Relationship between handedness and persistent emotional distress in adults experiencing an earthquake

Relazione tra dominanza emisferica e disturbi emotivi in una popolazione esposta a terremoto

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SUMMARY. Aim. Post-traumatic emotional distress follows exposure to trauma and may be affected by atypical cerebral lateralisation. We aimed to explore the relationship between handedness and emotional dysfunction in people exposed to a natural disaster. **Methods.** About 22 months after an earthquake, 326 exposed adults completed the Edinburgh Handedness Inventory, the Impact of Events Scale-Revised, and the Insomnia Severity Index. **Results.** Mixed-handed people, compared to right-handed, had a 3.3 fold increase in odds to have emotional distress. Consistent left-handers scored higher than consistent right- and mixed-handers on the ISI scale. **Conclusions.** Findings support that lateral preference is associated with emotional distress in people exposed to trauma.

KEY WORDS: disaster, handedness, post-traumatic stress disorder (PTSD), sleep disorder, lateralization.

RIASSUNTO. Scopo. I disturbi emotivi conseguenti a eventi traumatici possono essere mediati da atipie nella lateralizzazione delle funzioni mentali. Per questo motivo abbiamo esplorato la relazione tra preferenza manuale e disturbi emotivi in una popolazione esposta a un disastro naturale. **Metodi.** 326 adulti colpiti da un terremoto sono stati valutati dopo circa 22 mesi tramite la Edinburgh Handedness Inventory, l'Impact of Events Scale-Revised e l'Insomnia Severity Index. **Risultati.** Gli individui con una preferenza manuale mista, rispetto ai destrimani, hanno mostrato un rischio di sviluppare disturbi emotivi post-traumatici circa 3,3 volte superiore. Inoltre, gli individui totalmente mancini hanno mostrato punteggi significativamente più alti dei destrimani all'Insomnia Severity Index. **Conclusioni.** I risultati supportano l'ipotesi che la preferenza manuale sia associata allo sviluppo di disturbi emotivi conseguenti a traumi.

PAROLE CHIAVE: disastri, dominanza emisferica, disturbo da stress post-traumatico, disturbi del sonno, terremoto

INTRODUCTION

Lateral preference, as indicated by handedness, is associated with emotional disorders and increased perception of emotional peritraumatic stress in trauma-exposed people (1-3). Post-traumatic stress disorder (PTSD) was found to be associated with lower degree of consistent right-hand preference, mixed lateral preference (1,4,5) or left hand (2,6). Parental left-handedness and mixed lateral preference increased likelihood of PTSD (4); these are both associated with PTSD symptoms among children with history of interpersonal trauma (5), adolescents exposed to disasters (7), and adult army veterans (1). Finally mixed handedness predicts PTSD after two years post-disaster (8) and is associated with poorer PTSD treatment response (9).

The aim of the present study was to replicate previous findings and to study the relationship between handedness and persistent emotional distress in an earthquake-exposed population.

METHODS

Eligible were about 1000 adult inhabitants of San Giuliano di Puglia, a small village in southern Italy. People were exposed to an earthquake on 31st October, 2002, causing the collapse of a primary school and the death of 27 children and one teacher, and serious physical injuries in 61 adults present in the school area. All village inhabitants were dislocated for about two years and housed in temporary structures.

About 21 months after the earthquake, all inhabitants (aged 18-80 years) were contacted. Three-hundred-and-twenty-six agreed to participate in the study, and data from 300 complete questionnaires were analysed (median age=50; range 18-83 years; 200 women). Twenty-six incomplete psychometric reports were excluded from the analysis. Data on gender, age, marital status, and educational level were collected. Due to privacy regulations, data were not collected from non-participants.

Edinburgh Handedness Inventory (EHI) (10). The EHI is a questionnaire designed to evaluate handedness. Subjects are asked to indicate the preferred side for nine common activities. Hand-writing distinguishes between right- and left-handers. If they use the opposite limb for one of the other queried activities, they are classified as *mixed-handed*. They are defined as *consistent right-(or left-)handed* if they report a consistent side preference for all nine activities. Participants parents' handedness has been classified as *no parental left handedness* (NonPLH; both parents right-handers) or *parental left handedness* (PLH; one parent or both left-handed).

Impact of Event Scale-Revised (IES-R) (11). The IES-R is a 22-item self-rated scale reflecting the three DSM-IV PTSD symptom dimensions (Intrusion, Avoidance, and Hyperarousal). Each item is answered on a 5-point Likert-type scale, ranging from 0 (not at all) to 4 (very much). For comparability with other studies, participants who reported scores ≥50 have been considered emotional distress cases.

Insomnia Severity Index (ISI) (12). A 7-item questionnaire measuring severity of insomnia; a total score is obtained by summing up the 0-4 scores of each item. Total scores ranging from 0 to14 indicate absence of insomnia, whereas scores from 15 to 28 indicate moderate or severe insomnia.

Statistical analysis

The whole sample was divided in two sub-groups based on IES cut-off score (presence or absence of persistent emotional distress). Age, gender, education, marital status, IES and ISI scores, handedness and parental handedness, were compared between this two groups by multiple regression logistic analysis. We used STATA11.0 for statistical analyses.

RESULTS

Two-hundred-and-nineteen (76,3%) subjects were consistent right-handed, six (2%) were consistent left-handed, and 65 (21,6%) were mixed-handed. The prevalence of emotional distress was 54% (n=162). Insomnia was reported by 108 participants (36%). Parental left handedness (PLH) was found in 34 individuals (11.3%). PLH was associated with other than consistent right handedness (left-handed, OR=6.5; 95% CI, 1.1-38.4; mixed-handed, OR=3.3; 95% CI, 1.6-6.7). Detailed results of the comparison between groups are listed in **Table 1**.

DISCUSSION

Our results are consistent with previous data supporting that lateral preference is associated with the persistence of emotional distress following exposure to trauma. This study extends earlier findings from adolescent populations and city inhabitants to a large adult rural population. We found significant differences on the IES-R total, intrusion and hyperarousal subscale scores among mixed, consistent left-handers and consistent right-handers. Similar differences emerged between PLH and nonPLH participants. However, PLH status did not increase the likelihood to have emotional distress. Thus our data do not support that parental left-handedness could be associated to emotional problems following trauma, as previously proposed by Chemtob and Taylor (4).

We also found that subjects with persistent emotional distress scored higher on the ISI scale. It should be recalled that sleep complaints and disturbances are often associated with emotional problems and constitute core symptoms of PTSD.

The evidence of a relationship between abnormal lateral preference and emotional difficulties in response to trauma appears to be an important issue for implementation of early psychological support interventions. But the most intriguing issues arose from this

Table 1. Multivariate logistic regression analyses

Emotional distress	Cases	Non-cases	OR	95%CI	OR*	95%CI
Male	37 (37.0)	63 (63.0)	1.00		1.00	
Female	125 (62.5)	75 (37.5)	2.83	1.73-4.66	2.44	1.35-4.41
≤ 8 yrs of school	127 (62.2)	77 (37.8)	1.00		1.00	
> 8 yrs of school	35 (36.5)	61 (63.5)	0.35	0.21-0.57	0.49	0.25-0.96
Unmarried	34 (48.6)	36 (51.4)	1.00			
Married	115 (55.0)	94 (45.0)	1.29	0.75-2.23		
Divorced	13 (61.9)	8 (38.1)	1.72	0.63-4.67		
PLH	138 (51.9)	128 (48.1)	1.00			
nonPLH	24 (70.6)	10 (29.4)	2.23	1.02-4.84		
ISI score<15	69 (35.9)	123 (64.1)	1.00		1.00	
ISI score>15	93 (86.1)	15 (13.9)	11.05	5.95-20.54	8.64	4.37-17.09
Right-handed	118 (51.5)	111 (48.5)	1.00		1.00	
Left-handed	4 (66.7)	2 (33.3)	1.88	0.34-10.47	0.36	0.05-2.33
Mixed-handed	40 (61.5)	25 (38.5)	1.50	0.86-2.64	3.34	1.54-7.24

*All variables are adjusted for each other and for age.

study is the possible role of anomalous hemispheric specialization or integrative network failures in altered development of emotional processing circuits and in post-traumatic vulnerability.

As hypothesized by several scholars emotion processing functions are lateralized (13,14) and experimental data increasingly unveil a relationship between altered hemispheric specialization during the development and vulnerability to PTSD and other stress-induced emotional disorders (15).

Emotional distress is associated with consistent atypical cerebral laterality in the general population (6) and abnormalities in left-right cortical asymmetry and hemispheres connectivity have been found in children exposed to early life trauma that is a major risk factor for PTSD and emotional dysregulation under stress conditions in adulthood (15,16). Moreover studies in apes are consistent with the view that stress functioning and reactivity are associated with the development of hemispheric specialization in primates (17).

Limitations of this study may be constituted by the following: due to privacy regulations, we obtained no data from people who were contacted and decided not to participate in the study; hence, it is possible that some unexplored variables could have determined participation in the study. We also did not use specific interviews for diagnosing PTSD, so we are unable to infer how many people in our sample actually suffered from PTSD. Besides, we did not investigate the relatedness of participants with disaster victims, *i.e.*, whether they had a relative who was present in the theatre of the disaster or whether they were present themselves; however, in a small village with about 1000 residents, where almost all people are acquainted with each other, the emotional impact is high in every person. We feel that the major limitation of this study was its cross-sectional nature, hence we may not infer as to whether sleep disorder was a consequence of the earthquake and associated disaster or it was present before the traumatic event.

Despite the above limitations, our data are consistent with those from previous studies and should drive researchers to further investigate causality in the relationship between posttraumatic emotional distress, lateral preference and abnormal brain asymmetry.

REFERENCES

1. Boscarino JA, Hoffman SN. Consistent association between mixed lateral preference and PTSD: confirmation among a national study of 2490 US Army Vietnam veterans. Psychosom Med 2007; 69: 365-9.
2. Spivak B, Segal M, Mester R, Weizman A. Lateral preference in post-traumatic stress disorder. Psychol Med 1998; 28: 229-32.
3. Chemtob CM, Wang Y, Dugan KL, Abramovitz R, Marmar C. Mixed lateral preference and peritraumatic reactions to the World Trade Center attacks. J Nerv Ment Dis 2006; 194: 874-6.
4. Chemtob CM, Taylor KB. Mixed lateral preference and parental left-handedness: possible markers of risk for PTSD. J Nerv Ment Dis 2003; 191: 332-8.
5. Saltzman KM, Weems CF, Reiss AL, Carrion VG. Mixed lateral preference in posttraumatic stress disorder. J Nerv Ment Dis 2006; 194: 142-4.
6. Choudhary CJ, O'Carroll R E. Left hand preference is related to posttraumatic stress disorder. J Trauma Stress 2007; 20: 365-9.

7. Chemtob CM, Taylor KB, Woo L, Coel MN. Mixed handedness and trauma symptoms in disaster-exposed adolescents. J Nerv Ment Dis 2001; 189: 58-60.
8. Boscarino JA, Adams RE. PTSD onset and course following the World Trade Center disaster: findings and implications for future research. Soc Psychiatry Psychiatr Epidemiol 2009; 44: 887-98.
9. Forbes D, Carty J, Elliott P, et al. Is mixed-handedness a marker of treatment response in posttraumatic stress disorder?: a pilot study. J Trauma Stress 2006; 19: 961-6.
10. Oldfield RC. The assessment and analysis of handedness: the Edinburgh inventory. Neuropsychologia 1971; 9: 97-113.
11. Weiss DS, Marmar CR. The Impact of Event Scale-Revised. In: Wilson JP, Keane TM (eds). Assessing psychological trauma and PTSD. New York: Guilford Press; 1996.
12. Bastien CH, Vallieres A, Morin CM. Validation of the Insomnia Severity Index as an outcome measure for insomnia research. Sleep Med 2001; 2: 297-307.
13. Demaree HA, Everhart DE, Youngstrom EA, Harrison DW. Brain lateralization of emotional processing: historical roots and a future incorporating "dominance". Behav Cogn Neurosci Rev 2005; 4: 3-20.
14. Cope LM, Schaich Borg J, Harenski CL, et al. Hemispheric asymmetries during processing of immoral stimuli. Front Evol Neurosci 2010; 2: 110.
15. Schore AN. Dysregulation of the right brain: a fundamental mechanism of traumatic attachment and the psychopathogenesis of posttraumatic stress disorder. Aust N Z J Psychiatry 2002; 36: 9-30.
16. Teicher MH, Rabi K, Sheu YS, et al. Neurobiology of childhood trauma and adversity. In: Lanius RA, Vermetten E, Pain C (eds). The impact of early relational trauma on health and disease The hidden epidemic. Cambridge, UK: Cambridge University Press, 2010.
17. Westergaard GC, Lussier ID, Suomi SJ, Higley JD. Stress correlates of hand preference in rhesus macaques. Dev Psychobiol 2001; 38: 110-5.