D; =:B>HE=:G: 4!(1,15) = 5.58, $p = 0.032$, $\eta p^2 = 0.275$. !DG >CI:G68I>DCH 6BDC< I=: 3 K6G>67A:H, DCAN I=: >CI:G68I>DC 7:IL::C HI>BJAJH INE: 6C9 =:B>HE=:G: L6H H><C>;>86CI 4!(1.32, 19.79) = 10.55, $p = 0.002$, $\eta p^2 = 0.415$. '-D +DHI =D8 8DBE6G>HDC H=DL:9 I=6I I=: 6BEA>IJ9: D; +2 L6H A6G<:G JC9:G I=: ;68:->B6<:GN 8DC9>I>DC (10.38 ± 0.85 μ0) I=6C JC9:G I=: =DJH:->B6<:GN 8DC9>I>DC (9.44 ± 0.98 μ0) 4I(15) = 2.14, $p = 0.049$, CD=:C’H $d = 0.275$.

(DG:DK:G, I=: H>BEA: :;;:8I D; I=: ILD-L6N (HI>BJAJH INE: 7N =:B>HE=:G:) >CI:G68I>DC L6H 6C6ANO:9. .=: 6BEA>IJ9: D; +2 >C I=: G><=I =:B>HE=:G: L6H A6G<:G I=6C I=6I >C I=: A:;I =:B>HE=:G: L=:C I=: HI>BJA> L:G: :>I=:G 6B7><JDJH DC:H ;GDB ;68: E>8IJG:H 4I(15) = 2.36, $p = 0.032$, CD=:C’H $d = 0.425$ DG 6B7><JDJH DC:H ;GDB =DJH: E>8IJG:H 4I(15) = 2.94, $p = 0.010$, CD=:C’H $d = 0.465$, 7JI CDI L=:C I=: HI>BJA> L:G: "6JHH>6C-CD>H: DC:H ($p = 0.179$). .=: 8DBE6G>HDCH D; +2 6BEA>IJ9:H 6G: H=DLC >C I=: ADL:G E6C:A D; !><. 3.

!DG I=: A6I:C8N D; +2, 6 I=G::-K6G>67A: L>I=>C-HJ7?:8I A)*0A DCAN G:K:6A:9 6 H><C>;>86CI B6>C :;;:8I D; HI>BJAJH INE: 4!(1.28, 19.25) = 4.25, $p = 0.034$, $\eta p^2 = 0.225$. '-D +DHI #D8 8DBE6G>HDC H=DL:9 I=6I +2 >C9J8:9 7N 6B7><JDJH HI>BJA> ;GDB ;68: E>8IJG:H (229.0 ± 3.5 BH) D88JGG:9 :6GA>:G I=6C +2 >C9J8:9 7N "6JHH>6C CD>H: (235.2 ± 3.4 BH) 4I(15) = 2.22, $p = 0.043$, CD=:C’H $d = 0.455$. .=: 9>;;:G:C8: 7:IL::C +2 A6I:C8N ID 6B7><JDJH HI>BJA> ;GDB =DJH: E>8IJG:H (229.0 ± 3.3 BH) 6C9 I=6I ID "6JHH>6C CD>H: L6H B6G<>C6A 4I(15) = 2.10, $p = 0.053$, CD=:C’H $d = 0.475$. .=: B:6C A6I:C8N D; +2 L6H 229.1 ± 3.3 BH 6C9 223.1 ± 3.3 BH JC9:G I=: ;68:->B6<:GN 8DC9>I>DC 6C9 I=: =DJH:->B6<:GN 8DC9>I>DC, G:HE:8I>K:AN.

,+ L6K:;DGBH >C 5 E6GI>8>E6CIH :M=>7>I:9 6C D7H:GK67A:)170 8DBEDC:CI JC9:G :>I=:G I=: ;68:->B6<:GN 8DC9>I>DC DG I=: =DJH:->B6<:GN 8DC9>I>DC.)D)170 8DBEDC:CI L6H D7H:GK67A: ;GDB I=: <G6C9 6K:G6<: ,+ L6K:;DGB 68GDHH 16 E6GI>8>E6CIH.

.=: <G6C9 6K:G6<: ,+ L6K:;DGBH D; 6AA I=: 6C6ANO:9 :A:8IGD9: H>I:H (!CO, CO, +5, +6, +7, +8, +*5, +*6, +*7, +*8) JC9:G ;68:->B6<:GN 6C9 =DJH:->B6<:GN 8DC9>I>DCH ;DG I=: 4 HI>BJAJH INE:H (8DBEA:I:AN 6B7><JDJH R<JG:H ;GDB

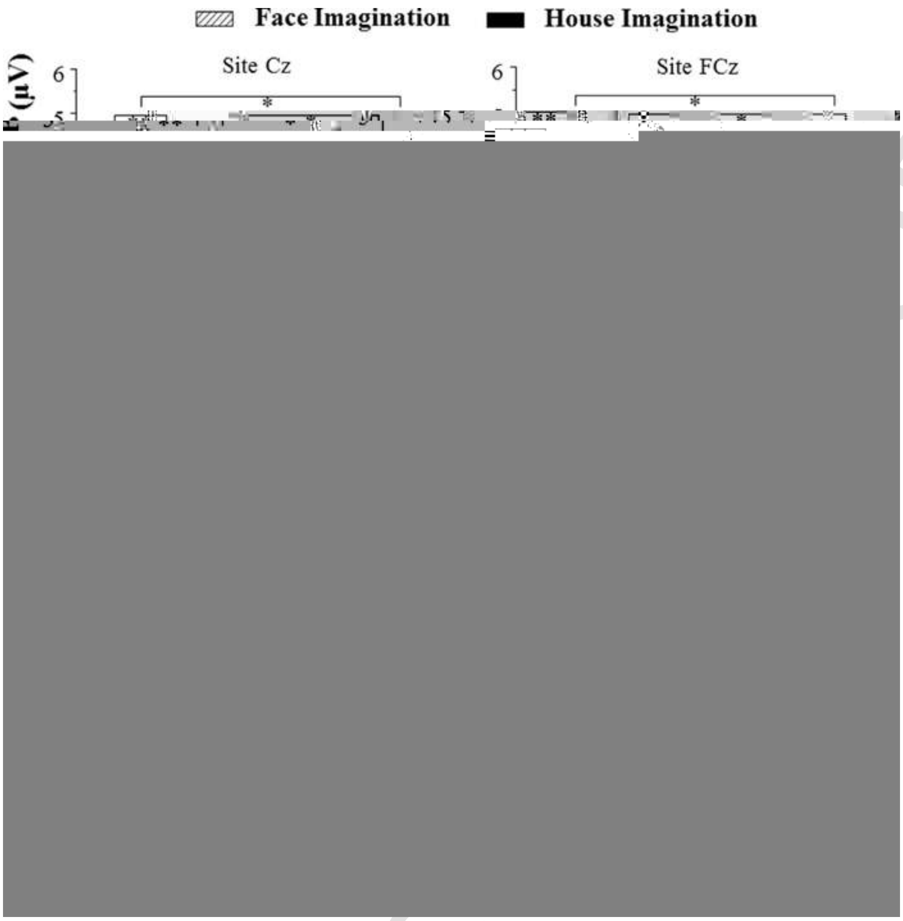

Fig. 3. -I6I>HI>86A 8DBE6G>HDCH D; 0++ 6C9 +2 6BEA>IJ9:H. .=: JEE:G E6C:A: +DHI #D8 8DBE6G>HDCH D; E:6@ 6BEA>IJ9:H D; 0++ 6I :A:8IGD9: H>I:H C0 6C9 !C0. .=: 6BEA>IJ9: D; 0++ JC9:G I=: ;68:->B6<:GN 8DC9>I>DC L6H H><C>;>86CIAN A6G<:G I=6C I=6I JC9:G I=: =DJH:->B6<:GN 8DC9>I>DC, 6C9 0++ :A>8>I:9 7N 6B7><JDJH E>8IJG:H L6H H><C>;>86CIAN A6G<:G I=6C I=6I :A>8>I:9 7N "6JHH>6C CD>H:. .=: ADL:G E6C:A: +DHI #D8 8DBE6G>HDCH D; E:6@ 6BEA>IJ9:H D; +2 >C I=: A:;I =:B>HE=:G: (+5, +7, +*5, +*7) 6C9 I=: G><=I =:B>HE=:G: (+6, +8, +*6, +*8). .=: 6BEA>IJ9: D; +2 JC9:G I=: ;68:->B6<:GN 8DC9>I>DC L6H H><C>;>86CIAN A6G<:G I=6C I=6I JC9:G I=: =DJH:->B6<:GN 8DC9>I>DC, 6C9 +2 :A>8>I:9 7N 6B7><JDJH R<JG:H L6H H><C>;>86CIAN A6G<:G I=6C I=6I :A>8>I:9 7N "6JHH>6C CD>H:. GGDG B6GH G:EG:H:CI I=: HI6C96G9 :GGDG D; I=: B:6C (- ( ). $^{*}p < 0.05$, $^{**}p < 0.01$.

;68:H, 8DBEA:I:AN 6B7><JDJH R<JG:H ;DGB =DJH:H, "6JHH>6C CD>H: 6C9 G:6A E>8IJG:H) 6G: H=DLC >C !><. 4.

3.2.2. *Comparisons of ERPs under the face-imagery condition and ERPs to real face-picture stimulation*

B6H:9 DC I=: G:HJAIH 9:H8G>7:9 67DK:, I=: >CSJ:C8: D; DG><>C6A E>8IJG: 8DCI:CI 86C 7: :M8AJ9:9. .D 8DBE6G: ,+H ID 6B7><JDJH HI>BJA> JC9:G I=: ;68:->B6<:GN 8DC9>I>DC 6C9 ,+H ID G:6A ;68:-E>8IJG: HI>BJA6I>DC (>C8AJ9>C< 7DI= =6A;-6B7><JDJH ;68: E>8IJG:H 6C9 8A:6C ;68: E>8IJG:H), L: B:G<:9 6B7><JDJH R<JG:H ;GDB ;68: E>8IJG:H 6C9 I=DH: ;GDB =DJH: E>8IJG:H ID ;DGB 6 H>C<A: 6B7><JDJH-R<JG: 8DC9>I>DC, 6C9 I=:C 8DBE6G:9 ,+H ID I=:H: 6B7><JDJH R<JG:H JC9:G I=: ;68:->B6<:GN 8DC9>I>DC L>I= ,+H ID G:6A ;68: E>8IJG:H.

AH H=DLC >C !><. 5, 7DI= 6B7><JDJH R<JG:H JC9:G I=: ;68:->B6<:GN 8DC9>I>DC 6C9 G:6A ;68: E>8IJG:H :A>8>I:9 I=: 0++ 8DBEDC:CI 6I I=: H>I: C0 6C9 I=: +2 8DBEDC:CI 6I I=: H>I: +8. AAHD, I=: ;68:-HE:8>R8)170 8DBEDC:CI L6H G:A>67AN :A>8>I:9 DCAN 7N I=: G:6A ;68: E>8IJG:H (CDI 7N I=: 6B7><JDJH R<JG:H).

!DG I=: 6BEA>IJ9: D; 0++ 8DBEDC:CI, 6 2 (HI>BJAJH INE:: 6B7><JDJH E>8IJG:H L>I= ;68: >B6<:GN, ;68:-E>8IJG: HI>BJA6I>DC) 7N 2 (:A:8IGD9: H>I:: C0, !C0) G:E:6I:9-B:6HJG:H A)*0A H=DL:9 6 H><C>;>86CI ILD-L6N >CI:G68I>DC 4!(1, 15) = 63.98, $p < 0.001$, ηp^{2} = 0.815. .=: 9>;;:G:C8: D; 0++ 6BEA>IJ9: 7:IL::C I=: ILD HI>BJAJH INE:H (;68:-E>8IJG: HI>BJA6I>DC B>CJH 6B7><JDJH E>8IJG: L>I= ;68: >B6<:GN) L6H A6G<:G 6I H>I: !C0 (1.93 ± 0.93 μ0) 8DBE6G:9 ID I=6I 6I H>I: C0 (0.16 ± 0.91 μ0) 4I(15) = 8.00, $p < 0.001$, CD=:C'H d = 0.485. AAHD, I=: A6I:C8N D; 0++ L6H 6C6AN0:9 6C9 I=: G:HJAIH H=DL:9 I=6I CD H><C>;>86CI 9>;;:G:C8:H L:G: ;DJC9 7:IL::C 2 HI>BJAJH INE:H (186.0 ± 9.2 BH ;DG 8DBEA:I:AN 6B7><JDJH HI>BJA> JC9:G I=: ;68:->B6<:GN 8DC9>I>DC; 185.3 ± 4.6 BH ;DG G:6A-;68:-E>8IJG: HI>BJA6I>DC).

AI I=: D88>E>ID-I:BEDG6A H>I:H, 6H I=: EDH>I>K: EDI:CI>6A +2 E6GI>6AAN DK:GA6EE:9 L>I= I=: C:<6I>K: EDI:CI>6A)170, I=: 6BEA>IJ9: D; +2 :A>8>I:9 7N ;68:-E>8IJG: HI>BJA> L6H CDI67AN G:9J8:9, HB6AA:G I=6C I=6I >C9J8:9 7N 6B7><JDJH HI>BJA> JC9:G I=: ;68:->B6<:GN 8DC9>I>DC. .=:G: L6H CD H><C>;>86CI 9>;;:G:C8: >C E:6@ A6I:C8N D; +2 7:IL::C I=: 2 HI>BJAJH INE:H (227.6 ± 3.5 BH ;DG 8DBEA:I:AN 6B7><JDJH HI>BJA> JC9:G I=: ;68:->B6<:GN 8DC9>I>DC; 232.2 ± 3.1 BH ;DG ;68:-E>8IJG: HI>BJA6I>DC).

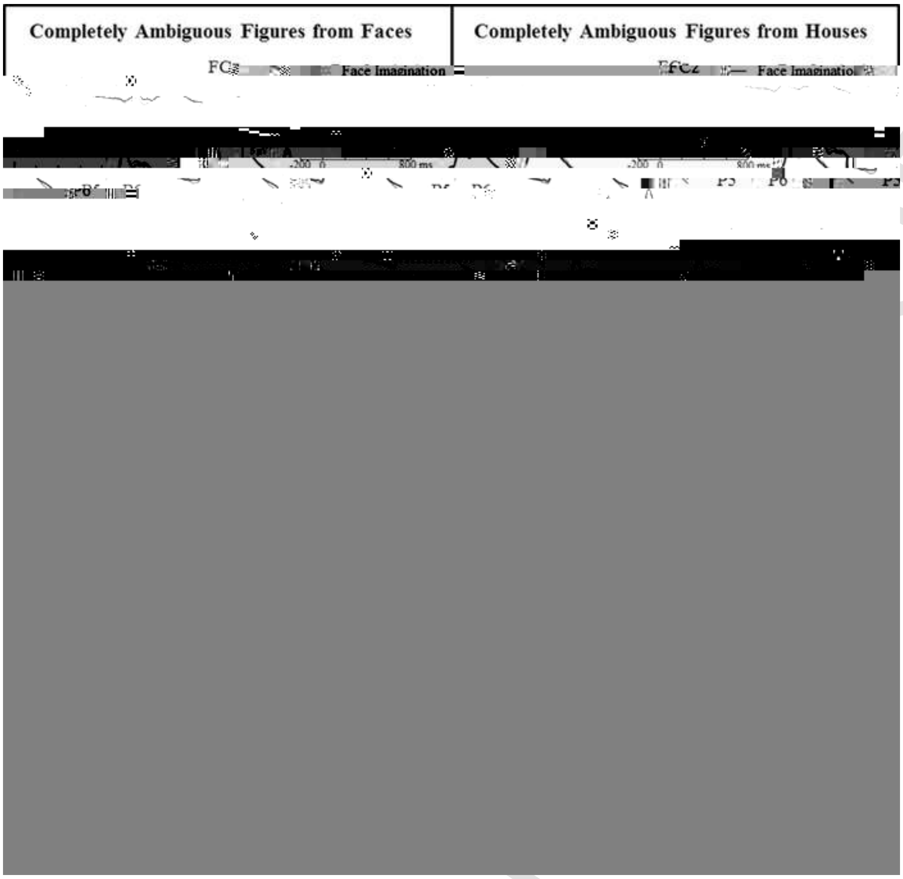

Fig. 4. Group grand average waveforms at all analyzed electrode sites. For the stimulus type of completely ambiguous figures from faces, completely ambiguous figures from houses, and Gaussian noise, the dark lines represent the face-imagery condition and the grey lines represent house-imagery condition. For the stimulus type of real pictures, the dark lines represent real-face-picture condition and the grey lines represent real-house-picture condition. The electrode sites included FCz, Cz, P5, P6, P7, P8, PO5, PO6, PO7, PO8.

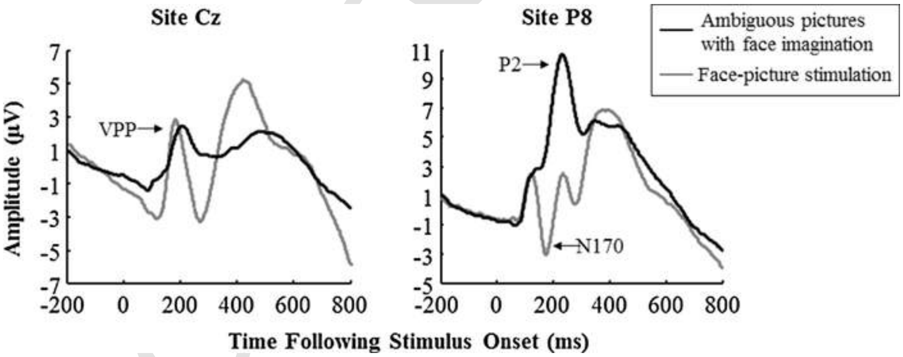

Fig. 5. Group grand average waveforms of electrode sites Cz and P8. Dark lines represent responses elicited by ambiguous figures with face imagination, and grey lines represent responses induced by real face pictures. VPP and P2 occurred in both the face-imagery condition and the face-perception condition, but N170 was found only in the face-perception condition.

3.2.3. Comparisons of preference of VPP to face between the ambiguous-figure condition and the

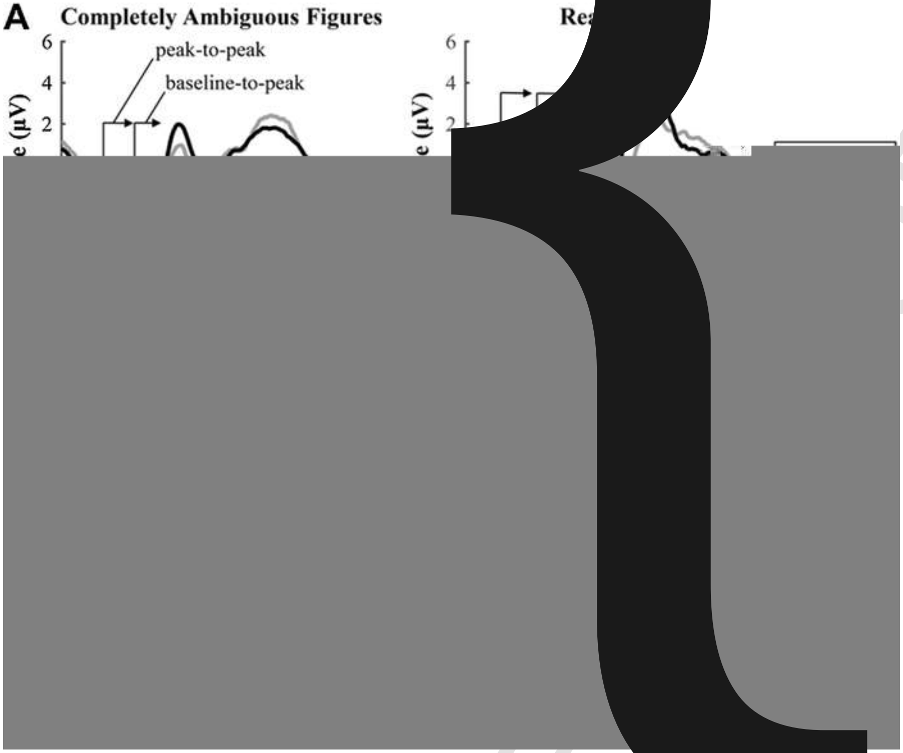

Fig. 6. .=: JEE:G E6C:AH (A): "GDJE <G6C9 6K:G6<: D; ,+ L6K:;DGBH 6I ;GDCID-8:CIG6A H>I:H (6K:G6<:9 68GDHH I=: !CO 6 7N 8DBEA:I:AN 6B7><JDJH R<JG:H (A:;I E6C:A) L>I= :>I=:G ;68: >B6<:GN (96G@ A>C:) DG =DJH: >B6<:GN (<G:N A>C:), DG 7N G:6A-;68: E>8IJG:H (96G@ A>C: >C G><=I E6C:A) D (<G:N A>C: >C G><=I E6C:A). .=: ADL:G E6C:AH (B): +DHI =D8 8DBE6G>HDCH D; 76H:A>C:-ID-E:6@ 6BEA>IJ9:H D; 0++ (A:;I E6C:A) 6C9 E:6@-ID-E:6@ 6BEA>IJ9:H D;)1-0++ (G><=I E6C:A) 68GDHH HI>BJAJH INE:H 6C9 8DC9>I>DCH. BDI= 76H:A>C:-ID-E:6@ 6C9 E:6@-ID-E:6@ B:6HJG:B:CIH H=DL:9 HIGDC<:G 0++ JC9:G ;68: 8DC9>I>DCH (96G@ 76G) I=6C =DJH: 8DC9>I>DCH (<G:N 76G). .=: E:6@-ID-E:6@ B:6HJG:B:CI 6AHD G:K:6AH 6 HIGDC<:G ;68:-69K6CI6<: :;;:8I ;DG G:6A E>8IJG:H I=6C 8DBEA:I:AN 6B7><JDJH R<JG:H. GGDG B6GH G:EG:H:CI I=: HI6C96G9 :GGDG D; I=: B:6C (- ( ). * $p < 0.05$, ** $p < 0.01$, *m.s.* B6G<>C6AAN H><C>;>86CI.

E:6I:9-B:6HJG:H A)*0A D; I=: 76H:A>C:-ID-E:6@ 0++ 6BEA>IJ9: G:K:6A:9 6 B6G<>C6AAN H><C>;>86CI B6>C :;;:8I D; HI>BJAJH INE: 4!(1, 15) = 4.40, $p = 0.053$, $\eta p^2 = 0.235$ 6C9 6 H><C>;>86CI B6>C :;;:8I D; HI>BJAJH-D7?:8I 8DC9>I>DC 4!(1, 15) = 4.93, $p = 0.042$, $\eta p^2 = 0.255$. .=: ILD-L6N >CI:G68I>DC L6H CDI H><C>;>86CI ($p = 0.63$). A '-D +DHI =D8 6C6ANH>H 6AHD H=DL:9 I=6I 0++ JC9:G I=: ;68: 8DC9>I>DC (3.91 ± 0.71 µ0) L6H H><C>;>86CIAN A6G<:G I=6C I=6I JC9:G I=: =DJH: 8DC9>I>DC (2.73 ± 0.51 µ0) 4I(15) = 2.22, $p = 0.042$, CD=:C'H $d = 0.475$. #DL:K:G, I=: 9>;;:G:C8: 7:ILL::C 0++ ID G:6A E>8IJG:H (3.95 ± 0.67 µ0) 6C9 I=6I ID 8DBEA:I:AN 6B7><JDJH R<JG:H (2.69 ± 0.61 µ0) L6H DCAN B6G<>C6AAN H><C>;>86CI 4I(15) = 2.10, $p = 0.053$, CD=:C'H $d = 0.495$. .=: G:HJAIH H=DL:9 I=6I I=: EG:;:G:C8: D; 0++ ID ;68: >B6<:GN JC9:G I=: 6B7><JDJH-R<JG: 8DC9>I>DC L6H H>B>A6G ID I=: EG:;:G:C8: D; 0++ ID G:6A-R<JG: HI>BJA> JC9:G I=: G:6A-E>8IJG: 8DC9>I>DC.

!DG I=: 0++ 6BEA>IJ9:H H=DLC >C I=: G><=I E6C:A D; !><. 6B, 6 2 (HI>BJAJH INE:: 8DBEA:I:AN 6B7><JDJH R<JG:H, G:6A E>8IJG:H) 7N 2 (HI>BJAJH-D7?:8I 8DC9>I>DC: ;68:, =DJH:) G:E:6I:9-B:6HJG:H A)*0A D; E:6@-ID-E:6@ 6BEA>IJ9: G:K:6A:9 6 H><C>;>86CI B6>C :;;:8I D; HI>BJAJH INE: 4!(1, 15) = 22.57, $p < 0.001$, $\eta p^2 = 0.605$, 6 H><C>;>86CI B6>C :;;:8I D; HI>BJAJH-D7?:8I 8DC9>I>DC 4!(1, 15) = 11.89, $p = 0.004$, $\eta p^2 = 0.445$, 6C9 6 H><C>;>86CI ILD-L6N >CI:G68I>DC 7:ILL::C I=: ILD ;68IDGH 4!(1, 15) = 5.52, $p = 0.033$, $\eta p^2 = 0.275$. !DG 8DBEA:I:AN 6B7><JDJH R<JG:H, I=: E:6@-ID-E:6@ 6BEA>IJ9: D; 0++ JC9:G ;68: >B6<:GN (5.47 ± 0.62 µ0) L6H H><C>;>86CIAN A6G<:G I=6C I=6I JC9:G =DJH: >B6<:GN (4.83 ± 0.50 µ0) 4I(15) = 2.28, $p = 0.037$, CD=:C'H $d = 0.295$. !DG G:6A E>8IJG:H, I=: G:6A-;68: E>8IJG: 6AHD :A>8>I:9 HIGDC<:G 0++ (8.17 ± 0.78 µ0) I=6C G:6A-=DJH: E>8IJG: 9>9 (5.96 ± 0.56 µ0) 4I(15) = 3.17, $p = 0.006$, CD=:C'H $d = 0.815$. AAHD, I=: ;68:/=DJH: 9>;;:G:C8: ;DG G:6A E>8IJG:H (2.21 ± 0.70 µ0) L6H H><C>;>86CIAN A6G<:G I=6C I=6I ;DG 8DBEA:I:AN 6B7><JDJH R<JG:H (0.64 ± 0.28 µ0) 4I(14) = 2.35, $p = 0.033$, CD=:C'H $d = 0.745$. .=: G:HJAIH D; E:6@-ID-E:6@-6BEA>IJ9: 96I6 H=DL:9 I=6I ;DG B:CI6A >B6<:GN, I=: ;68:-EG:;:G:CI>6A :;;:8I 8DJA9 6AHD 7: EG:H:CI:9 7N I=:)1-0++ 6BEA>IJ9:.

4. Discussion

AH B:CI>DC:9 >C I=: $CIGD9J8I>DC, EG:K>DJH HIJ9>:H =6K: H=DLC I=6I 6 EG:;:G:C8: ID ;68: HI>BJA6I>DC :M>HIH >C I=: ILD ,+ 8DBEDC:CIH,)170 6C9 0++. .=: 6>B D; I=: EG:H:CI HIJ9N L6H ID :M6B>C: L=:I=:G 6 EG:;:G:C8: D;)170 6C96.567 200.854 Td1 67 5.41 200.854 TdE0A0E0E08> Tj2<T.

6<:GN 8DC9>I>DC, EG:H:CI>C< 8DBEA:I:AN 6B7><JDJH E>8IJG:H DCAN G:A>67AN :A>8>I:9 I=: 0++ 6C9 +2 8DBEDC:CIH, 7JI CDI I=:)170 8DBEDC:CI (L=>8= L6H CDI 9:I:8I67A: >C I=: B6?DG>IN D; I=: E6GI>8>E6CIH). *7K>DJHAN, I=: G:HJAIH D; I=>H HIJ9N 9>9 CDI ;JAAN HJEEDGI I=: CDI>DC I=6I 0++ 6C9)170 B6C>;:HI I=: >9:CI>86A 7G6>C EGD8:HH:H (%:B:A :I 6A., 2003; %DN8: & ,DHH>DC, 2005).

$I =6H 7::C @CDLC I=6I)170 B6>CAN G:S:8IH I=: :6GAN 6C9 6JIDB6I>8 HIGJ8IJG6A :C8D9>C< HI6<:H >C ;68: EGD8:HH>C< (B:CI>C & D:DJ:AA, 2000; B:CI>C :I 6A., 1996; C6JFJ>A :I 6A., 2000; >B:G, 2000).)170 86C 7: G:A>67AN :A>8>I:9 7N CD>H: >B6<:H DCAN L=:C 7DIIDB-JE ;68: H><C6AH DG D7?:8I H><C6AH 6G: 6K6>A67A:, HJ8= 6H L=:C LDG@>C< B:BDGN D; 6 G:6A ;68: >B6<:H L:AA B6>CI6>C:9 (-G::C>K6H6C :I 6A., 2007) DG

References

BöIO:A, &., "GüHH:G, *.%., 1989. A:8IG>8 7G6>C EDI:CI>6AH :KD@:9 7N E>8IJG:H D; ;68:H 6C9 CDC-;68:H: A H:6G8= ;DG ;68:-HE:8>R8 "-EDI:CI>6AH. ME:G>B:CI6A BG6>C ,:H:6G8= 77 (2), 349Q360.

BöIO:A, &., -8=JAO:, -., -ID9>:8@, -.,., 1995. -86AE IDED<G6E=N 6C9 6C6ANH>H D; >CIG68G6C>6A HDJG8:H D; ;68:-:KD@:9 EDI:CI>6AH. ME:G>B:CI6A BG6>C ,:H:6G8= 104 (1), 135Q143.

B6C@ó, É. (., "áA, 0., &öGIKéAN:H, %., &DKá8H, "., 0>9CNáCHO@N, 3., 2011. D>HHD8>6I>C< I=: :;;:8I D; CD>H: DC H:CHDGN EGD8:HH>C< 6C9 DK:G6AA 9:8>H>DC 9>;R8JAIN. %DJGC6A D;):JGD-H8>:C8: 31 (7), 2663Q2674.

B:CI>C, -., D:DJ:AA, '.2., 2000. -IGJ8IJG6A :C8D9>C< 6C9 >9:CI>R86I>DC >C ;68: EGD8:HH>C<: ,+ :K>9:C8: ;DG H:E6G6I: B:8=6C>HBH. CD<C>I>K:):JGDEHN8=DAD<N 17 (1-3), 35Q55.

B:CI>C, -., "DAA6C9, 2., 2002. (:6C>C<;JA EGD8:HH>C< D; B:6C>C<A:HH HI>BJA>: .=: >CSJ:C8: D; E:G8:EIJ6A :ME:G>:C8: DC :6GAN K>HJ6A EGD8:HH>C< D; ;68:H. CD<C>I>DC 86 (1), B1QB14.

B:CI>C, -., AAA>HDC, .., +J8:, A., +:G:O, ., (8C6GI=N, "., 1996. A:8IGDE=NH>DAD<>86A HIJ9>:H D; ;68: E:G8:EI>DC >C =JB6CH. %DJGC6A D; CD<C>I>K:):JGDH8>:C8: 8 (6), 551Q565.

B:CI>C, -., -6<>K,)., (:8@A>C<:G, A., !G>:9:G>8>, A., KDC CG6BDC, 2.D., 2002. +G>B>C< K>HJ6A ;68:-EGD8:HH>C< B:8=6C>HBH: A:8IGDE=NH>DAD<>86A :K>9:C8:. +HN8=DAD<>86A -8>:C8: 13 (2), 190Q193.

C6JFJ>A, A.-., 9BDC9H, ". ., .6NADG, (.%., 2000. $H I=: ;68:-H:CH>I>K:)170 I=: DCAN ,+ CDI 6;;:8I:9 7N H:A:8I>K: 6II:CI>DC?.):JGDG:EDGI 11 (10), 2167Q2171.

D: #66C, (., +6H86A>H, *., %D=CHDC, (.#., 2002. -E:8>6A>O6I>DC D; C:JG6A B:8=6C>HBH JC-9:GAN>C< ;68: G:8D<C>I>DC >C =JB6C >C;6CIH. %DJGC6A D; CD<C>I>K:):JGDH8>:C8: 14 (2), 199Q209.

>B:G, (., 2000. K:CI-G:A6I:9 7G6>C EDI:CI>6AH 9>HI>C<J>H= EGD8:HH>C< HI6<:H >CKDAK:9 >C ;68: E:G8:EI>DC 6C9 G:8D<C>I>DC. CA>C>86A):JGDE=NH>DAD<N 111 (4), 694Q705.

"6C>H, "., -8=:C96C, #. ., 2011. 0>HJ6A >B6<:GN. 1>A:N $CI:G9>H8>EA>C6GN ,:K>:LH: CD<C>I>K: -8>:C8: 2 (3), 239Q252.

":DG<:,)., K6CH, %., !>DG>,)., D6K>9DT, %., ,:C6JAI, B., 1996. BG6>C :K:CIH G:A6I:9 ID CDG-B6A 6C9 BD9:G6I:AN H8G6B7A:9 ;68:H. CD<C>I>K: BG6>C ,:H:6G8= 4 (2), 65Q76.

"DHH:A>C, !., -8=NCH, +.".., 2003. -JE:GHI>I>DJH E:G8:EI>DCH G:K:6A EGDE:GI>:H D; >CI:GC6A G:E-G:H:CI6I>DCH. +HN8=DAD<>86A -8>:C8: 14 (5), 505Q509.

#69?>@=6C>,)., &K:G6<6, &.,)6>@, +., A=A;DGH, -.+., 2009. 6GAN ()170) 68I>K6I>DC D; ;68:-HE:8>R8 8DGI:M 7N ;68:-A>@: D7?:8IH.):JGDG:EDGI 20 (4), 403Q407.

#6CH:C, B.C., .=DBEHDC, B., #:HH, ,.!., AA:B7:G<, D., 2010. MIG68I>C< I=: >CI:GC6A G:E-G:H:CI6I>DC D; ;68:H ;GDB =JB6C 7G6>C 68I>K>IN: AC 6C6AD<J: ID G:K:GH: 8DGG:A6I>DC.):JGD>B6<: 51 (1), 373Q390.

#6M7N, %.0., #DTB6C, .A., "D77>C>, (.$., 2000. .=: 9>HIG>7JI:9 =JB6C C:JG6A HNHI:B ;DG ;68: E:G8:EI>DC. .G:C9H >C CD<C>I>K: -8>:C8:H 4 (6), 223Q233.

#DGDK>IO, -."., ,DHH>DC, B., -@J9A6GH@>, +., "DG:, %.C., 2004. +6G6B:IG>8 9:H><C 6C9 8DGG:-A6I>DC6A 6C6ANH:H =:AE >CI:<G6I>C< ;(,$ 6C9 :A:8IGDE=NH>DAD<>86A 96I6 9JG>C< ;68: EGD-8:HH>C<.):JGD>B6<: 22 (4), 1587Q1595.

$H=6>, A., /C<:GA:>9:G, '."., (6GI>C, A., -8=DJI:C, %.'., #6M7N, %.0., 1999. D>HIG>7JI:9 G:E-G:H:CI6I>DC D; D7?:8IH >C I=: =JB6C K:CIG6A K>HJ6A E6I=L6N. +GD8::9>C<H D; I=:)6-I>DC6A A869:BN D; -8>:C8:H 96 (16), 9379Q9384.

$H=6>, A., #6M7N, %.0., /C<:GA:>9:G, '."., 2002. 0>HJ6A >B6<:GN D; ;6BDJH ;68:H: T:8IH D; B:BDGN 6C9 6II:CI>DC G:K:6A:9 7N ;(,$.):JGD>B6<: 17 (4), 1729Q1741.

$H=6>, A., /C<:GA:>9:G, '."., #6M7N, %.0., 2000. D>HIG>7JI:9 C:JG6A HNHI:BH ;DG I=: <:C:G6-I>DC D; K>HJ6A >B6<:H.):JGDC 28 (3), 979Q990.

$H=6>, A., /C<:GA:>9:G, '."., (6GI>C, A., #6M7N, %.0., 2000. .=: G:EG:H:CI6I>DC D; D7?:8IH >C I=: =JB6C D88>E>I6A 6C9 I:BEDG6A 8DGI:M. %DJGC6A D; CD<C>I>K:):JGDH8>:C8: 12 (-JEEA. 2), 35Q51.

$I>:G, ,.%., .6NADG, (.%., 2002. $CK:GH>DC 6C9 8DCIG6HI EDA6G>IN G:K:GH6A 6;;:8I 7DI= :C8D9>C< 6C9 G:8D<C>I>DC EGD8:HH:H D; JC;6B>A>6G ;68:H: A G:E:I>I>DC HIJ9N JH>C< ,+H.):JGD>B-6<: 15 (2), 353Q372.

$I>:G, ,.%., .6NADG, (.%., 2004.)170 DG)1? -E6I>DI:BEDG6A 9>;;:G:C8:H 7:IL::C D7?:8I 6C9 ;68: EGD8:HH>C< JH>C< ,+H. C:G:7G6A CDGI:M 14 (2), 132Q142.

%:;;G:NH, D.A., .J@B68=>, ., 1992. .=: K:GI:M-EDH>I>K: H86AE EDI:CI>6A :KD@:9 7N ;68:H 6C9 7N D7?:8IH. ME:G>B:CI6A BG6>C ,:H:6G8= 91 (2), 340Q350.

%:;;G:NH, D.A., 1989. A ;68:-G:HEDCH>K: EDI:CI>6A G:8DG9:9 ;GDB I=: =JB6C H86AE. ME:G>-B:CI6A BG6>C ,:H:6G8= 78 (1), 193Q202.

%:;;G:NH, D.A., 1996. KD@:9 EDI:CI>6A HIJ9>:H D; ;68: 6C9 D7?:8I EGD8:HH>C<. 0>HJ6A CD<C>-I>DC 3 (1), 1Q38.

%:B:A, B., -8=JAA:G, A. (., C=:G:;-&=6C, 2., "D;;6JM, 0., CGDBB:A>C8@, (., BGJN:G, ,., 2003. -I:EL>H: :B:G<:C8: D; I=: ;68:-H:CH>I>K:)170 :K:CI-G:A6I:9 EDI:CI>6A 8DBEDC:CI.):JGDG:EDGI 14 (16), 2035Q2039.

%D=CHIDC, +.%., -ID?6CDK, 1., D:K>G, #., -8=6AA, /., 2005. !JC8I>DC6A (,$ D; ;68>6A :BDI>DC G:8D<C>I>DC 9:R8>IH >C H8=>ODE=G:C>6 6C9 I=:>G :A:8IGDE=NH>DAD<>86A 8DGG:A6I:H. JGD-E:6C %DJGC6A D;):JGDH8>:C8: 22 (5), 1221Q1232.

%DN8:, C., ,DHH>DC, B., 2005. .=: ;68:-H:CH>I>K:)170 6C9 0++ 8DBEDC:CIH B6C>;:HI I=: H6B: 7G6>C EGD8:HH:H: .=: :;;:8I D; G:;:G:C8: :A:8IGD9: H>I:. CA>C>86A):JGDE=NH>DAD<N 116 (11), 2613Q2631.

&6CL>H=:G,)., (8D:GBDII, %., C=JC, (.(., 1997. .=: ;JH>;DGB ;68: 6G:6: A BD9JA: >C =J-B6C :MIG6HIG>6I: 8DGI:M HE:8>6A>O:9 ;DG ;68: E:G8:EI>DC. .=: %DJGC6A D;):JGDH8>:C8: 17 (11), 4302Q4311.

&:N:H, #., BG69N,)., ,:>AAN, ,.B., !DM:, %.%., 2010. (N ;68: DG NDJGH? K:CI-G:A6I:9 EDI:C-I>6A 8DGG:A6I:H D; H:A;-;68: EGD8:HH>C<. BG6>C 6C9 CD<C>I>DC 72 (2), 244Q254.

&A:>C, $., DJ7D>H, %., (6C<>C, %., &=:G>;, !., !A6C9>C, "., +DA>C:, %.-B., :I 6A., 2004. ,:I>CD-IDE>8 DG<6C>O6I>DC D; K>HJ6A B:CI6A >B6<:H 6H G:K:6A:9 7N ;JC8I>DC6A B6<C:I>8 G:HD-C6C8: >B6<>C<. CD<C>I>K: BG6>C ,:H:6G8= 22 (1), 26Q31.

&DHHANC, -. (., .=DBEHDC, 1.'., 2003. 1=:C >H :6GAN K>HJ6A 8DGI:M 68I>K6I:9 9JG>C< K>HJ6A B:CI6A >B6<:GN?. +HN8=DAD<>86A BJAA:I>C 129 (5), 723Q746.

'6I>CJH, (., .6NADG, (.%., 2005. #DA>HI>8 EGD8:HH>C< D; ;68:H: ':6GC>C< :;;:8IH L>I= (DDC:N ;68:H. %DJGC6A D; CD<C>I>K:):JGDH8>:C8: 17 (8), 1316Q1327.

'6I>CJH, (., .6NADG, (.%., 2006. !68: EGD8:HH>C< HI6<:H: $BE68I D; 9>;R8JAIN 6C9 I=: H:E6-G6I>DC D; :;;:8IH. BG6>C ,:H:6G8= 1123 (1), 179Q187.

'>, %., '>J, %., '>6C<, %., 3=6C<, #., 3=6D, %., ,>:I=, C.A., :I 6A., 2010. ;;:8I>K: 8DCC:8-I>K>I>:H D; 8DGI>86A G:<>DCH ;DG IDE-9DLC ;68: EGD8:HH>C<: A 9NC6B>8 86JH6A BD9:A>C< HIJ9N. BG6>C ,:H:6G8= 1340, 40Q51.

'>J, %., '>, %., !:C<, '., '>, '., .>6C, %., '::, &., 2014. -::>C< %:HJH >C ID6HI:):JG6A 6C9 7:-=6K>DG6A 8DGG:A6I:H D; ;68: E6G:>9DA>6. CDGI:M 53, 60Q77.

(:8=:AA>, A., +G>8:, C.%.,)DEE:C:N, /., !G>HIDC, &.%., 2003. A 9NC6B>8 86JH6A BD9:A>C< HIJ9N DC 86I:<DGN :;;:8IH: BDIIDB-JE DG IDE-9DLC B:9>6I>DC?. %DJGC6A D; CD<C>I>K:):JGDH8>:C8: 15 (7), 925Q934.

(:8=:AA>, A., +G>8:, C.%., !G>HIDC, &.%., $H=6>, A., 2004. 1=:G: 7DIIDB-JE B::IH IDE-9DLC:):JGDC6A >CI:G68I>DCH 9JG>C< E:G8:EI>DC 6C9 >B6<:GN. C:G:7G6A CDGI:M 14 (11), 1256Q1265.

)éB:I=, &., &DKá8H, +., O6@A>, +., &DKá8H, "., 3>BB:G, (., 2014. +=6H: CD>H: G:K:6AH :6GAN 86I:<DGN-HE:8>R8 BD9JA6I>DC D; I=: :K:CI-G:A6I:9 EDI:CI>6AH. !GDCI>:GH >C +HN8=DAD<N 5 (367)=IIE://9M.9D>.DG</10.3389/;EHN<.2014.00367.

):HIDG, A., O:II:A, %. (., .6GG, (.%., 2013. $CI:GC6A G:EG:H:CI6I>DCH ;DG ;68: 9:I:8I>DC: AC 6EEA>86I>DC D; CD>H:-76H:9 >B6<: 8A6HH>R86I>DC ID B*'D G:HEDCH:H. #JB6C BG6>C (6E-E>C< 34 (11), 3101Q3115.

*'CG6K:C, &. (., &6CL>H=:G,)., 2000. (:CI6A >B6<:GN D; ;68:H 6C9 EA68:H 68I>K6I:H 8DG-G:HEDC9>C< HI>BJAJH-HE:8>R8 7G6>C G:<>DCH. %DJGC6A D; CD<C>I>K:):JGDH8>:C8: 12 (6), 1013Q1023.

+GDK:G7>D, A. (., "6AA>, %., 2016. 1DB:C 6G: 7:II:G 6I H::>C< ;68:H L=:G: I=:G: 6G: CDC::AC ,+ HIJ9N D; ;68: E6G:>9DA>6. -D8>6A CD<C>I>K: 6C9 A;;:8I>K:):JGDH8>:C8: 11 (9), 1501Q1512.

,><=6GI, ,., AC9:GHHDC, !., -8=L6GIO, -., (6N:G, ., OJ>AA:JB>:G, +., 2009. .DE-9DLC 68-I>K6I>DC D; ;JH>;DGB 8DGI:M L>I=DJI H::>C< ;68:H >C EGDHDE6<CDH>6. C:G:7G6A CDGI:M 20 (8), 1878Q1890.

,DHH>DC, B., %68FJ:H, C., 2008. DD:H E=NH>86A >CI:GHI>BJAJH K6G>6C8: 688DJCI ;DG :6GAN :A:8IGDE=NH>DAD<>86A ;68: H:CH>I>K: G:HEDCH:H >C I=: =JB6C 7G6>C? .:C A:HHDCH DC I=:)170.):JGD>B6<: 39 (4), 1959Q1979.

,DHH>DC, B., "6JI=>:G, $., .6GG, (.%., D:HEA6C9, +., BGJN:G, ,., '>CDII:, -., :I 6A., 2000. .=:)170 D88>E>ID-I:BEDG6A 8DBEDC:CI >H 9:A6N:9 6C9 :C=6C8:9 ID >CK:GI:9 ;68:H 7JI CDI ID >CK:GI:9 D7?:8IH: AC :A:8IGDE=NH>DAD<>86A 688DJCI D; ;68:-HE:8>R8 EGD8:HH:H >C I=: =JB6C 7G6>C.):JGDG:EDGI 11 (1), 69Q72.

,DHH>DC, B., %DN8:, C.A., CDIIG:AA, ".1., .6GG, (.%., 2003. 6GAN A6I:G6A>O6I>DC 6C9 DG>:CI6-I>DC IJC>C< ;DG ;68:, LDG9, 6C9 D7?:8I EGD8:HH>C< >C I=: K>HJ6A 8DGI:M.):JGD>B6<: 20 (3), 1609Q1624.

,DHH>DC, B., 2014. /C9:GHI6C9>C< ;68: E:G8:EI>DC 7N B:6CH D; =JB6C :A:8IGDE=NH>DAD<N. .G:C9H >C CD<C>I>K: -8>:C8:H 18 (6), 310Q318.

,DHH>DC, B., C6BE6C:AA6, -., "DB:O, C. (., D:A>CI:, A., D:76I>HH:, D., '>6G9, '., :I 6A., 1999. .6H@ BD9JA6I>DC D;

7G6>C 68I>K>IN G:A6I:9 ID ;6B>A>6G 6C9 JC;6B>A>6G ;68: EGD8:HH>C<: AC ,+ HIJ9N. CA>C>86A) :JGDE3NH>DAD<N 110 (3), 449Q462.

,DHH>DC, B., D:AK:CC:, %., D:76I>HH:, D., "D;;6JM, 0., BGJN:G, ,., CGDBB:A>C8@, (., :I 6A., 1999. -E6I>D-I:BEDG6A AD86A>O6I>DC D; I=: ;68: >CK:GH>DC :;;:8I: AC :K:CI-G:A6I:9 ED-I:CI>6AH HIJ9N. B>DAD<>86A +HN8=DAD<N 50 (3), 173Q189.

-66K:9G6, C., *A>K6G:H, .$., $<A:H>6H, %., 2012. CD<C>I>K: 9:8A>C: :;;:8IH 6I 6C :6GAN HI6<:: K>9:C8: ;GDB) 170 6C9 0++.) :JGDH8>:C8: ':II:GH 518 (2), 149Q153.

-B>I=, (.'., "DHH:A>C, !., -8=NCH, +.", 2012. (:6HJG>C< >CI:GC6A G:EG:H:CI6I>DCH ;GDB 7:=6K>DG6A 6C9 7G6>C 96I6. CJGG:CI B>DAD<N 22 (3), 191Q196.

-G::C>K6H6C, &.&., &6IO, %., %=6, A.+., 2007. .:BEDG6A 8=6G68I:G>HI>8H D; IDE-9DLC BD9J-A6I>DCH 9JG>C< LDG@>C< B:BDGN B6>CI:C6C8:: AC :K:CI-G:A6I:9 EDI:CI>6A HIJ9N D; I=:) 170 8DBEDC:CI. %DJGC6A D; CD<C>I>K:) :JGDH8>:C8: 19 (11), 1836Q1844.

-I6=A, %., 1>:H:, #., -8=L:>C7:G<:G, -.,., 2008. ME:GI>H: 6C9 DLC-G68: 7>6H >C ;68: EGD-8:HH>C<: AC :K:CI-G:A6I:9 EDI:CI>6A HIJ9N.) :JGDG:EDGI 19 (5), 583Q587.

.6NADG, (.%., (8C6GI=N, "., -6A>76, ., D:<>DK6CC>, ., 1999. ,+ :K>9:C8: D; 9:K:ADEB:C-I6A 8=6C<:H >C EGD8:HH>C< D; ;68:H. CA>C>86A) :JGDE=NH>DAD<N 110 (5), [illegible]

1>A9, #.A., BJH:N, ..A., 2004. -::>C< ;68:H >C I=: CD>H:: -ID8=6HI>8 68I>K>IN >C E:G8:EIJ6A G:<>DCH D; I=: 7G6>C B6N >CSJ:C8: I=: E:G8:EI>DC D; 6B7><JDJH HI>BJA>. +HN8=DCDB>8 BJAA:I>C & , :K>:L 11 (3), 475Q481

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