

# Leader–follower behavioural coordination and neural synchronization during intergroup conflict

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## Contents

Supplementary Table 1.....	2
Supplementary Table 2.....	4
Supplementary Table 3.....	5
Supplementary Table 4.....	6
Supplementary Table 5.....	8
Supplementary Table 6.....	10
Supplementary Table 7.....	12
Supplementary Table 8.....	13

**Supplementary Table 1 | Matched demographic and social-related traits among four conditions.**

**a. Behavioral data analysis sample ( $N = 88$  sessions)**

Measurement	Defender		Attacker		Role	Leader	Interaction
	Leader	Follower	Leader	Follower			
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)			
<b>● Demographic information</b>							
Sex ( $N_{male}$ vs. $N_{female}$ )	40 vs. 48		40 vs. 48		-	-	-
Age (year)	22.091 (0.293)	22.091 (0.211)	21.830 (0.295)	22.170 (0.197)	0.711	0.392	0.501
Education year	17.080 (0.192)	17.011 (0.118)	16.802 (0.205)	16.983 (0.130)	0.329	0.591	0.468
<b>● Psychological information</b>							
Social value orientation	25.334 (1.463)	25.595 (1.027)	25.479 (1.444)	27.322 (0.972)	0.478	0.362	0.550
Prosocial personality	3.265 (0.046)	3.346 (0.041)	3.290 (0.050)	3.303 (0.034)	0.824	0.249	0.452
Justice sensitivity	2.776 (0.066)	2.687 (0.055)	2.671 (0.075)	2.805 (0.047)	0.905	0.713	0.086
Preference of social hierarchy	4.460 (0.062)	4.403 (0.044)	4.497 (0.062)	4.423 (0.045)	0.628	0.184	0.875
Collectivism	5.134 (0.068)	5.118 (0.045)	5.098 (0.070)	5.119 (0.054)	0.767	0.965	0.756
Individualism	5.024 (0.073)	5.028 (0.056)	5.152 (0.073)	4.997 (0.053)	0.427	0.231	0.278
Life satisfaction	3.173 (0.126)	3.209 (0.08)	3.28 (0.126)	3.202 (0.088)	0.599	0.854	0.608

**b. Neural data analysis sample ( $N = 80$  sessions)**

Measurement	Defender		Attacker		Role	Leader	Interaction
	Leader	Follower	Leader	Follower			
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)			
<b>● Demographic information</b>							
Sex ( $N_{male}$ vs. $N_{female}$ )	36 vs. 44		36 vs. 44		-	-	-
Age (year)	22.05 (0.314)	22.025 (0.207)	21.725 (0.319)	22.194 (0.212)	0.760	0.295	0.368
Education year	17.075 (0.205)	17.025 (0.120)	16.775 (0.219)	16.931 (0.134)	0.203	0.748	0.582
<b>● Psychological information</b>							
Social value orientation	24.529 (1.546)	25.456 (1.103)	25.393 (1.520)	27.125 (1.009)	0.371	0.278	0.768
Prosocial personality	3.254 (0.050)	3.314 (0.042)	3.297 (0.053)	3.297 (0.036)	0.765	0.492	0.526
Justice sensitivity	2.782 (0.069)	2.689 (0.059)	2.703 (0.079)	2.808 (0.050)	0.754	0.924	0.145
Preference of social hierarchy	4.452 (0.066)	4.412 (0.047)	4.520 (0.060)	4.434 (0.047)	0.456	0.218	0.671
Collectivism	5.119 (0.073)	5.118 (0.049)	5.077 (0.073)	5.120 (0.057)	0.763	0.732	0.734
Individualism	5.016 (0.077)	5.026 (0.057)	5.145 (0.077)	4.996 (0.057)	0.443	0.298	0.294
Life satisfaction	3.198 (0.132)	3.209 (0.087)	3.327 (0.127)	3.176 (0.093)	0.633	0.534	0.486

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Note: We conducted a 2 (role: attacker vs. defender) × 2 (leader: leader vs. follower) repeated measures ANOVAs on the demographic information and social-related traits. Social value orientation was measured by the 6 primary items of the Social value orientation Slider task<sup>1</sup>. Prosocial personality was measured by the Social Responsibility, Other-Oriented Moral Reasoning, and Mutual Concerns Moral Reasoning sub-scales of Prosocial Personality Battery<sup>2</sup>, which consists of 13 items on a 5-point (1-5) Likert scale (higher values reflecting more pro-social of an individual). Justice sensitivity was measured using Justice Sensitivity Inventory<sup>3</sup>, which consists of 40 items on 6-point (0-5) Likert scale (higher values reflecting more sensitive to justice). Individual's preference for social hierarchy was measured using Social Dominance Orientation (SDO) scale<sup>4</sup>, which consists of 16 items on 7-point (1-7) Likert scale (higher values reflected stronger preference for inequality among social groups). Cultural orientation was measured using the sub-scales of the Individualism-Collectivism Scale<sup>5</sup>, which separately consists of 12 items on 7-point (1-7) Likert scale (higher values reflecting stronger collectivism or individualism). Life satisfaction was measured using the Satisfaction with Life Scale, which consists of 5 items on a 7-point (1-7) Likert scale (higher scores reflecting more satisfied with life)<sup>6</sup>.

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2. Penner LA. Dispositional and organizational influences on sustained volunteerism: An interactionist perspective. *J. Soc. Issues* **58**, 447-467 (2002).
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5. Singelis, T. M. & Brown, W. J. Culture, self, and collectivist communication: linking culture to individual behavior. *Hum. Commun. Res.* **21**, 354-389 (1995).
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**Supplementary Table 2 | Payoff matrix of one-round inter-group contest game.**

Role	Leader	Initial endowment (MU)	Individual contribution (x/y)	Group pool (G)	Payment	
					Defender win $G_d \geq G_a$	Defender lose $G_d < G_a$
<i>Defend</i>	<i>D-leader</i>	20	$x_{leader}$	$G_d = x_{leader} + x_{follower1} + x_{follower2}$	$20 - x_{leader}$	0
	<i>D-follower1</i>	20	$x_{follower1}$		$20 - x_{follower1}$	0
	<i>D-follower2</i>	20	$x_{follower2}$		$20 - x_{follower2}$	0
<i>Attack</i>	<i>A-leader</i>	20	$y_{leader}$	$G_a = y_{leader} + y_{follower1} + y_{follower2}$	$20 - y_{leader}$	$(20 - y_{leader}) + (60 - G_d)/3$
	<i>A-follower1</i>	20	$y_{follower1}$		$20 - y_{follower1}$	$(20 - y_{follower1}) + (60 - G_d)/3$
	<i>A-follower2</i>	20	$y_{follower2}$		$20 - y_{follower2}$	$(20 - y_{follower2}) + (60 - G_d)/3$

**Note:** For each inter-group contest round, each individual received an initial endowment of 20 MUs (Monetary Units). Members of attack(defend) could each contribute  $x$  ( $y$ ) out of 20. Each individual decided the amount to the group's pool  $G$  ( $0 \leq G \leq 60$ ). When  $G_d \geq G_a$ , defender group would survive from attacking and the members of both groups would earn what remained from their endowment. When  $G_d < G_a$ , defender group failed defending and left with 0. Attacker group won and took away defender group's remaining MUs ( $60 - G_d$ ), which were divided equally among members of attacker group and added to their remaining endowment.

**Supplementary Table 3 | Full statistical reports of the increased neural synchronization during intergroup contest than resting-state.**

Channel	Mean (SE)	<i>t</i>	<i>p</i>	FDR-corrected <i>p</i>	<i>Cohen's d</i>
<b>rDLPFC</b>					
2	-0.010 (0.007)	-1.420	0.159	0.297	-0.159
<b>5</b>	0.020 (0.007)	2.819	0.006	<b>0.021</b>	0.315
<b>6</b>	0.026 (0.008)	3.404	$1.044 \times 10^{-3}$	<b>0.005</b>	0.381
<b>8</b>	0.034 (0.008)	4.149	$8.365 \times 10^{-5}$	<b>1.171×10<sup>-3</sup></b>	0.464
<b>11</b>	0.030 (0.009)	3.465	$8.596 \times 10^{-4}$	<b>0.005</b>	0.387
12	0.005 (0.007)	0.689	0.493	0.627	0.077
14	-0.004 (0.008)	-0.489	0.626	0.675	-0.055
<b>rTPJ</b>					
1	0.010 (0.007)	1.445	0.153	0.297	0.162
3	0.004 (0.007)	0.497	0.621	0.675	0.056
4	0.011 (0.007)	1.512	0.135	0.297	0.169
7	0.009 (0.007)	1.310	0.194	0.302	0.146
9	0.006 (0.007)	0.873	0.385	0.540	0.098
10	-0.002 (0.007)	-0.290	0.773	0.773	-0.032
13	0.010 (0.008)	1.385	0.170	0.297	0.155

**Note:** We compared neural synchronization during intergroup contest and during resting-state for 14 channels using one sample t-test<sup>1</sup>. FDR-corrected *p*: *p*-value corrected for 14 channels showing mean difference. Channels and *p*-values in bold indicate effects survived FDR correction.

#### References

1. Cui, X., Bryant, D. M. & Reiss, A. L. NIRS-based hyperscanning reveals increased interpersonal coherence in superior frontal cortex during cooperation. *Neuroimage* **59**, 2430-2437 (2012).

**Supplementary Table 4 | Full statistical reports of neural synchronization in all 7 channels of the rDLPFC.**

**a. Descriptive statistic in each condition**

Channel	Conditions	Mean	SE	95% CI		
				Lower Bound	Upper Bound	
2	Defender	L-F pair	0.026	0.013	-0.001	0.052
		F-F pair	-0.008	0.019	-0.046	0.030
	Attacker	L-F pair	0.020	0.012	-0.004	0.045
		F-F pair	0.002	0.015	-0.027	0.031
5	Defender	L-F pair	0.068	0.012	0.044	0.092
		F-F pair	0.037	0.015	0.007	0.067
	Attacker	L-F pair	0.038	0.013	0.012	0.063
		F-F pair	0.030	0.017	-0.004	0.064
6	Defender	L-F pair	0.076	0.015	0.046	0.107
		F-F pair	0.039	0.016	0.006	0.071
	Attacker	L-F pair	0.033	0.012	0.009	0.057
		F-F pair	0.057	0.017	0.024	0.090
8	Defender	L-F pair	0.080	0.013	0.053	0.107
		F-F pair	0.073	0.017	0.039	0.107
	Attacker	L-F pair	0.045	0.015	0.016	0.074
		F-F pair	0.040	0.018	0.004	0.077
11	Defender	L-F pair	0.096	0.012	0.071	0.121
		F-F pair	0.025	0.017	-0.010	0.060
	Attacker	L-F pair	0.043	0.015	0.012	0.074
		F-F pair	0.041	0.018	0.005	0.077
12	Defender	L-F pair	0.041	0.012	0.016	0.065
		F-F pair	0.045	0.015	0.016	0.074
	Attacker	L-F pair	0.013	0.012	-0.011	0.038
		F-F pair	0.019	0.017	-0.015	0.053
14	Defender	L-F pair	0.034	0.013	0.008	0.060
		F-F pair	0.014	0.015	-0.015	0.043
	Attacker	L-F pair	0.014	0.015	-0.016	0.045
		F-F pair	0.004	0.016	-0.027	0.036

**b. Results of Leader × Role × Session-sex mixed-model ANOVAs**

Channel	Effect	<i>F</i>	<i>p</i>	$\eta^2$	FDR-corrected <i>p</i>	
2	Role	0.027	0.870	3.462×10 <sup>-4</sup>	0.870	
	Leader	2.510	0.117	0.031	0.273	
	Leader × Role	0.159	0.691	0.002	0.927	
	Interaction with session-sex					
	Role × Sex	2.047×10 <sup>-6</sup>	0.999	2.624×10 <sup>-8</sup>	0.999	
	Leader × Sex	1.168	0.283	0.015	0.495	
	Leader × Role × Sex	1.030	0.313	0.013	0.888	
5	Role	1.595	0.210	0.020	0.490	
	Leader	2.692	0.105	0.033	0.273	
	Leader × Role	0.547	0.462	0.007	0.927	
	Interaction with session-sex					
	Role × Sex	0.032	0.858	4.152×10 <sup>-4</sup>	0.999	

	Leader × Sex	1.706	0.195	0.021	0.455
	Leader × Role × Sex	0.004	0.951	4.798×10 <sup>-5</sup>	0.951
	Role	0.702	0.405	0.009	0.511
	Leader	0.094	0.760	0.001	0.760
	<b>Leader × Role</b>	6.613	0.012	0.078	<b>0.042</b>
6	Interaction with session-sex				
	Role × Sex	0.003	0.959	3.377×10 <sup>-5</sup>	0.999
	Leader × Sex	2.139	0.148	0.027	0.455
	Leader × Role × Sex	0.296	0.588	0.004	0.888
	Role	3.918	0.051	0.048	0.189
	Leader	0.113	0.738	0.001	0.760
	Leader × Role	0.015	0.904	1.894×10 <sup>-4</sup>	0.927
8	Interaction with session-sex				
	Role × Sex	0.383	0.538	0.005	0.999
	Leader × Sex	0.256	0.614	0.003	0.834
	Leader × Role × Sex	0.186	0.668	0.002	0.888
	Role	0.846	0.361	0.011	0.511
	Leader	6.566	0.012	0.078	0.084
	<b>Leader × Role</b>	7.312	0.008	0.086	<b>0.042</b>
11	Interaction with session-sex				
	Role × Sex	3.766	0.056	0.046	0.392
	Leader × Sex	0.098	0.756	0.001	0.834
	Leader × Role × Sex	4.591	0.035	0.056	0.245
	Role	3.821	0.054	0.047	0.189
	Leader	0.204	0.652	0.003	0.760
	Leader × Role	0.008	0.927	1.081×10 <sup>-4</sup>	0.927
12	Interaction with session-sex				
	Role × Sex	0.119	0.731	0.002	0.999
	Leader × Sex	2.147	0.147	0.027	0.455
	Leader × Role × Sex	0.227	0.635	0.003	0.888
	Role	0.607	0.438	0.008	0.511
	Leader	1.326	0.253	0.017	0.443
	Leader × Role	0.166	0.685	0.002	0.927
14	Interaction with session-sex				
	Role × Sex	0.917	0.341	0.012	0.999
	Leader × Sex	0.044	0.834	0.001	0.834
	Leader × Role × Sex	0.093	0.761	0.001	0.888

**Note:** FDR-corrected  $p$ :  $p$ -value corrected for the main effects and the interactions effects on INS in 7 channels in rDLPFC. Effects and  $p$ -values in bold indicate effects survived FDR correction.



**Supplementary Table 5 | Full statistical reports of neural activity in all 7 channels of the rDLPFC.**

**a. Descriptive statistic in each condition**

Channel	Measurement		Mean	SE	95% CI	
					Lower Bound	Upper Bound
2	Defender	Leader	0.113	0.036	0.041	0.185
		Follower	0.058	0.024	0.011	0.106
	Attacker	Leader	0.091	0.040	0.011	0.170
		Follower	0.099	0.025	0.049	0.148
5	Defender	Leader	0.285	0.039	0.207	0.363
		Follower	0.222	0.028	0.167	0.277
	Attacker	Leader	0.196	0.037	0.123	0.270
		Follower	0.223	0.031	0.162	0.284
6	Defender	Leader	0.338	0.045	0.248	0.428
		Follower	0.272	0.030	0.213	0.331
	Attacker	Leader	0.274	0.042	0.191	0.357
		Follower	0.268	0.030	0.209	0.328
8	Defender	Leader	0.438	0.048	0.343	0.534
		Follower	0.341	0.031	0.279	0.403
	Attacker	Leader	0.313	0.040	0.234	0.392
		Follower	0.318	0.032	0.255	0.381
11	Defender	Leader	0.409	0.049	0.311	0.507
		Follower	0.297	0.030	0.236	0.357
	Attacker	Leader	0.230	0.043	0.143	0.316
		Follower	0.301	0.035	0.232	0.371
12	Defender	Leader	0.341	0.047	0.247	0.434
		Follower	0.217	0.028	0.161	0.272
	Attacker	Leader	0.248	0.040	0.170	0.327
		Follower	0.268	0.026	0.216	0.321
14	Defender	Leader	0.186	0.049	0.089	0.284
		Follower	0.112	0.028	0.056	0.169
	Attacker	Leader	0.130	0.036	0.057	0.202
		Follower	0.142	0.029	0.085	0.199

**b. Results of Leader × Role × Session-sex mixed-model ANOVAs**

Channel	Effect	<i>F</i>	<i>p</i>	$\eta^2$	FDR-corrected <i>p</i>
2	Role	0.032	0.858	4.156×10 <sup>-4</sup>	0.858
	Leader	0.425	0.516	0.005	0.572
	Leader × Role	1.093	0.299	0.014	0.345
	Interaction with session-sex				
	Role × Sex	1.031	0.313	0.013	0.678
	Leader × Sex	0.274	0.602	0.003	0.851
	Leader × Role × Sex	0.342	0.560	0.004	0.903
5	Role	1.703	0.196	0.021	0.457
	Leader	0.348	0.557	0.004	0.572
	Leader × Role	2.245	0.138	0.028	0.242
	Interaction with session-sex				
	Role × Sex	0.077	0.782	0.001	0.925
Leader × Sex	1.442	0.233	0.018	0.851	

	Leader × Role × Sex	0.191	0.664	0.002	0.903
6	Role	0.974	0.327	0.012	0.572
	Leader	0.952	0.332	0.012	0.572
	Leader × Role	0.901	0.345	0.011	0.345
	Interaction with session-sex				
	Role × Sex	0.009	0.925	1.139×10 <sup>-4</sup>	0.925
	Leader × Sex	0.262	0.610	0.003	0.851
	Leader × Role × Sex	0.083	0.774	0.001	0.903
8	Role	4.126	0.046	0.050	0.160
	Leader	1.578	0.213	0.020	0.572
	Leader × Role	2.528	0.116	0.031	0.242
	Interaction with session-sex				
	Role × Sex	1.181	0.281	0.015	0.678
	Leader × Sex	0.120	0.730	0.002	0.851
	Leader × Role × Sex	0.095	0.758	0.001	0.903
11	Role	4.427	0.039	0.054	0.160
	Leader	0.321	0.572	0.004	0.572
	<b>Leader × Role</b>	7.883	0.006	0.092	<b>0.044</b>
	Interaction with session-sex				
	Role × Sex	0.755	0.388	0.010	0.678
	Leader × Sex	0.449	0.505	0.006	0.851
	Leader × Role × Sex	0.263	0.610	0.003	0.903
12	Role	0.394	0.532	0.005	0.742
	Leader	2.514	0.117	0.031	0.572
	Leader × Role	4.579	0.035	0.055	0.124
	Interaction with session-sex				
	Role × Sex	0.024	0.876	3.132×10 <sup>-4</sup>	0.925
	Leader × Sex	0.001	0.979	9.120×10 <sup>-6</sup>	0.979
	Leader × Role × Sex	4.971×10 <sup>-6</sup>	0.998	6.373×10 <sup>-8</sup>	0.998
14	Role	0.226	0.636	0.003	0.742
	Leader	1.076	0.303	0.014	0.572
	Leader × Role	1.894	0.173	0.024	0.242
	Interaction with session-sex				
	Role × Sex	0.827	0.366	0.010	0.678
	Leader × Sex	0.238	0.627	0.003	0.851
	Leader × Role × Sex	0.166	0.685	0.002	0.903

**Note:** FDR-corrected  $p$ :  $p$ -value corrected for the main effects and the interactions effects on neural activity in 7 channels in rDLPFC. Effects and  $p$ -values in bold indicate effects survived FDR correction.

**Supplementary Table 6 | Full statistical reports for the functional connectivity of rDLPFC-rTPJ**

**a. Descriptive statistics for grand mean functional connectivity (FC) of rDLPFC-rTPJ**

Measurement		Mean	SE	95% CI	
				Lower Bound	Upper Bound
Defender	Leader	0.534	0.016	0.501	0.566
	Follower	0.505	0.010	0.484	0.525
Attacker	Leader	0.549	0.017	0.515	0.584
	Follower	0.515	0.011	0.493	0.537

**b. Results of Leader × Role × Sex mixed-model ANOVA on the grand mean FC**

Effect	<i>F</i>	<i>p</i>	$\eta^2$
Role	1.062	0.306	0.013
Leader	7.065	9.533×10 <sup>-3</sup>	0.083
Leader × Role	0.023	0.880	2.957×10 <sup>-4</sup>
Interaction with session-sex			
Role × Sex	1.692	0.197	0.021
Leader × Sex	0.041	0.839	0.001
Leader × Role × Sex	0.121	0.729	0.002

**c. The leader effect on the channel-pair-wise functional connectivity of rDLPFC-rTPJ**

Channel pairs (rDLPFC-rTPJ)	<i>F</i>	<i>p</i>	$\eta^2$	FDR-corrected <i>p</i>
CH2 - CH1	0.027	0.869	3.504×10 <sup>-4</sup>	0.906
CH2 - CH3	0.034	0.855	4.314×10 <sup>-4</sup>	0.906
CH2 - CH4	0.158	0.692	0.002	0.808
CH2 - CH7	0.118	0.733	0.002	0.813
CH2 - CH9	1.343	0.250	0.017	0.364
CH2 - CH10	0.007	0.933	9.045×10 <sup>-4</sup>	0.933
CH2 - CH13	1.180	0.281	0.015	0.393
CH5 - CH1	0.359	0.551	0.005	0.692
CH5 - CH3	0.145	0.704	0.002	0.808
CH5 - CH4	4.598	0.035	0.056	0.087
CH5 - CH7	2.167	0.145	0.027	0.237
CH5 - CH9	3.428	0.068	0.042	0.133
CH5 - CH10	6.099	0.016	0.073	0.055
CH5 - CH13	4.569	0.036	0.055	0.087
CH6 - CH1	0.140	0.709	0.002	0.808
CH6 - CH3	0.192	0.662	0.002	0.808
CH6 - CH4	1.331	0.252	0.017	0.364
CH6 - CH7	1.575	0.213	0.020	0.326
CH6 - CH9	3.906	0.052	0.048	0.109
CH6 - CH10	3.851	0.053	0.047	0.109
CH6 - CH13	6.571	0.012	0.078	0.055

CH8 - CH1	5.010	0.028	0.060	0.087
CH8 - CH3	1.593	0.211	0.020	0.326
CH8 - CH4	6.301	0.014	0.075	0.055
<b>CH8 - CH7</b>	9.182	0.003	0.105	<b>0.041</b>
<b>CH8 - CH9</b>	8.105	0.006	0.094	<b>0.046</b>
<b>CH8 - CH10</b>	9.361	0.003	0.107	<b>0.041</b>
<b>CH8 - CH13</b>	12.243	$7.750 \times 10^{-4}$	0.136	<b>0.019</b>
CH11 - CH1	2.240	0.138	0.028	0.234
CH11 - CH3	0.430	0.514	0.005	0.681
CH11 - CH4	4.758	0.032	0.057	0.087
CH11 - CH7	4.976	0.029	0.060	0.087
CH11 - CH9	4.410	0.039	0.054	0.091
CH11 - CH10	7.531	0.008	0.088	0.053
CH11 - CH13	6.770	0.011	0.080	0.055
CH12 - CH1	4.850	0.031	0.059	0.087
CH12 - CH3	0.983	0.324	0.012	0.442
CH12 - CH4	4.173	0.044	0.051	0.099
CH12 - CH7	6.956	$1.008 \times 10^{-2}$	0.082	0.055
CH12 - CH9	6.351	0.014	0.075	0.055
<b>CH12 - CH10</b>	8.181	0.005	0.095	<b>0.046</b>
<b>CH12 - CH13</b>	12.750	$6.134 \times 10^{-4}$	0.140	<b>0.019</b>
CH14 - CH1	0.020	0.887	$2.602 \times 10^{-4}$	0.906
CH14 - CH3	0.105	0.746	0.001	0.813
CH14 - CH4	0.394	0.532	0.005	0.686
CH14 - CH7	2.967	0.089	0.037	0.168
CH14 - CH9	2.856	0.095	0.035	0.172
CH14 - CH10	6.213	0.015	0.074	0.055
CH14 - CH13	2.296	0.134	0.029	0.234

**Note:** The grand mean functional connectivity (FC) of rDLPFC-rTPJ was indexed by the averaged 49 coherence value of all channel pairings between the right rDLPFC (i.e. 7 channels within rDLPFC) and rTPJ (i.e. 7 channels within rTPJ); The 49 channel-pair-wise FC were indexed by the averaged coherence value from each rDLPFC-rTPJ channel pairings. FDR correction in Table C was applied for the main effect of leader in all 49 channel pairs. Channel pairs and  $p$ -values in bold indicate effects survived FDR correction.

**Supplementary Table 7 | No significant effect of in-group bonding on behavioral indices.**

**a. The reported effects remained when including bonding as between-sessions factor.**

Behavioral indices	Effect	<i>F</i>	<i>p</i>	$\eta^2$
Contribution	<b>Role</b>	254.561	<b>1.968×10<sup>-27</sup></b>	0.747
	<b>Leader</b>	28.786	<b>6.735×10<sup>-7</sup></b>	0.251
	<b>Leader × Role</b>	6.565	<b>0.012</b>	0.071
Prediction of contest success	<b>Leader × Role</b>	12.081	<b>8.306×10<sup>-4</sup></b>	0.133
Leader – follower alignment	<b>Role</b>	9.507	<b>0.003</b>	0.106
	<b>Leader</b>	12.710	<b>6.171×10<sup>-4</sup></b>	0.137
	<b>Leader × Role</b>	4.317	<b>0.041</b>	0.051
Compensatory contribution	<b>Role</b>	9.726	<b>0.003</b>	0.107
Free-riding behavior	<b>Role</b>	36.836	<b>5.910×10<sup>-8</sup></b>	0.345
Individual earnings	<b>Role</b>	1172.166	<b>6.969×10<sup>-52</sup></b>	0.932
	<b>Leader</b>	27.384	<b>1.162×10<sup>-6</sup></b>	0.242
	<b>Leader × Role</b>	3.996	<b>0.049</b>	0.044

**b. In-group bonding did not interact with leader or/and group role on behavior indices.**

Behavioral indices	Effect	<i>F</i>	<i>p</i>	$\eta^2$
Contribution	Bonding × Role	0.133	0.716	0.002
	Bonding × Leader	0.397	0.530	0.005
	Bonding × Leader × Role	1.360	0.247	0.016
Prediction of contest success	Bonding × Role	0.588	0.445	0.007
	Bonding × Leader	1.169	0.283	0.015
	Bonding × Leader × Role	0.123	0.727	0.002
Leader – follower alignment	Bonding × Role	0.994	0.322	0.012
	Bonding × Leader	2.618	0.110	0.032
	Bonding × Leader × Role	1.127	0.292	0.014
Compensatory contribution	Bonding × Role	0.334	0.565	0.004
Free-riding behavior	Bonding × Role	2.681	0.106	0.037
Individual earnings	Bonding × Role	1.255	0.266	0.014
	Bonding × Leader	0.373	0.543	0.004
	Bonding × Leader × Role	1.983	0.163	0.023

**Note:** Effects and *p*-values in bold indicate significant effects.

**Supplementary Table 8 | No significant effect of in-group bonding on neural indices.**

**a. The reported effects remained when including bonding as between-sessions factor.**

Neural indices	Effect	<i>F</i>	<i>p</i>	$\eta^2$
<i>Interpersonal neural synchronization in rDLPFC</i>				
Channel 6	<b>Leader × Role</b>	6.378	<b>0.014</b>	0.076
Channel 11	<b>Leader × Role</b>	5.929	<b>0.017</b>	0.071
<i>Intra-individual neural activity in rDLPFC</i>				
Channel 11	<b>Leader × Role</b>	8.230	<b>0.005</b>	0.095
<i>Functional connectivity (FC) between rDLPFC and rTPJ</i>				
Grand mean FC	<b>Leader</b>	7.090	<b>0.009</b>	0.083
CH8 - CH7	<b>Leader</b>	8.776	<b>0.004</b>	0.101
CH8 - CH9	<b>Leader</b>	7.898	<b>0.006</b>	0.092
CH8 - CH10	<b>Leader</b>	9.057	<b>0.004</b>	0.104
CH8 - CH13	<b>Leader</b>	12.472	<b>6.973×10<sup>-4</sup></b>	0.138
CH12 - CH10	<b>Leader</b>	8.010	<b>0.006</b>	0.093
CH12 - CH13	<b>Leader</b>	12.745	<b>6.149×10<sup>-4</sup></b>	0.140

**b. In-group bonding did not interact with leader or/and group role on neural indices.**

Neural indices	Effect	<i>F</i>	<i>p</i>	$\eta^2$
<i>Interpersonal neural synchronization in rDLPFC</i>				
Channel 6	Bonding × Role	2.143	0.147	0.027
	Bonding × Leader	1.614	0.208	0.020
	Bonding × Leader × Role	0.023	0.879	2.984×10 <sup>-4</sup>
Channel 11	Bonding × Role	0.338	0.563	0.004
	Bonding × Leader	0.122	0.728	0.002
	Bonding × Leader × Role	0.202	0.655	0.003
<i>Intra-individual neural activity in rDLPFC</i>				
Channel 11	Bonding × Role	0.466	0.497	0.006
	Bonding × Leader	0.510	0.477	0.006
	Bonding × Leader × Role	0.022	0.883	2.791×10 <sup>-4</sup>
<i>Functional connectivity (FC) between rDLPFC and rTPJ</i>				
Grand mean FC	Bonding × Role	1.123	0.293	0.014
	Bonding × Leader	0.735	0.394	0.009
	Bonding × Leader × Role	1.068	0.305	0.014
CH8 - CH7	Bonding × Role	0.499	0.482	0.006
	Bonding × Leader	0.258	0.613	0.003
	Bonding × Leader × Role	0.761	0.386	0.010

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CH8 - CH9	Bonding × Role	1.732	0.192	0.022
	Bonding × Leader	0.088	0.768	0.001
	Bonding × Leader × Role	0.498	0.482	0.006
CH8 - CH10	Bonding × Role	0.092	0.763	0.001
	Bonding × Leader	0.016	0.899	2.084×10 <sup>-4</sup>
	Bonding × Leader × Role	0.796	0.375	0.010
CH8 - CH13	Bonding × Role	0.013	0.908	1.722×10 <sup>-4</sup>
	Bonding × Leader	2.442	0.122	0.030
	Bonding × Leader × Role	0.654	0.421	0.008
CH12 - CH10	Bonding × Role	0.030	0.864	3.794×10 <sup>-4</sup>
	Bonding × Leader	0.285	0.595	0.004
	Bonding × Leader × Role	1.847	0.178	0.023
CH12 - CH13	Bonding × Role	0.021	0.885	2.699×10 <sup>-4</sup>
	Bonding × Leader	5.693	0.019	0.068
	Bonding × Leader × Role	0.055	0.814	0.001

**Note:** Effects and *p*-values in bold indicate significant effects.