Mixed Lateral Preference in Posttraumatic Stress Disorder

Kasey M. Saltzman, PhD,* Carl F. Weems, PhD,† Allan L. Reiss, MD,* and Victor G. Carrión, MD*

Abstract: Recent research indicates that adults with posttraumatic stress disorder (PTSD) have a higher incidence of mixed laterality with respect to handedness than the rest of the population. To test if this relationship also occurs early in life, we evaluated children with history of interpersonal trauma. Fifty-nine traumatized children were evaluated with the Clinician Administered PTSD Scale for Children and Adolescents and the Edinburgh Handedness Inventory. Forty matched healthy controls were used for comparison. Increased mixed laterality was found in all children exhibiting symptoms of PTSD when compared with healthy controls, and children who met DSM-IV diagnostic criteria for PTSD had more mixed laterality than the subthreshold traumatized group (F = 7.71; df = 2.96; p = 0.001). Within the entire traumatized group, there was a positive correlation between PTSD symptom severity and mixed laterality. Mixed laterality was positively associated with PTSD symptoms in traumatized children, suggesting that neurological abnormalities may be related to degree of PTSD symptom expression.

Key Words: PTSD, laterality, handedness.

(J Nerv Ment Dis 2006;194: 142–144)

It has been posited that mixed lateralization, characterized by a lack of fully dominant lateral preference and a shared facility between right and left hands, may be a marker for brain development abnormalities (Green et al., 1989). It has been found to be correlated with and potentially pathoformic for a variety of psychiatric diagnoses, such as schizophrenia (Green et al., 1989; Taylor and Amir, 1995), phobias (Chemtob et al., 2002), and personality disorders (Standage, 1983). Recent research in adults has linked mixed laterality to posttraumatic stress disorder (PTSD); Chemtob and Taylor, 2003; Spivak et al., 1998). Research also suggests a lack of hemispheric differentiation may contribute to this relationship (Teicher et al., 1997). For example, EEG studies in abused children found a lack of expected left hemispheric dominance and poorly differentiated hemispheres overall (Ito et al., 1998). Alternatively, mixed laterality may be an example of a neurological soft sign, or neurological abnormality, associated with childhood psychopathology, including general anxiety disorders (Pine et al., 1997) and PTSD in particular (Green, 1983).

Compared with adults, little is known about mixed lateralization in traumatized youth. To date, there has only been one such study examining this relationship. Chemtob et al. (2001) found that mixed laterality was associated with more posttraumatic symptoms in children exposed to a natural disaster. The current study was conducted to examine how laterality interacts with trauma in the context of the developing brain. We examined lateral preference of 59 traumatized children and compared them to a nontraumatized control group. To test for unique effects of traumatization, the traumatized sample was further broken down into a PTSD-negative group (symptomatic) and a PTSD-positive group (meeting full DSM-IV criteria for the disorder).

We hypothesized that traumatized children would present with more mixed lateral preference when compared with controls. We also hypothesized that PTSD-positive children would have more mixed lateral preference than PTSD-negative children. Finally, positive correlations between PTSD symptom severity and degree of mixed laterality were hypothesized.

METHODS

The sample was recruited from local social service departments and mental health clinics. All children had a history of interpersonal trauma (physical abuse, sexual abuse, and/or witnessing violence). We recruited only children who 1) had at least one episode of exposure to trauma, as defined by DSM-IV criterion A1 (“the person experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others [and] the person’s response involved intense fear, helplessness, or horror”); American Psychiatric Association, 1994); 2) were exposed to trauma more than 6 months prior to the evaluation; 3) had no known history of alcohol or drug abuse/dependence; and 4) had a currently safe, stable home environment with an adult caretaker willing to participate in the study.

Fifty-nine traumatized children and adolescents participated in this study. Thirty-one subjects were PTSD-negative (exhibiting subthreshold DSM-IV PTSD diagnostic criteria), and 28 were PTSD-positive (exhibiting full DSM-IV PTSD diagnostic criteria). After a full description of the study was presented, written consent was obtained from all caregivers and written assent from all participants. Fifty-six percent of the sample was male, and 44% was female. The mean age of the children was 10.6 (SD = 1.9) years, with a range of 7 to

*Stanford University School of Medicine, Stanford, California; and †University of New Orleans, New Orleans, Louisiana.

Supported by NIH grant MH63893-01 to Dr. Carrión.

Send reprint requests to Victor G. Carrión, MD, Division of Child and Adolescent Psychiatry, Stanford University School of Medicine, 401 Quarry Road, Stanford, CA 94305.

Copyright © 2006 by Lippincott Williams & Wilkins.

ISSN: 0022-3018/06/19402-0142

DOI: 10.1097/01.nmd.0000198201.59824.37

The Journal of Nervous and Mental Disease • Volume 194, Number 2, February 2006

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.
14 years. Ethnic composition was Euro-American (N = 25), African American (N = 25), Hispanic (N = 5), Asian (N = 2), and other (N = 2).

A cohort of control subjects (N = 40) was selected from an existing database to match the group of clinic referred participants on gender, age, and race. Subjects in the database were recruited from a broad range of socioeconomic levels and geographic locations. Control participants had a score of less than 65 (i.e., nonclinical levels) on the Child Behavior Checklist internalizing, externalizing, and total scales. The mean age was 10.4 (SD = 1.9), with a range of 7 to 14 years. Forty percent was female, and 60% was male. Ethnic composition was Euro-American (N = 18), African American (N = 10), Asian (N = 3), Hispanic (N = 3), Pacific Islander (N = 2), and other (N = 4). χ² Analyses showed no significant differences between the traumatized population and controls on gender and ethnicity, and t test analysis showed no difference on age.

Given previous research suggesting age-related shifts in childhood from mixed laterality to right-sidedness (Brito et al., 1992), as well as established gender differences in lateral preference (Annett, 1970), correlations and t tests were calculated on all study participants to test for potentially confounding effects of age and/or gender. No age or gender effects were found in the current sample.

### Measures and Procedures

**Clinician-Administered PTSD Scale for Children and Adolescents**

To assess PTSD symptoms, the Clinician-Administered PTSD Scale for Children and Adolescents (CAPS-CA; Nader et al., 1996) was used. The CAPS-CA is the child version of the Clinician Administered PTSD Scale, a well-validated assessment tool for assessment of PTSD in adults (Blake et al., 1995). It is a semistructured clinical interview for DSM-IV (American Psychiatric Association, 1994) PTSD diagnostic criteria, consisting of standardized prompt questions, follow-up questions, and behaviorally and cognitively anchored rating scales. The frequency and intensity of each symptom are rated on a scale of 0 (“never” or “not at all”) to 3 (“very often” or “very much”), based on behavioral or cognitive anchors, with diagnostic criteria for a symptom being met with a score of at least 2 on both frequency and severity. The CAPS-CA has shown concurrent validity with the Child PTSD Checklist (Amaya-Jackson et al., 1995) and the PTSD Reaction Index (Nader et al., 1990) and had good internal consistency in the current study (coefficient α of .82 for the total symptom score).

The CAPS-CA also provides a measure of PTSD symptom severity, which is comprised of the sum of the reported frequency and intensity of all DSM-IV diagnostic criteria symptoms for PTSD (ranging from a possible 0 to 6 per symptom).

**Edinburgh Handedness Inventory**

This self-report measure provides a quantitative, continuous assessment of lateral preference, or the degree to which a person habitually uses the right and left hands to complete unilateral tasks (Oldfield, 1971). Possible scores on this measure range from −100 (pure left lateral preference) to 100 (pure right lateral preference). Pure mixed laterality, or the presence of equal amounts left and right lateral preferences, is represented by a score of 0, the midpoint between pure right and pure left lateral preferences. The score is derived from participants’ lateral preferences for each of 10 physical activities (such as writing, drawing, and throwing).

### Statistical Analyses

Control and traumatized samples were compared with t test and χ² analyses on gender, ethnicity, and age. An ANOVA was conducted to test for differential levels of lateral preference in the threshold traumatized group, the subthreshold traumatized group, and the control group. Follow-up t test analyses were conducted to examine differences between groups with respect to lateral preference. Additionally, degree of mixed laterality was calculated from lateral preference score, and an ANOVA and follow-up t test analyses were conducted to compare groups on mixed laterality. Correlations were also conducted to examine the relationship between CAPS-CA total symptom severity score and degree of mixed laterality in traumatized children.

### RESULTS

Mean lateral preference quotients were calculated for PTSD-negative children (mean = 75.8; SD = 22.7), PTSD-positive children (mean = 51.0; SD = 48.6), and nontraumatized controls (mean = 79.8; SD = 32.7). Based on an analysis of variance, degree of lateral preference significantly differed between groups (F = 5.95; df = 2.96; p = 0.004). Follow-up t test analyses indicated the PTSD-positive group (mean = 51.0; SD = 48.6) had significantly lower laterality scores than did the PTSD-negative group (mean = 75.8; SD = 22.7; t = 2.56; df = 57; p = 0.013). A t test revealed trauma exposure alone was not correlated with Edinburgh scale scores (t = −0.57; df = 69; p = 0.57), as the PTSD-negative group (mean = 75.8; SD = 22.7) did not differ from nontraumatized controls (mean = 79.8; SD = 32.8) with respect to laterality scores. There was a significant correlation between CAPS-CA PTSD symptom severity and degree of mixed lateral preference, as measured by the Edinburgh Handedness Inventory (r = −.33; df = 57; p = 0.01).

To explore whether results represented a shift toward mixed laterality, i.e., a shift away from pure right or left handedness, the absolute values of the Edinburgh scale scores, or laterality quotients, were also examined. Mean absolute values of lateralization quotients were calculated for PTSD-negative children (mean = 75.8; SD = 22.7), PTSD-positive children (mean = 61.9; SD = 32.9), and nontraumatized controls (mean = 84.8; SD = 15.2). Based on an analysis of variance, degree of mixed lateral preference, or deviation from right or left handedness, was significantly different among the three groups (F = 7.71; df = 2.96; p = 0.001). Follow-up t test analysis indicated the PTSD-positive group had significantly more mixed laterality than did the PTSD-negative group (t = 1.91; df = 57; p = 0.03), and that the PTSD-negative group had significantly more mixed laterality than did the nontraumatized controls (t = 1.99; df = 69; p = 0.025; Fig 1).
DISCUSSION

The current study provides evidence that degree of lateral preference is related to PTSD in traumatized children, consistent with previous findings with adults. Children with a diagnosis of PTSD had mean laterality quotients that suggested they were less likely to be predominately right-preferred when compared with traumatized children not meeting diagnostic criteria for PTSD, as well as controls. Further analysis revealed this relationship appears to represent a shift away from both pure left or right handedness, not just a weaker right lateral preference. When degree of mixed lateral preference was specifically examined, it was found that it differentiated between all three groups of children; traumatized children with symptoms of PTSD presented with more mixed laterality than did controls, but traumatized children meeting full diagnostic criteria for PTSD had even higher rates of mixed laterality than the other two groups. Consistent with this, PTSD symptom severity scores were positively correlated with degree of mixed laterality, with the more symptomatic children evidencing more mixed laterality. This suggests that a higher degree of mixed lateral preference is associated with both trauma exposure, as well as presence of PTSD diagnosis, in children.

Such findings are consistent with the literature on lateral preference and other psychiatric conditions, which were associated with increased rates of mixed handedness, rather than a shift away from right-handedness.

These findings suggest that mixed lateralization may be a neurological covariate of PTSD in children, potentially a risk factor for general psychopathology, including expression of PTSD symptoms. Alternatively, it may represent a neurological consequence of the traumatic experience itself and/or later development of PTSD symptoms. If it does represent a risk factor, it is unclear how lack of left hemisphere differentiation may be associated with PTSD, but it is possible that this represents a vulnerability that potentiates the impact of traumatic events such that higher levels of PTSD symptoms are more likely.

One caveat is that mixed laterality appears to be related to many different types of psychopathology. While this and other studies have linked it to PTSD, it is possible that this association represents a general risk for psychopathology. However, the present study adds increasing evidence that PTSD is associated with neurological soft signs or anomalies. Focus on this and specific assessment of hemispheric differentiation will help us understand the role of brain development in the expression of PTSD.

ACKNOWLEDGMENTS

We thank San Francisco and Santa Clara Counties for their participation in this project. We thank Sari Wade, LCSW, Cynthia Hyman, RN, and Stephanie Evans, PhD, for their assistance with subject recruitment and Christine Blaszy, PhD, for her statistical consultation.

REFERENCES