

CDC1: CIH A>HIH 6K6>A67A: 61 -8>: C8: D>G: 8I

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



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

(: C16A >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/J0}, C=6C<M>C 3=6C<⁸, ' >6C< ' >^{6/J0/JU}

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A,.\$C'\$)!*

Keywords: O+HJ6A B: C16A >B6<: GN . DE-9DLC BD9JA61>DC ! 68: O: G1: M EDH>I>K: EDI: CI>6A +2) 170 K: C1-G: A61: 9 EDI: CI>6AH

AB-., AC.

O-HJ6A B: C16A > B6<: GN ;DGBH B: C16A G: EG: H: C16I > DCH D; K-HJ6A D7?: 8IH L=: C 8DGG: HEDC9: C1 HI>BJA> 6G: 67H: C1 6C9 H=6G: H HDB: 8=6G681: GH L>1= K-HJ6A E; G8: E1>DC. BD1= 1=: K: G1: M-EDH>1-K: -ED1: C1>6A (O++) 6C9) 170 8DBEDC: C1H D; : K: C1-G: A61: 9 ED1: C1>6AH (, +H) ID K-HJ6A HI>BJA> =6K: 6 G: B6G@67A: EG: ;: G: C8: ID ;68: H. . =>H HIJ9N >CK: H1><61: 9 L=: 1=: G K-HJ6A B: C16A > B6<: GN BD9JA61: H I=: ;68: -H: CH>1-K: O++ 6C9/DG) 170 8DBEDC: CIH . . =: G: HJAIH H=DL: 9 I=61 L>1= H><C>>>86C1AN A6G<: G 6BEA>IJ9: H JC9: G I=: ;68: ->B6<: GN 8DC9>I>DC I=6C I=: =DJH: ->B6<: GN 8DC9>I>DC, I=: O++ 6C9 +2 G: HEDCH: H, 7J1 CD1 I=:) 170 8DBEDC: C1, L: G: :A>31: 9 7N E=6H: -G6C9DB>0: 9 6B7><JDJH HI>BJA>. . =JH, I=: 7G6>C HJ7HIG61: H JC9: GAN>C< O++ 6G: CD1 8DBEA: I: AN >9: C1>86A ID I=DH: JC9: GAN>C<) 170, 6C9 I=: O++/ +2 B6C>:: H16I>DC D; I=: 861: <DGN H: A: 8I>K>IN >C >B6<: GN EGD767AN G: S: 8IH 6C >C1: <G6I>DC D; E6G69><BH, HJEEDGI>C< I=: K>: L I=61 K>HJ6A B: C16A >B6<: GN 6C9 E: G8: E-I>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: HD; 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>1: 9 7N 6 G: 6A ;68: HI>BJAJH 6C9 L>I= 6C 68I>K6I>DC HDJG8: >C I=: K: C-IG6A ! ! A. AAA I =: H: G: EDGIH HJ <<: HI I=6I I=: ! ! A >H 6C >CI: G;68: I=6I >H >C-KDAK: 9 >C ; JC8I>DC6A >C1: <G6I>DC 7: IL: : C I=: IDE-9DLC >B6<: GN EGD8: HH 6C9 I=: 7DIIDB-JE H: CHDGN EGD8: HH. \$I H >BEDGI6CI ID : HI67AH= 6 C: JGD-E=NH>DAD<>86A BD9: A D; I=: IDE-9DLC BD9JA6I>C< : ;;: 8I D; K>HJ6A B: C16A >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 (O++) 8DBEDC:CI 6C9 I=:) 170 8DB-EDC: CI D; : K: CI-G: A61: 9 EDI: CI>6AH (, +H) 6G: B6G@: 9AN ;68: H: CH>I>K:: 7DI= O++ 6C9) 170 66: :C=6C8:9 L=:C :A>8>I>C< HI>BJA> 66: ;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 O++, H: : BÖIO: A, -8=JA0:, & -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, & . 66G, 2003; ;DG) 170, H:: B: CI>C, AAA>HDC, +J8:, +:G:O, & (8C6GI=N, 1996; D: #66C, +6H86AH, & %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, O++) 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:-6: HEDCH-K:) 170 8DBEDC: CI B6>CAN D88JGH 6I D88>E>ID-I: B-EDG6A 6: 8DG9>C< H>I: H DC I=: H86AE, L>I= I=: 6BEA>IJ9: E: 6@ C: 6G 170 BH ;DADL>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: 6: HI>C<AN,) 170 86C 7: :A*8>I: 9 7N CDC-;68: CD>H: >B6<: H :>I=: 6 9J6>C< I=: B6>CI: C6C8: D; I=: LDG@>C< B: BDGN D; 6 6; 6A ;68: >B-6<: (-6:: C>K6H6C, &610, & %=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). (D6: DK: 6,) 170 86C : K: C 7: :A*8>I: 9 7N H>BEA: H8=: B6I>8 DG A>C: 966L>C<H >CI: 6EG: I: 9 6H ;68: H DG : N: H (B: CI>C & "DA6C9, 2002; B: CI>C : I 6A, 2002). #DL: K: 6, >I >H CDI 8A: 6G L=: I=: G IDE-9DLC >B6<: GN 86C HI>A 6;;: 8I) 170 L=: C 6CN 7DIIDB-JE ;68: -H><C6A >CEJIH 6G: HJ7HI6CI>6AN A>B>I: 9 DG : K: C 8DB-EA: I: AN :A>B>C6I: 9.

. =: O++ : B:G<:H 6I ;GDCID-8: CIG6A G: 8DG9>C< H-1: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=: H16<: 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, H866B7A:, DG B6H@>C< IG:6I- -DB: EG: K>DJH HIJ9>:H =6K: HJ<<:HI:9 I=6I O++ 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; O++ 6C9 I=6I D;) 170 6G: =><=AN 8DGG: A61: 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= >C-K: 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= O++ 6C9) 170 LDJA9 7: DG><>-C61: 9 ;GDB 7DI= ;JH>;DGB <NGJH G: <>DCH 6C9 A61: G6A >C;: G>DG D88>E>I6A 8DG-I:M (, DHH>DC, C6BE6C: A6 : 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 O++ 6C9) 170 6G: 76H: 9 DC 9>;;: G: CI 766>C B: 8=6C>HBH (\$I>: G & . 6NADG, 2004 Böl0: A : I 6A., 1995; ": DG<: : I 6A., 1996; . 6NADG : I 6A., 1999; -66K: 966 : I 6A., 2012): (1) I=: O++ <: C: G61DG >CKDAK: H 6 A6G<: G C: ILDG@ >C8AJ9>C< 7DI= >C;: G>D-1: BED-G6A 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; O++, >C9>-861>C< 1=61 O++ >H 6AHD 6HHD8>61:9 L>I= B: BDGN-G: A61:9 EGD8: HH (BÖIO: A : I 6A., 1995); (3) 6 HI: 69N 6<: -G: A6I: 9 8=6C<: D;) 170 H D7H: GK: 9 6C9 O++ >H 67H: CI >C NDJC< 8=>A9G: C, >C9>86I>C< 6 9: K: ADEB: C16A 9>;;: G: C8: 7: IL:: C) 170 6C9 O++ (. 6NADG : I 6A., 1999); (4) 8D<C>I>K: 9: 8A>C: 6;-::81H I=: O++ 6C9) 170 >C I=: DEEDH>I: 9>6:81>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; O++ (\$I>: G & . 6NADG, 2004).

. =>H HIJ9N 6>B:9 ID >CK:HI><61: L=:I=:G >CHIGJ8I>DC->C9J8:9 B:C-I6A >B6<:GN D; ;68:H 86C IDE-9DLC BD9JA61: I=: ILD ;68:-H:CH>I>K: , + 8DBEDC:CIH, O++ 6C9) 170, L=:C I=: , +-:A*8>I>C< HI>BJA> 6G: 8DB-EA:I:AN 6B7><JDJH E>8IJG:H I=61 =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

 $\begin{array}{l} -\ast MI:: C \ JC>K: GH>IN \ HIJ9: CIH \ (8 \ B6A: H \ 6C9 \ 8 \): B6A: H, \ 6<: 9 \ 7: IL:: C \\ \textbf{20} \ 6C9 \ \textbf{28} \ N: 6GH \ L>I= I=: B: 6C \ D; \ \textbf{22.9} \pm \textbf{2.0} \ N: 6GH) \ E6GI>8>E6I: 9 \times C \ I=>H \\ HIJ9N. \ .=: N \ L: G: \ 6><=I \ =6C9: 9 \ 6C9 \ =69 \ :>I=: G \ CDGB6A \ DG \ 8DGG: 8I-ID-CDG-\\ B6A \ 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: CI \ 6C9 \ L: G: \ E6>9 \ 6 \ BD9: HI \ HI>E: C9 \ ;DG \ I=:>G \ E6GI>8>E6I>DC. \ .=: \\ :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: CI \ 6C9 \ L: G: \ E6>9 \ 6 \ BD9: HI \ HI>E: C9 \ ;DG \ I=:: G \ E6GI>8>E6I>DC. \ .=: \\ :ME: G>B: CI \ 6C9 \ AC>B6A \ -J7?: \ 8IH \ D; \ I=: \ D: \ E6GIB: CI \ D; \ \ HN8=DAD<N \ 6I \ +: @>C< \ /C>K: \ 6H>IN. \end{array}$

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 8DB-EA: I: AN 6B7><JDJH R<JG: H JH>C< I=: E=6H: G6C9DB>06I>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: L: G: B69: ;GDB ;68: E>8IJG: H 6C9 150 8DBEA: I: AN 6B7><JDJH R<JG: H L: G: B69: ;GDB ;68: E>8IJG: H A;-I: G I=: E=6H: -G6C9DB>06I>DC B6C>EJA6I>DC, I=: H: 6B7><JDJH R<JG: H = 46 C:>I=: G G: 8D<C>067A: ;68: D7?: 8IH CDG G: 8D<C>067A: =DJH: D7?: 8IH. =: I=>69 86I: <C0N D; HI>BJA> L: G: 150 " 6JHH>6C CD>H: HI>BJA>, L=DH: 7G><=I-C: HH L6H B6I8=: 9 ID I=61 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>;>86AMN, 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: :6HAN 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;-6B-7><JDJH E>8IJG:H L:G: JH:9 (!>.1).

2.3. Procedures

$$\begin{split} \mathsf{DJG}{} < \mathsf{I} = :: \mathsf{ME}: \mathsf{G}{} > \mathsf{B}: \mathsf{CI}, \mathsf{E}\mathsf{G}\mathsf{G}\!\!> \mathsf{S}\!\!> \mathsf{E}\mathsf{C}\mathsf{IH} \mathsf{H}\mathsf{G}\mathsf{I} \times \mathsf{C} \mathsf{G} \mathsf{P}\!\!> \mathsf{B}\mathsf{A}\mathsf{N}\!\!= \mathsf{A}\!\!> \mathsf{G}\!\!< \mathsf{G} \mathsf{P}\mathsf{H}\mathsf{D}\mathsf{J}\mathsf{C}\!\!> \mathsf{G}\!\!> \mathsf{I}\!\mathsf{G}\!\!> \mathsf{A}\!\!> \mathsf{D}\!\!> \mathsf{D}\!\!>$$

\$C 6 IG>6A, 6 RM6I>DC 8GDHH L6H EG: H: CI: 9 ;DG 6 9JG6I>DC 66C9DBAN 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@, E6G-I>8>E6CIH L: G: >CHIGJ8I: 9 ID >B6<>C: :>I=: G 6 ;68: (>C I=: ;68: ->B6<: GN 7AD8@) DG 6 =DJH: (>C =DJH: ->B6<: GN 7AD8@). .=: >CHIGJ8I>DC ;DG I=: ;68: ->B6<: GN 7AD8@ L6H I=61 "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: AGG: HEDC9>C< 7JI-IDCH. .=: 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: M I=: <:C9: G. 2DJ ?JHI >B6<>C: 6 ;68: ;6DB 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>BA6G; :M-8: EI I=6I I=: E6GI>8>E6CIH' 16H@ L6H ID ?J9<: L=: I=: G I=: >B6<; 9



Real Face/House Pictures

Fig. 1. - \bBJ& 6C9 +GD8:9JG:H. =: JEE:G E6C:A (A): M6BEA:H D; I=: :ME:G:B:CI6A HI>BJ&>CDBEA:I:AN 6B7>JDJH R<JG: HI>BJ&>L:G: JH:9>C 7DI= I=: ;68: >B6<:GN 6C9 =DJH: >B6<:GN 7AD8#L. CDG6: HEDC9>C< G: 6A ;68: /=DJH: E-81JG:H L:G: JH:9>C I=: ;68: >B6<:GN 7AD8# 6C9 I=: =DJH: >B6<:GN 7AD8#L. =: ADL:G E6C:A (B): ME:G:B:CI6A EGD8:9JG:H. DJG:C< HI>BJAJH EG:H:C-16J:DC, E661>8>E6CIH L:G: >CHIGJ8I:9 ID >B6<C: :>I=: G 6;68: DG 6 =DJH:, 6C9 I=: C B6@: 2-6AI:GC6/X::-;D68:9-8=D>8: G: HEDCH:H (B6A: /;: B6A:, ILD/I=G:: SDDGH).

=DJH:H =69 :>I=: 6 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:->B-6<: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=61 I=: N =69 ;JAAN JC9: GHIDD9 I=: EGD8: 9JG: 6C9 E: G;DGB: 9 I=: I6H@ 8DGG: 8IAN. .=: EJGEDH: D; I=>H HJJ9N 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, O>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 61 I=: DJI:G 86CI=> D; I=: ILD :N:H. A:8IGD9: >BE:96C8: L6H @:EI 7:-ADL 5 @ . " H><C6AH L:G: EGD8:HH:9 61 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;1: 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 861: <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;1: G I=: HI>BJAJH DCH: I. ED8=H L>I= D8JA6G 6G-I>;68IH : M8: : 9>C< \pm 100 μ O L: G: G: ?:8I:9, 6C9 I=: C I=: L6K: ;DGB L6H DT-A>C: ADL-E6HH RAI: G: 9 61 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 A61: C8N D; I=:) 170 8DBEDC: C1 L: 6: EGD8: HH: 9 61 I=: D88E>ID-1: BEDG6A H>1: H>C I=: G><=I =: B>HE=: 6: (+6, +8, +*6, +*8) 6C9 A: ;I =: B>HE=: 6: (+5, +7, +*5, +*7) 9JG>C< I=: I>B: L>C-9DL D; 140-220 BH 6;I: G I=: HI>BJAJH DCH: I. . =: O++ L6H EGD8: HH: 9 61I=: ;GDCID-8: CIG6A H>1: H D; I C0 6C9 C0 140-220 BH 6;I: G I=: HI>BJAJH DC-H: I; I=: D88>E>ID-1: BEDG6A +2 8DBEDC: CI L6H EGD8: HH: 9 61 I=: H>I AI H D; H C 6C9 C0 140-220 BH 6;I: G I=: HI>BJAJH DC-H: I; I=: D88>E>ID-1: BEDG6A +2 8DBEDC: CI L6H EGD8: HH: 9 61 I=: H>I AI H C I=: G><=I =: B>HE=: 6: (+6, +8, +*6, +*8) 6C9 A: ;I =: B>HE=: 6: (+5, +7, +*5, +*7) 9JG>C< I=: I>B: L>C9DL D; 200-260 BH 6;I: G I=: HI>BJAJH DCH: 1, \$C I=: E: 6@-ID-E: 6@ B: 6HJG: B: CI D; O++, ;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; I 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-O++ 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; GD; GA) 1 ;GDB I=: 76H: A>C: -ID-E: 6@ 6BEA>IJ9: D; 70-150 BH 6;I

3. Results

3.1. Behavioral testing

E: G;DGB I=: I6H@, 6C9 9>H8G>B>C6I: ;:6IJG:H D; I=: G:6A D7?:8IH (;68:H DG =DJH:H).

3.2. ERP recordings

3.2.1. Amplitudes and latencies of ERPs to completely ambiguous figures

. =: G: HJAIH D; G: 8DG9>C<H 6I H>I: C0 H=DL: 9 I=6I I=: 6BEA>IJ9: D; O++ L6H A6G<: G JC9: G I=: ;68: ->B6<: GN 8DC9>I>DC I=6C JC9: G I=: =DJH: ->B-6<: GN 8DC9>I>DC. . =: 6BEA>IJ9: 6C9 A6I: C8N D; O++ L:G: HI6I>HI>86AAN 6C-6ANO: 9 JH>C< 6 G: E: 61: 9-B: 6HJG: H 6C6ANH: H D; K6G>6C8: (A) *OA) L>I= I=: ;DAADL>C< 3 K6G>67A: H: (1) >B6<: GN 861: <DGN (;68: >B6<: GN, =DJH: >B6<: GN), (2) HI>BJAJH INE: (6B7>< JDJH R<JG: H; GDB; 68: E>8IJG: H, 6B-7><JDJH R<JG:H ;GDB =DJH: E>8IJG:H, "6JHH>6C CDH:), 6C9 (3) :A:8-IGD9: H>I: (!CO, CO). A I=G::-K6G>67A: L>I=>C-HJ7?:8I A) *OA H=DL:9 6 H><C>;>86C1 B6>C : ;;:81 D; >B6<:GN 861: <DGN 4! (1,15) = 18.27, $p = 0.001, \eta p^{p} = 0.555, H < C_{>>}86C1 B6>C :;;:81 D; HI>BJAJH INE:$ 4! (2,30) = 6.58, p = 0.004, $\eta p^{12} = 0.315$, 6C9 H<C>;>86C1 B6>C : ;;:81 D; : A: 8IGD9: H>1: 4! (1,15) = 4.87, p = 0.043, $\eta p^{12} = 0.255$.) D H>C>:>-86C1 >C1: G681>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; O++ L6H H><C>;>86CIAN A6G<: G JC9: G I=: ;68: ->B6<: GN 8DC9>I>DC (2.95 ± 0.63 μO) I=6C JC9: G I=: =DJH: ->B-6<:GN 8DC9>I>DC (1.80 \pm 0.52 $\mu\text{O})$ 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 O++ I=6C >CIGD9J8->C< B: CI6A >B6<: GN D; =DJH: .

(DG: DK: G, I=: B: 6C O++ 6BEA>IJ9: ID I=: 6B7><JDJH HI>BJA> ;GDB ;68: E>8IJG: H (2.87 ± 0.64 µO) L6H A6G<: G I=6C B:6C O++ 6BEA>IJ9: ID "6JHH>6C CD>H: $(1.74 \pm 0.50 \mu O)$ 4I(15) = 3.42, p = 0.004, CD-=: C'H d = 0.495, 6C9 I=: B:6C O++ 6BEA>IJ9: ID I=: 6B7><JDJH HI>B-JA> ;GDB =DJH: E>8IJG: H (2.51 ± 0.62 µO) L6H A6G<: G I=6C B: 6C O++ 6B-EA>IJ9: ID " 6JHH>6C CD>H: 4I(15) = 2.49, p = 0.025, CD=: C'H d = 0.345. AMHD, CD H><C>;>86C1 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: 66C9DB>06I>DC L6H CDI H><C>;>86CI. . =: G:-HJAIH 6AHD H=DL: 9 I=61 O++ 61 I=: H>1: CO (2.68 ± 0.65 µO) L6H A6G<:G I=6C 61 I=: H>I: ! C0 $(2.07 \pm 0.49 \mu O)$ 1=61



Fig. 2. 1 6K: :DGBH D; O++ 6C9 +2. "GDJE <G6C9 6K: G6<: L6K: :DGBH 6I :A: 81GD9: H-1: CO (I=: JEE: G E6C: A) 6C9 +8 (I=: ADL: G E6C: A) JC9: G :>I=: :G I=: :G8: >B6<: GN 8DC9>I>DC DG I=: =DJH: >B6<: GN 8DC9>I>DC. O++ (I>B: L>C9DL: 140-220 BH) 6C9 +2 (I>B: L>C9DL: 200-260 BH) L:G: :C=6C8: 9 JC9; G I=: :G8: >B6<: GN 8DC9>I>DC (96G@ A-C:) 8DBE66: 9 ID I=: =DJH: >B-6<: GN 8DC9>I>DC (<G: N AC:).

4I(15) = 2.27, p = 0.043, CD=: C'H d = 0.275. . =: 8DBE6GHDCH > C O++ 6BEA>IJ9:H 66: H=DLC > C I=: JEE: G E6C:A D; !><. 3.

. =: 6BEA>IJ9: 6C9 A61:C8N D; +2 L:G: 6C6ANO:9 6AHD JH>C< 6 G:-E:61:9-B:6HJG:H A) *OA L>I= I=: ;DAADL>C< 3 K6G>67A:H (1) >B6<:GN 861:<DGN (;68: >B6<:GN, =DJH: >B6<:GN), (2) HI>BJAJH INE: (6B7><J-DJH 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: 6 E6C: A D; !><. 2 H=DLH I=: 8DBE66*HDCH D; <66C9 6K: 6 6<: , + L6K: ;D6BH JC9: 6 I=: ;68: >B6<: GN 8DC9>I>DC 6C9 I=DH: JC9: 6 I=: =DJH: ->B6<: GN 8DC9>I>DC L>I= I=: 6: 8D69>C<H 6I I=: :A: 8I6D9: H>I: D; +8. !D6 I=: +2 6BEA: J9:, 6 I=6: :-K66*67A: L>I=>C-HJ7?: 8I A) *OA 6:-K: 6A: 9 6 H><C>;>86CI B6>C :;;: 8I D; >B6<: GN 86I: <DGN 4! (1,15) = 4.58, $p = 0.049, \eta p^{g} = 0.235, H><C>;>86CI B6>C :;;: 8I D; HI>BJAJH INE:$ $4! (2.30) = 35.19, <math>p < 0.001, \eta p^{g} = 0.705, 6C9 H><C>;>86CI B6>C :;;: 8I$ $D; =: B>HE=: 6: 4! (1,15) = 5.58, <math>p = 0.032, \eta p^{g} = 0.275.$!D6 >CI: 668-I>DCH 6BDC< I=: 3 K66*67A: H, DCAN I=: >CI: 668I>DC 7: IL:: C HI>BJAJH INE: 6C9 =: B>HE=: 6: L6H H><C>;>86CI 4! (1.32, 19.79) = 10.55, $p = 0.002, \eta p^{g} = 0.415.' - D +DHI =D8 8DBE66>HDC H=DL: 9 I=61 I=: 6B-$ EA*IJ9: D; +2 L6H A6G<: G JC9: 6 I=: ;68: ->B6<: GN 8DC9>I>DC(10.38 ± 0.85 µO) I=6C JC9: 6 I=: =DJH: ->B6<: 6N 8DC9>I>DC(9.44 ± 0.98 µO) 4I(15) = 2.14, <math>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: 668I>DC L6H 6C6AN0: 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; I><. 3.

! DG I=: A61: C8N D; +2, 6 I=G: :-K6G>67A: L>I=>C-HJ7?: 8I A) *OA DCAN G: K: 6A: 9 6 H<C>>86C1 B6>C :;;:8I D; HI>BJAJH INE: 4! (1.28, 19.25) = 4.25, p = 0.034, $\eta p^8 = 0.225$. '-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>8-IJG: 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>|>DC, G: HE: 8I>K: AN.

, + L6K:;DGBH>C 5 E6GI>8>E6CIH: M=>7>I: 9 6C D7H:GK67A:) 170 8DB-EDC: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.

. =: <66C9 6K:66<: , + L6K:;DGBH D; 6AA I=: 6C6AN0:9 :A:81GD9: H>I:H (!C0, C0, +5, +6, +7, +8, +*5, +*6, +*7, +*8) JC9:6 ;68:->B-6<:GN 6C9 =DJH:->B6<:GN 8DC9>I>DCH ;DG I=: 4 HI>BJAJH INE:H (8DB-EA:I:AN 6B7><JDJH R<JG:H ;GDB



Fig. 3. -161/H1>866 8DBE66/HDCH D; 0++ 6C9 +2 6BE/k1J9;H...=: JEE: 6 E6C: A: +DHI #D8 8DBE66/HDCH D; E: 6@ 6BE/k1J9;H D; O++ 61 : A: 816D9; H>1: H C0 6C9 ! C0...=: 6BE/k1J9;D; O++ JC9: 6 I=: ;68: >B6<: 6N 8DC9>I>DC L6H H<C>>86C1AN A66<: 6 I=66 I=61 JC9: 6 I=: =DJH: >B6<: 6N 8DC9>I>DC, 6C9 O++ :A*D1: 9 7N 6B7<JDJH E>81J6;H L6H H<C>>86C1AN A66<: 6 I=66 I=61 :A*D1: 9 7N "6JHH>6C CDH:...=: ADL: 6 E6C: A: +DHI #D8 8DBE66/HDCH D; E: 6@ 6BE/k1J9;H D; +2 × I=: A: ;I =: BHE=: 6: (+5, +7, +*5, +*7) 6C9 I=: 6<= I=: BHE=: 6: (+6, +8, +*6, +*8)...=: 6BE/k1J9: D; +2 JC9: 6 I=: ;68: >B6<: 6N 8DC9>I>DC L6H H<C>>86C1AN A66<: 6 I=6C I=61 JC9: 6 I=: =DJH: >B6<: 6N 8DC9>I>DC, 6C9 +2 :A*B1: 9 7N 6B7<JDJH R<J6;H L6H H<C>>86C1AN A66<: 6 I=6C I=61 :A*B1: 9 7N "6JHH>6C CDH:... 6GD6 B66H 6: E6;H: CI I=: HI6C9669 : 6GD6 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>8-IJG: 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 6: 6A ;68: -E>8IJG: HI>BJ-A6I>DC (>C8AJ9>C< 7DI= =6A; -6B7><JDJH ;68: E>8IJG: H 6C9 8A: 6C ;68: E>8-IJG: 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 8DC-9>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=: O++ 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; O++ 8DBEDC: CI, 6 2 (HI>BJAJH INE:: 6B7><J-DJH E>8IJG: H L>I= ;68: >B6<: GN, ;68: -E>8IJG: HI>BJA6-

I>DC) 7N 2 (: A: 8IGD9: H>I:: CO, ! CO) G: E: 6I: 9-B: 6HJG: H A) * OA H=DL: 9 >C1:G681>DC 6 H><C>:>86C1 ILD-L6N 4! (1, (15) = 63.98 $p < 0.001, \eta p^{D} = 0.815.$. =: 9>;;:G:C8: D; O++ 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 \pm 0.93 μ O) 8DBE6G:9 ID I=6I 6I H>I: C0 (0.16 \pm 0.91 μ O) 4I(15) = 8.00, p < 0.001, CD-=: C'H d = 0.485. AAHD, I=: A61: C8N D; O++ L6H 6C6ANO: 9 6C9 I=: G: HJAIH H=DL: 9 I=61 CD H><C>;>86C1 9>;;:G: C8: H L: G: ;DJC9 7: IL: : C 2 HI>BJ-AJH 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>BJA6-I>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>B-JAJH INE: H (227.6 \pm 3.5 BH ;DG 8DBEA: I: AN 6B7><JDJH HI>BJA> JC9: G I=: ;68: ->B6<: GN 8DC9>I>DC; 232.2 \pm 3.1 BH ;DG ;68: -E>8IJG: HI>BJA6I>DC).



Fig. 4. "GDJE <66C9 6K: 66<: L6K: ;DGBH 6I 6M 6C6AN0: 9 : A: 8IGD9: H>: H. !DG I=: H>BJAJH INE: D; 8DBEA: I: AN 6B7<JDJH R<JC: H;GDB ;68: H, 8DBEA: I: AN 6B7<JDJH R<JC: H;GDB =DJH: H, 6C9 "6JHH>6C CDH:, I=: 966@ A>C: H 6: E6: H: CI I=: ;68: >B6<: GN 8DC9>J>DC 6C9 I=: <6: N A>C: H 6: E6: H: CI =DJH: >B6<: GN 8DC9>J>DC 0. +5, +6, +7, +8, +*5, +*6, +*7, +*8.



Fig. 5. " GDJE <66C9 6K: 66<: L6K: ;D6BH 6I : Å: 816D9: I+J: H CO 6C9 +8. D66@ AC: H 6: E6: H: CI 6: HEDCH: H : A*8-I: 9 7N 6B7><JDJH R<J6: H L>I= ;68: >B6<: GN, AC: H 6: E6: H: CI 6: HEDCH: H >C9J8: 9 7N 6: 6A ;68: E>81J6: H. O++ 6C9 +2 D88J66: 9 >C 7DI= I=: ;68: -B6<: GN 8DC9>I>DC 6C9 ;68: -E: 68: EI>DC 8DC9>I>DC, 7JI) 170 L6H ;DJC9 DCM >C I=: ;68: -E: 68: EI>DC 8DC9>I>DC.





Fig. 6. .=: JEE: 6 E6C: AH (A): " GDJE <66C9 6K: 66<: D; , + L6K: ;DGBH 6I ;GDCID-8: CI66A H51: H (6K: 66<: 9 680DHH 1=: ! C0 6C9 C0- =: 6 7N 8DBEA: 1: AN 6B7×JDJH R<J6: H (A: ;1 E6C: A) L51=: 51=: 6 ;68: >B6<: GN (96G* AC:) D6 =DJH: >B6<: GN (<G: N AC:), D6 7N 6: 6A-;68: E>81J6: H (96G* AC: >C 6<=I E6C: A) D6 6: 6A=DJH: E>81J6: H (-G: N AC: >C 6<=I E6C: A) L51=: 51=: 6 ;68: >B6<: GN (96G* AC: >C 6<=I E6C: A) L51=: 51=: 6 ;68: >B6<: GN (96G* AC: >C 6<=I E6C: A) L51=: 51=: 6 ;68: >B6<: GN (96G* AC: >D G=DJH: >B6+;68: E>81J6: H (96G* AC: >C 6<=I E6C: A) D6 6: 6A=DJH: E>81J6: H (-G: N AC: >C 6<=I E6C: A) .=: ADL; G E6C: AH (B): +DHI =D8 8DBE65HDCH D; 76H: AC: -ID-E: 6 @ 6BEAJ9: H D; O++ (A: ;I E6C: A) 6C9 E: 6@=ID-E: 6 @ 6BEAJ9: H D;) 1-0++ (6<=I E6C: A) 680DHH H3: BJJH H3: BJJH H3: H5 69 8DC9>i>DCH. BDI= 76H: AC: -ID-E: 6 @ C9 E: 6@=ID-E: 6 @ B: 6HJ6: B: CI H H=DL; 9 HIGDC<: G O++ JC9: G ;68: 8DC9>i>DCH (96G* 76G) I=6C =DJH: 8DC9>i>DCH (<G: N 76G). .=: E: 6@=ID-E: 6 @ B: 6HJ6: B: CI 6HD G: K: 6AH 6 H1GDC<: 60: 66S: -69K6C16<: :;;;:81: ;DG G: 6A E-8JJ6: H I=6C 8DBEA: I: AN 6B7<JDJH R<JG: H. GGDG B6GH G: EG: H: CI I=: H16C9669 : GGDG D; I=: B: 6C (- (). * p < 0.05, ** p < 0.01, m.s. B6G<<C6ANN H<C>>86C1.

E:61:9-B:6HJG:H A) *OA D; I=: 76H:A>C:-ID-E:6@ O++ 6BEA>IJ9: G:-K:6A:9 6 B6G<>C64NN H><C>>86CI B6>C :;;:8I D; HI>BJAJH INE; 4! (1, 15) = 4.40, p = 0.053, $\eta p^{0} = 0.235$ 6C9 6 H><C>>86CI B6>C :;;:8I D; HI>BJAJH INE; 4! (1, 15) = 4.40, p = 0.053, $\eta p^{0} = 0.235$ 6C9 6 H><C>>86CI B6>C :;;:8I D; HI>BJAJH-D7?:8I 8DC9>I>DC 4! (1, 15) = 4.93, p = 0.042, $\eta p^{0} = 0.255$. =: ILD-L6N >CI:668I>DC L6H CDI H><C>>86CI (p = 0.63). A ' -D +DHI =D8 6C6ANH>H 6AHD H=DL:9 I=6I O++ JC9:6 I=: ;68: 8DC9>I>DC (3.91 ± 0.71 μ O) L6H H><C>>86CIAN A6G<:G I=6C I=6I JC9:G I=: =DJH: 8DC9>I>DC (2.73 ± 0.51 μ O) 4I(15) = 2.22, p = 0.042, CD=: C'H d = 0.475. #DL-:K:G, I=: 9>;;:G:C8: 7: IL::C O++ ID G:6A E>8IJG:H (3.95 ± 0.67 μ O) 6C9 I=6I ID 8DBEA: I:AN 6B7><JDJH R<JG:H (2.69 ± 0.61 μ O) L6H DCAN B6G-<>C6ANN H><C>>86CI 4I(15) = 2.10, p = 0.053, CD=: C'H d = 0.495. =: G:HJAIH H=DL: 9 I=6I I=: E6: ;:G:C8: D; O++ ID ;68: >B6<: GN JC9:G I=: 6B= 7><JDJH-R<JG: 8DC9>I>DC L6H H>B>A6G ID I=: E6: ;:G:C8: D; O++ ID G:6A-R<-JG: HI>BJA> JC9:G I=: G: 6A-E>8IJG: 8DC9>I>DC.

!DG I=: O++ 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) *OA D; E: 6@-ID-E: 6@ 6BEA>IJ9: G: K: 6A: 9 6 H><C>;>86CI B6>C : ;;: 8I D; HI>BJ-AJH INE: 4! (1, 15) = 22.57, p < 0.001, $\eta p^2 = 0.605$, 6 H>C>;>86C1 B6>C HI>BJAJH-D7?: 81 : ;;: 81 D; 8DC9>I>DC 4! (1, (15) = 11.89 $p = 0.004, \eta p^{12} = 0.445, 6C9.6 \text{ H} < C > > 86C1 \text{ ILD-L6N} > C1: G681 > DC.7: \text{IL}::C$ I=: ILD ;68IDGH 4! (1, 15) = 5.52, p = 0.033, $\eta p^{2} = 0.275$. !DG 8DB-EA: I: AN 6B7><JDJH R<JG: H, I=: E: 6@-ID-E: 6@ 6BEA>IJ9: D; O++ JC9: G :68: >B6<:GN (5.47 ± 0.62 µO) L6H H><C>;>86CIAN A66<: G I=6C I=6I JC9: G =DJH: >B6<: GN (4.83 \pm 0.50 μ O) 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 O++ (8.17 \pm 0.78 μ O) I=6C G: 6A-=DJH: E>8IJG: 9>9 (5.96 \pm 0.56 μ O) 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 \pm 0.70 μ O) L6H H><-C>:>86CIAN A6G<: G I=6C I=6I ;DG 8DBEA: I:AN 6B7><JDJH R<JG: H (0.64 \pm 0.28 μ O) 4I(14) = 2.35, p = 0.033, CD=: C'H d = 0.745. .=: G:-HJAIH D; E: 6@-ID-E: 6@-6BEA>IJ9: 9616 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-O++ 6B-EA>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 : MHIH >C I=: ILD , + 8DBEDC: CIH,) 170 6C9 O++. . =: 6>B D; I=: EG: H: CI HIJ9N L6H ID : M6B>C: L=: I=: G 6 EG: ;-: G: C8: D;) 170 6C97 200. 854 Td(:. 1 671. 48 322. 484 T90E0A0E0E08> Tj2< $\label{eq:states} \begin{array}{l} $I = 6H \ 7:: C \ @CDLC \ I = 6I \) \ 170 \ B6>CAN \ G: S: 8IH \ I =: : 6GAN \ 6C9 \ 6J \ IDB6I>8 \\ HIGJ8IJG6A : C8D9>C< \ HI6<: H \ >C \ ;68: \ EGD8: \ HH>C< (B: CI>C \ \& \ D: DJ: M, \ 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 \ CCAN \ L=: C \ 7DIIDB-JE \ ;68: \ H><C6AH \ GG \ 77: \ 8I \\ H><C6AH \ 6G: \ 6K6>A67A: , \ HJ8= \ 6H \ L=: C \ LDG@>C< \ B: BDGN \ D; \ 6 \ G: 6A \ ;68: \ >B-6<: \ >H \ L: \ AB \ B6>CI6>C: 9 \ (-G: \ C>K6HCC: \ I \ 6A, \ 2007) \ DG \end{array}$

CD>H: ;

37652633 : 32 が 16.68 兆(156) 〒11月1月4月931950 1841 F3272632 333 2 X&(11世) (心形1) FBME F57K07520 F34 53942313 P3437C64(& T26) いてきひれてかかわり 555K16859 2 P3 3 75 X 4 (3)

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