

... a a c a . F b a ,
 c a a a d d a a c c a d
 a a c a a -
 ab a d , a ac a cc
 d c a c d (c - -) -
 a a a c d (c - -
 c) (Sc a., 2004; Sc a d McG a ,
 2013), a c ca a b
 c c c a a a .
 P c a c d c
 d ac a a
 a ca c d c
 (G a a d G d, 2003; B a a d L , 2005). Pa-
 c a , c c c a a
 a d c ab a , ca a-
 a a (L a., 2004; R a., 2007; W
 a., 2012, 2013, 2017a,b; Z
 a., 2016). F
 a , b - d a a d c c a
 c c a a a c d
 a c c a c a c a
 a , a c a a - a - c a -
 d (W a., 2012, 2013, 2017a,b; Z
 a., 2016). U da , ba b a d
 c c a- a d a a a ab
 a c c a a c a a
 a a . T , a -
 a a a a d a a ab
 a a a a d a a c -
 - d c d FC STG d c - -
 c a .
 T c c d c c a - a
 c d a , ca
 a c a/c c a a ab ac a
 c a a b c c a d
 a c c a a c . O
 a c c d c c- d c d c d
 a a a (PSS) b a c a d
 a c (F a a., 1999; L a., 2004;
 W a., 2005; Ra d a., 2006; H a a., 2008;
 Z a., 2016). Z a. (2016) a c
 d a c a d c d a a c -
 ca (PSC) c d (a c
 a d a c a c d a ca
 ba a d c d c c), d c-
 c d c d a a a a-
 (b a a c a d a c),
 c a a c a a c
 a , d c a c d ac a
 a a b (SPL), c , a c a c -
 , a a dd a , a d a a
 a . l c a FC STG
 c ca d c
 a a a a a .
 T d a d d c c -
 - d c d FC STG d a a
 c a c d b a
 a d c a. M c ca ,
 a c ca ac (PPI) a a
 (McLa a., 2012) d d FC
 STG a ca d a - c a a
 c a a a d

c a, c d
 PSS PSC b a c a d a
 c a d c d (Z a., 2016).

EXPERIMENTAL PROCEDURES

Participants

Pa c a c a (a a a
 Ma da C), da d S c d
 C ca l DSM-IV (SCID-DSM-IV, F a.,
 1997), c d A a d B a H a
 G a M dca U (G a H a H -
 a). S a a c a c d d
 d ad c b d d a , b a c d -
 d c , a d/ c d a a c d a
 (. . , a a a c c -
 a (ECT) a , a a-
 d d c d a d
 a 6 /da , a d/ a a a 18
 d a 59) (Z a., 2016).
 D a ca ac d a a c a (. . ,
 a c) c d c
 a d a c c a d
 (W a., 2012, 2013, 2017a,b; Z
 a., 2016). T d a d
 a d d a d
 SCID-DSM-IV a d a a c a .
 N c d a c ad a
 A l c a c d d a d db DSM-IV.
 T - a a d 18 a c
 a c a d d . T a a c a a d 1
 a -c a c a c d d da a
 a a d c ad (a
 a 3 a a a d/ 3° a). T
 a a c a a d 4 a a c a
 c d d d a c
 b - . T a 20 a (9 a a d
 11 a , a d 32 9.8 a) a d 16 c (8
 a a d 8 a , a d 30.3 9.1 a)
 c d d MRI da a a a (Tab 1). A a c a
 - a d d a - a
 d a ac a (<30 dB H a L) a
 c b 125 a d 8000 H . A
 a c a ad Ma da C a
 a a . A a a c a c ca
 ab d a c a , a d c d
 a c c dca d d
 a a c a a 605 /da
 ba d c ac d c b d b W d
 (2003). S a a c a c db d-
 a ba d d c ' ad c
 .
 T ca a da d P a d
 N a S d Sca (PANSS) (S a.,
 2004) a c d c d da MRI ca
 a a c a . Pa , a ' a a (a
 c a ' a c a d) a d a
 a c a a d c a c-
 a d . T c d d
 a db l d d E c C (IEC)
 G a H a H a .

Table 1. C a a c c a c a c a a d a c

| C a a c c | Sc (= 20) | H a C (= 16) |
|---------------|--------------|---------------|
| A (a SD) | 32.0 (9.8) | 30.3 (9.1) |
| Ma % | 55.00 (11) | 50.00 (8) |
| Ed ca (a SD) | 13.05 (3.07) | 14.56 (2.80) |
| MID (a SD) | 7.75 (6.39) | NA |
| PANSS | 53.65 (6.51) | NA |
| P- ca | 14.50 (5.28) | NA |
| N- ca | 11.25 (4.30) | NA |
| G- ca | 27.75 (3.84) | NA |
| Da c b | N | |
| Pa a d | 9 | |
| N - a a d | 11 | |
| T ca | 10 | |
| A ca | 17 | |
| T ca/a ca | 7 | |
| C a | M a :605.38 | |
| a | SD:365.00 | |
| | Ra :200 | |
| | 1600 | |

SD: a da d d a ; PANSS: a d a d ca ; MID: a d a ; NA: a cab . N a 7 a c d 2 d - a c c .

Speech stimuli

T c : a c
 a d a c . Ta - c
 C d c a d 2 ab . T a - c
 c b a a a (Ta A).
 T ac ca d a b a ca
 a (Ya a., 2007; Z a., 2016). T
 c a a a47- d a c b d c -
 c d C c)
 (d d d a a a c) ,
 c b a a
 (a Ta B a d C, Z a., 2016).
 A c a d a c d
 ad- a d a c (HRTF) a
 a d a a a d cc d -
 d c d . T c a a
 c d HRTF a c
 ca a 90 d a d 90 d
 a , c (d a
 Z a., 2016). B PSS a d PSC c a
 c ba d a d c c
 (F .1; a L a., 2004). U d PSC c d ,
 a a c a d a a c
 c d a c a d a
 a d a c a c d ab a d
 b a a c . U d PSS c d , b
 a a c a d a a c
 , ad a a c a a d
 a a a (F .1).
 Ac c c d a
 a c a c -c a b a c ad
 (SAMRTEC, G a , C a) d b

Perceived Spatial Separation

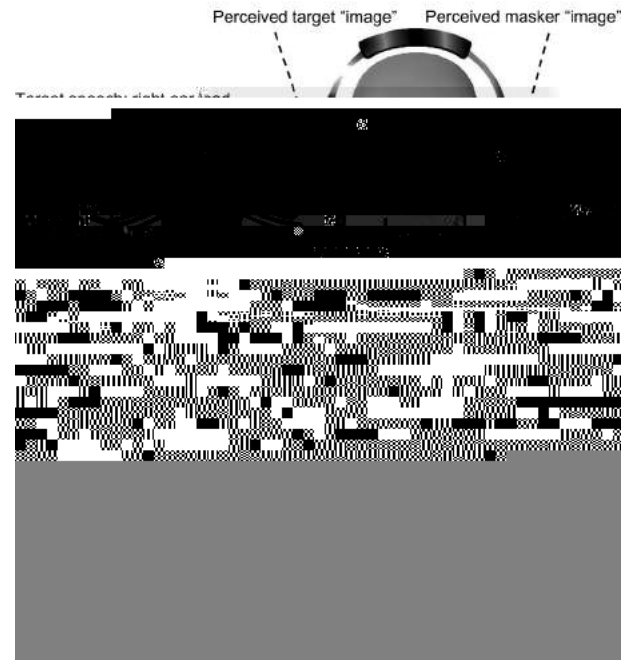


Fig. 1. Ba d b a d c d c - c a ad a d ad- a d a c (HRTF), a c a d a c a a a a d " d a d b ac - c a 3 . F a , d c d a a a a (PSS) c d (a) , a a d d ad d a ad b 3 , a d a d a ad d b 3 , d ad a d b d a ad d a a c d a c ca a d c a d a a a c d a c ca . A , d c d a a c - ca (PSC) c d (a) , b a da d a a a d ad ad a d b d ad b 3 , ad a c a d a d " a a d a c a a " a a c a ca .

P a a (V 0.70). T a d- a) a 90 dB SPL (b a a b a - - a a (SMR) a a -4 dB.

Imaging acquisition

MRI ca a d a 3.0-T a P Ac a MRI ca (V 4 6, 5680 DA B , N a d) a G a B a H a MRI Fac . B d- - -d d (BOLD) ad c - a a a (64 × 64 × 33 a 3.44 × 3.44 × 4.6 3 a a , ac = 2000 , a = 9000 , c = 30 , a = 90° , d = 211 × 211 2) ac d. A T1- d c a a (256 × 256 × 188 a a a 1 × 1 × 1 3, = 8.2 , c = 3.8 , a = 7°) a b b a d.

Design and procedures

T ca c c d a 8-
 ca a ad c , 2 d ca 10-
 c a ca a c d ca
 a a a c a d a 8- c -
 ca . A - a d MRI d a d
 c a .
 A a 61 ac d ac
 a c a ca ca a
 a d c . T a c 0
 a a d a a d c ()
 d a a 500 a ca a .
 l a ca a - c c d ,
 c a d 800 a
 a ca a . T d a c d
 a 3200 (F . 2). l a d -c - ca
 a , a c c d c
 c d a d 30 a c c d c
 c d , 1 d a a b
 (c a d ca d d a a).
 T 61 ca a ac 2
 c a a d a a b a d a
 b (c d d da a a a) ac
 a d 60 a a (20 a ac
 3 c d : PSS, PSC, a d ba a)
 (F . 2). T ba - a c d c a d
 a c . F a d d a a c a ,
 60 a ac 3 c d d
 a a d d . Ac 2 c a ca ,
 120 a ac d a d c d d da a
 a a ac a c a . F a
 c c d ac c d .
 T a - a c (Ha a., 1999)
 a d a d c ac
 a da a c c : S c d
 d d ca b
 cc ca (F . 2). l ac a d
 c a d 4100
 ca , a
 d a c d b c -
 a d ca d (W d a.,
 2012).
 l a ca a PSS PSC
 c d (F . 2), -a a a d
 800 a a ca a . Ab 1
 a , a c a d . T a a
 c a d a . l a ca a
 ba c d , a ()
 a a) a d 800 a a
 ca a a d a 4200 . T a a
 a c a 'a a c , a c a
 c d b a
 b c (a a d)
 b b d d .
 A a c a c d MR a
 ca . A b a a c d c d a
 a c a d d c a d
 c d c b - . S c
 c d a d
 a ca .

fMRI data preprocessing

A MRI da a c d a d a a d
 S a ca Pa a c Ma (SPM8, W c
 T C N a , L d , UK). F c a
 a c d c d a
 (c c ad) , c - a
 a a ca a , a da d M a
 N ca l (MNI) ac (- a a
 3.0 × 3.0 × 4.0³), a d a a
 a Ga a 8- - d
 a a a (FWHM). N c a d
 d TR a - a a ad .
 A d a d a ca
 a a SPM8. A , a d
 d a ac d d a
 G a L a M d (GLM) acc d c d
 . F ca a d
 c , c d (c a , c)
 c d d d d ca ca
 d a c c (HRF). A c d
 , c a a ' c > c'
 - a a ac a c a d
 c d - - a a
 c a d a a a , a d
 a a c a (c a d a
 d). T a a a
 a ca ca a a a 0.05
 [-ba d a - (FWE) c c d,
 ac a a a 10 c].
 T c d a d d d d a
 (a a , c - ca , a d a)
 c d d d . S a a a
 c d d acc d a -
 a d c , a d a - d ac c -
 0.5 a d (P a., 2012).

Generalized psychophysiological interaction (gPPI) analyses

T P c ca ac (PPI) a a
 (F a., 1997) a d a FC
 b a d a d b a d
 a d a c ca a ab (. . a c d -
). G a d PPI (PPI, //b a a . c. d /
 PPI), c c d a a ca acc da
 a a c d a PPI d
 b a a ca d a d d
 c a d c a PPI d (McLa a.,
 2012).
 l d , PPI a a d d
 c b a ca FC d
 ac d (. . , STG) a d (1)
 PSS c d PSC c d , (2) PSS
 c d a - c d , a d (3)
 PSC c d a - c d ,
 c . B d- - -d d (BOLD)
 a ac d d a d
 d c d . T PPI a ab a c a d b

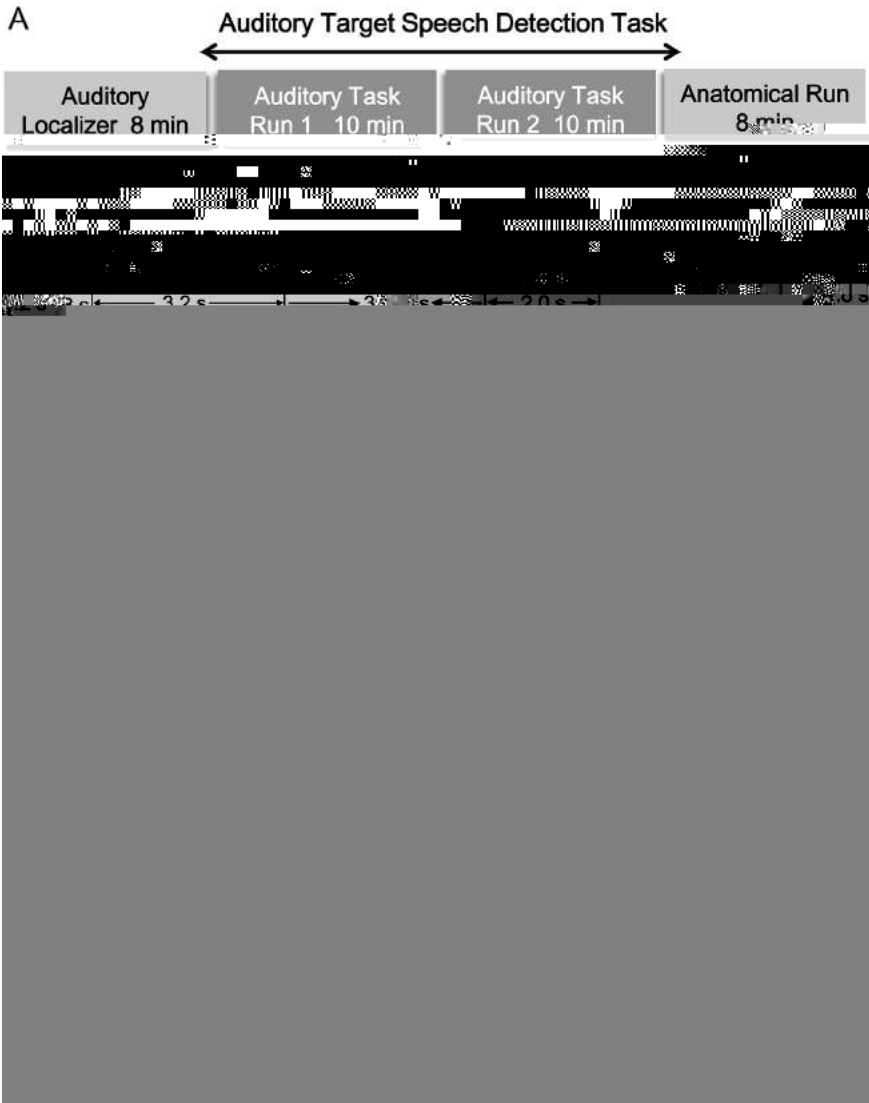


Fig. 2. fMRI results for the Auditory Target Speech Detection Task. (A) Task design showing the sequence of runs: Auditory Localizer (8 min), Auditory Task Run 1 (10 min), Auditory Task Run 2 (10 min), and Anatomical Run (8 min). (B) Brain scan showing significant activation in the Superior Temporal Gyrus (STG) for the PSS > PSC comparison. The MNI coordinates for the STG cluster are: (1) STG (x, y, z) = (-42, -25, 6), t = 10.96; (2) STG (x, y, z) = (-54, -1, -6), t = 11.98; (3) STG (x, y, z) = (-48, -16, 2), t = 14.31; (4) STG (x, y, z) = (54, -13, -2), t = 9.34; (5) STG (x, y, z) = (60, -10, -2), t = 11.68; (6) STG (x, y, z) = (54, -13, -2), t = 14.48. The results are significant at $p < 0.05$ FWE corrected (CDT) and $p < 0.001$ uncorrected.

STG ba d
 d da a ac a c a ,
 a a d
 d ac a c a a d
 c a ab
 b a c a .
 F - a a ,
 ac a c a , a a a PPI
 d a a d ac d.
 T PPI a d
 : a
 c d , d, a d
 d x c d
 ac . T ba d ac
 a ab a c d
 ca ca d a c
 c (HRF) a ca
 BOLD (Z a a., 2016).
 O add a c c
 c c b -
 a c d d GLM ac a -
 c a b ca
 c a ad c
 c c - a c
 d c a a c
 (75.6% a c a d
 65.8% c a,
 Z a., 2016). T c a
 PSS > PSC a c a d ac
 PPI d c d a d
 b b ac PPI ac
 PSC c d
 ac PSS
 c d . S a , c a
 PSS > a - a ba d
 ac PPI d c d
 a d b b ac PPI
 ac a -
 c d ac
 PSS c d , a d
 PSS > a -
 c a PSC > a -
 a ba d ac PPI d
 c d a d b b ac -
 PPI ac
 a c d ac
 PSC c d .
 F c d - a a ,
 d d a c a a , c c d c
 PPI b d a d ba a a ,
 b b c d - a
 ac a c a d ba
 a a c - a a ac d
 a a (1) PSS c d
 PSC c d , (2) PSS c d a -
 c d , a d (3) PSC c d
 a - c d , c . T d d a
 a c a ' c a a d
 c d - - a c a .
 A d a < 0.05 FWE c c d
 c a c -d d (CDT)
 < 0.001, c c d.

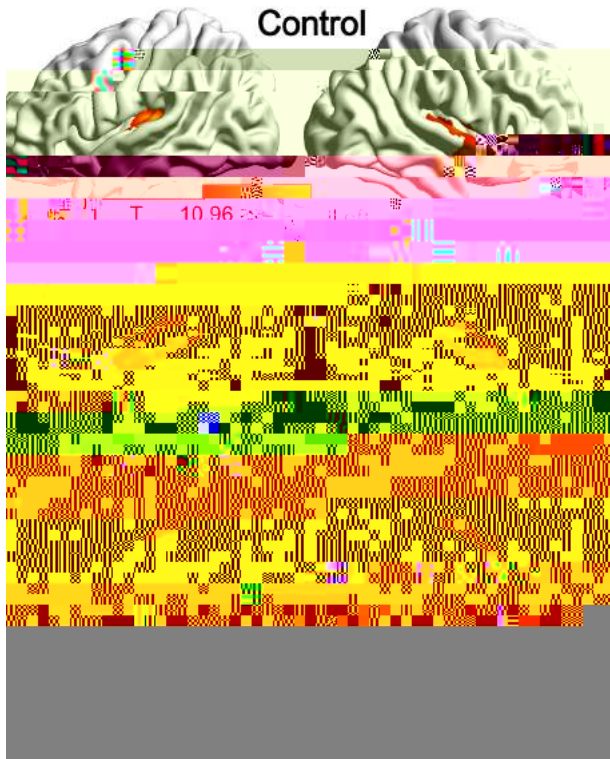


Fig. 3. Brain connectivity maps for Control participants. The top part shows two lateral views of a brain with colored regions. Below is a large connectivity matrix heatmap with a color scale from blue (low) to red (high).

N ... a da a a d ... a c PSS
 a - c c a a c a
 a b d d (Z a., 2016). T
 c d ad c FC STG d
 a - c a a a a c
 a

RESULTS

Functional connectivity of the STG in healthy participants and participants with schizophrenia

F c a PSS c d a a a -
 c d , a c d FC STG a
 = -30, -37, 62 = 6.06), c a (, ,
 = 6, -64, 46 = 5.69) a d a a
 b (, , = -18, -70, 50 = 5.04) (
 a F . 4A). E a c d FC STG a
 b d a a b (IPL; , ,
 = -30, -40, 30 = 6.55) (a
 F . 4A). l a c a c a ,
 ca c a FC STG STG

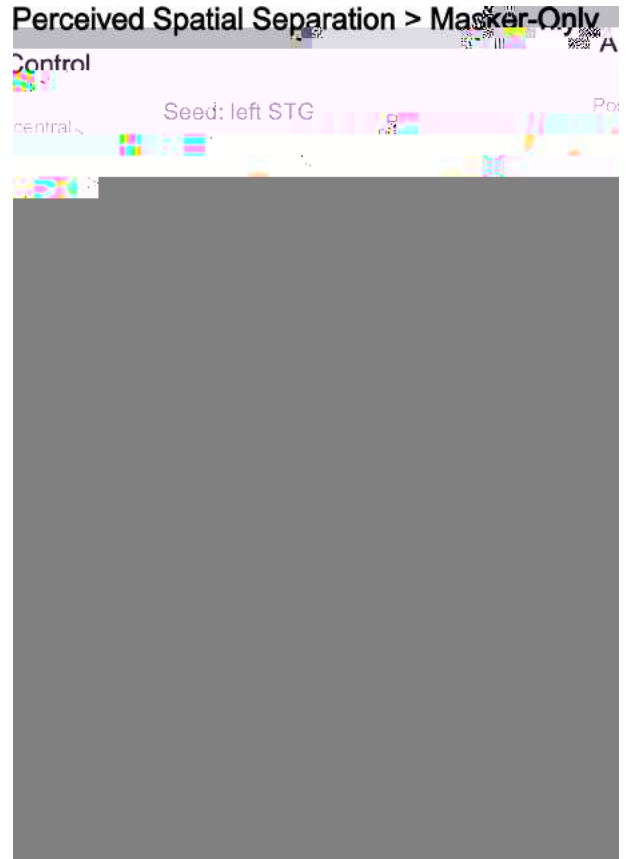
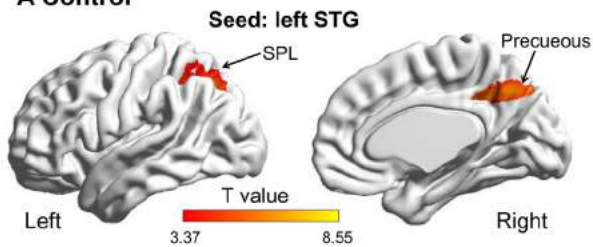


Fig. 4. Brain connectivity maps for Perceived Spatial Separation > Masker-Only. The top part shows two lateral views of a brain with colored regions. Below is a large connectivity matrix heatmap with a color scale from blue (low) to red (high).

b d a d < 0.05 (c -
 FWE c c d).
 F c a PSC c d a a
 a - c d , a c d FC STG
 a a c a a b d
 a a b (, , = -18, -64, 42 = 8.55)
 a d c (, , = 18, -61, 42
 = 7.73) (F . 5A). N ca a c d FC
 STG a b d. l a c a
 c a, ca a c d FC STG
 a b d dd a (MFG; ,
 = -30, 2, 34 = 5.41) (a
 F . 5B), a d a c d FC STG a
 b d MCC (, , = -12, 11, 42
 = 7.56), c a a
 (O IFG; , , = 48, 14, 14 = 6.92), a d
 a ac a b (, , = 9, -28, 70 = 6.61)
 (a F . 5B).
 F c a PSS c d a a PSC
 c d , ca a c d d c d FC
 STG a b d a

Perceived Spatial Co-location > Masker-Only

A Control



B Patient

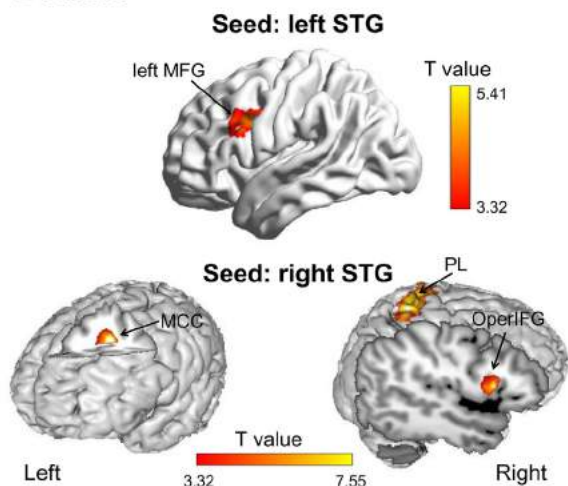


Fig. 5. P c ca ac (PPI) a a c a c c (STG) a ca d c a " c d a a c - ca > a - c a B. a c d (a A) a d c a (a B). Ac - d = 3.31 d (CDT) = 0.001 (= 3.37 a d = 0.05 a d. T a a ad a B a N V a d Ma S a . MFG = dd a ; O IFG = c a a ; PL = a ac a b ; SPL = a a b ; STG = a

a c a a d a c a c a (a d < 0.001, c c d), a FC STG a d a c c a a a a - c

Difference in functional connectivity of the STG between healthy participants and participants with schizophrenia

T d c c a b a c a d a c a c a d a (1) c a PSS c d a a a a - c d , STG b d d c d FC b a a c (c : , , = -9, -64, 46 = 4.36; c : , , = 6, -64, 46 = 4.40), SPL (, , = 15, -58, 66 = 4.32), a d a a (SMA; , , = 6, -28, 54 = 4.18) a c a c a a a a

a c a ; (2) c a PSC c d a a a - c d , STG b d d c d FC b a a c (c : , , = -9, -67, 42 = 4.61; c : , , = 12, -58, 42 = 4.77) a d SPL (, , = 21, -61, 54 = 4.58) a c a c a a a a a a c a . N a c d d c d FC STG a b d (F . 6).

DISCUSSION

P d a a c - d ac a STG a c d b d c a c , a STG d c c a a a - d c d d c (Sc a., 2004, 2009; Na a a., 2005; Sc a d McG a , 2013; D a., 2014; E a a., 2016). I a b a c - c a c d c c a - a c d (a a) (W a., 2012, 2013, 2017a,b; Z a., 2016). T d a d FC STG a - c d a a - a c d a T c a. a. PPI a a d c d a a a b d ca c a FC STG c a PSS c d a a PSS c d (a FC c c STG d a c d d PSC c d PSS c d), c a PSS c d PSS c d c d a a a - c d a d FC STG c a a a a a . PSS c d a a a - c d a d a c d FC STG c a c , SPL a d , a d a c d FC STG IPL. A , c a PSS c d a a a - c d a d a d a c d FC STG SPL a d (a a c a) a a SPL c ca a PSS c d a c c a a a a a (Z a., 2016). A , d a a d "c c a - a c d - , SPL d d c a a - c a a (H a d M , 2010), c a a (R a., 2009), a d a d ac a a c c - d ac b a a d d ac (P a a., 2003; K a., 2007; Z a., 2016). M , c d c ac a a ca a d d c (Z d a., 2013), a d IPL d - a

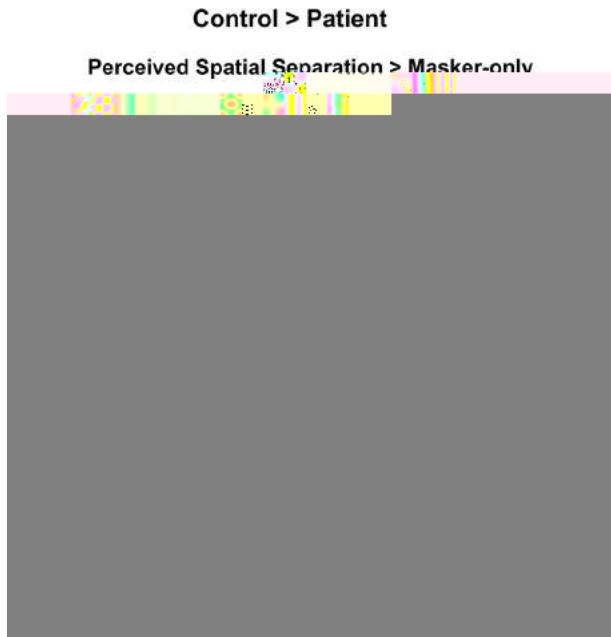


Fig. 6. D c PPI a a c a c c a. T
 STG b a c a d c c a. T
 a a d a d -a a c a a .Ac -
 d (CDT) = 0.001 (= 3.82
 "PSS > a - c d a d = 3.35 "PSC > a -
 - c d) a d a FWE-c c d = 0.05 a
 d. SMA = a a a; SPL = a a
 b .
 d c c (Ca a a., 2004; W a d
 lac b , 2006; D a., 2014). T , FC STG
 a a a a (SPL, c , a d IPL) a a
 ac a c a a a a
 c a b a a c c d-
 d c a a c a a , c
 a a a b , a d ac ,
 d ca a , a d - ac d
 c c .
 l , d , a c a c a ,
 , b d c c FC a
 STG. E a c d FC STG a b d
 MCC, O IFG, a d a ac a b .
 N a , b a a a d c
 c , d c , c ,
 a c , a d (V a
 a., 2001; Ca a a., 2007; S ac a a.,
 2011; Z a a., 2011; A a., 2013). M
 d a , a , MCC ac a d d a a
 c a c d c c ,
 d c , c a d a c
 (S ac a a., 2011; A a., 2013). T
 IFG d d c c
 (V a a., 2001) b a c d c
 c d ca d c (Ca a a., 2007). T ,
 a c a- a d a
 FC STG c a c a- a d c -
 a a c a a a -
 a (. ., SPL a d c , Z a.,
 2016). Ob , c a- d c d c -
 a a c c a a
 c c a a a a a . T

c a c a c ca d
 c a (Ta a., 2007) a a
 a d d a .
 N ab , c a d a ,
 c a b ca d c d FC
 STG a a (SPL/ c) a d SMA
 d a - c a a a a
 a . A d ab , FC STG
 a a a a c d SPL a d c ac a
 c a a a a c a
 a a b a d c a
 a c a a , c a a a b , a d
 a d ac . T SMA a a
 a , a , c a d c
 c (Nac a., 2008; P c , 2012).
 T , d c d FC STG c , SPL, a d
 SMA a b a d a c
 a - c d ca a a c a
 c a d d c a -
 c d ca a , a -a ,
 a , a d c .
 l a , d a FC STG
 a a a a (c d SPL a d c)
 a d a c a a
 a a c a b a
 a , a c a d ca , a d
 a c c . T c a-
 a ca d a FC STG MCC,
 O IFG, a d a ac a b a c
 c a- a d a c a a a .
 T d c d FC STG a a a a
 c a d ab a a c a .
 A N
 N F C (81671334, 81601168,
 31170985), P P G -
 (2014 2-00105), G M K D
 M G B H (GBH2014- D06,
 GBH2014-QN04), C N K C P
 P G B H (201201004), B
 M & C (161100002616017),
 (2016 90050). P F P

REFERENCES

A MA, L c d PL, Ba JH (2013) T
 dc a c ' d c . F
 N c 7:251.
 Bd a GM, D L (2015) B a a "c c a a :
 d cab a ac a d - c ba
 a b ca ba a ' c - -
 c d c . Ba La 143:32 41.
 Ba DL, L GA (2005) T ca
 d a d c ba
 c a. Da C N c 7:125 135.
 Ca a DE, J JA, Ca a AM, A a a -Ya ada R (2004)
 P c c a d ca b a - a d c d-
 a a a d a ac a ba d
 ac c c a d d
 a c a -a d / a d . N a
 22:1182 1194.

- Ca a M, M c A, E A, P c CJ (2007) B a ac a
ca d c a d ad a d: d a c ?
J C N c 19:433 444.
- D N, S JZ (2012) E c a c d a d
b c c a . P c Na Acad Sc
USA 109:11854 11859.
- D N, S JZ (2013) Ada a c d ad a
bac d- c ca a c . J
N c 33:5728 5735.
- D M, M F, H M (2014) F c a c a
c - - c a d a: a MRI d .
N c a 60:103 114.
- D Y, B c ba BR, G ad CL, A a C (2014) N d a
ac a ad ad c
. P c Na Acad Sc USA 111:7126 7131.
- E a S, Mc a C, A ZK, R S, Sc SK (2016) G
c c a a a d: a c c c . J
C N c 28:483 500.
- F MB, S RL, M a G, W a JBW (1997) S c d
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