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Glenn W. Currier, M.D., M.P.H.[1,2]
Robert Sitzman, Ph.D.[3]
Adam Trenton[1]

[1] University of Rochester Medical Center, Department of Psychiatry, 300 Crittenden Boulevard, Rochester, New York 14642. Send reprint requests to Dr. Currier.
[2] Department of Emergency Medicine, University of Rochester Medical Center, Rochester, New York.
[3] Department of Psychiatry, Los Angeles County & University of Southern California Medical Center, Los Angeles, California.

Mixed Handedness and Trauma Symptoms in Disaster-Exposed Adolescents

A number of psychological disorders have been associated with personal and familial left-handedness (see reviews by Geschwind and Galaburda, 1985; Hardyck and Petrinovich, 1977). However, it has also been suggested that mixed lateral preference, rather than left-handedness in and of itself, may be a risk factor for some psychological disorders. Evaluating a hypothesis proposed by Chemtob and Hamada (*cf.* Watson et al., 1988), Spivak et al. (1998) reported that mixed lateral preference among right-handed men was associated with increased susceptibility to combat-related posttraumatic stress disorder in a sample of Israeli combat veterans. This finding was recently replicated using a sample of U.S. Vietnam veterans (Chemtob, 1999). The present study sought to extend this finding to another trauma-exposed population by evaluating a sample of adolescents who had experienced a catastrophic natural disaster. Specifically, we sought to determine whether disaster-exposed adolescents with mixed-handedness reported more trauma symptoms than did adolescents who use the same hand for all activities. We also evaluated the relationship between mixed-handedness and depression symptoms.

Methods

Participants. Participants were 203 students from a Kauai high school who completed questionnaires designed to assess their reactions to a hurricane, as part of a larger project aimed at assisting students with psychological recovery. The average age of the participants was 15.59 (SD 1.16). Male subjects comprised 49.7% of the sample. All participants were exposed to Hurricane Iniki, a category-5 hurricane that struck Kauai, Hawaii, on September 11, 1992. Hurricane Iniki caused over 2 billion dollars in damage. Over 75% of the housing on the island of Kauai was damaged.

Procedure. Questionnaires were administered to participants 18 months after the hurricane. Informed consent was obtained for each participant. Participation was voluntary and took place in the first school period of the day. Participants were asked to report the hand that they used for writing and whether they did anything better with the other hand. Although using a multi-item handedness inventory would have been preferable (*e.g.*, Oldfield, 1971), the hand used for writing correlates very highly with overall handedness (Annett, 1970).

Following Annett (1970), we asked whether participants did anything better with the other hand, to assess whether participants were consistent or mixed in handedness. A single-item that asks participants whether they do something better with the other hand appears to permit classification that is consistent with multi-item inventories. Among 78 right-handed adult participants studied in our laboratory who reported consistent right hand use, none reported doing anything better with the left on a four-item inventory, and only three (3.8%) reported ambidextrous hand use on one or more items (Chemtob, unpublished data[1]).

The Impact of Events Scale (IES; Horowitz et al., 1979) was used to measure trauma symptoms. The IES is a widely used 15-item scale that measures the frequency of trauma-related intrusion and avoidance symptoms in the past 2 weeks. The IES has previously been validated as a measure of trauma symptoms (Zilberg et al., 1982). It yields an intrusion score, an avoidance score, and a total score. Instructions were modified to focus responses on the hurricane experience.

The Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977), which consists of 20 items, was used to measure depression symptoms. This scale has previously been used to assess depression in adolescents with adequate results (Roberts et al., 1990). Each item is scored with a value ranging from 0 to 3. Scores of 16 or greater suggest high levels of depression and are about 1 SD above the national mean (Sayetta and Johnson, 1980).

In order to assess the severity of subjective exposure to the hurricane, participants were also asked to indicate whether, during the hurricane, they were, "fearful that you might lose your life or suffer a serious injury," and if, during the hurricane, they were, "fearful that a family member or loved one might lose their life or suffer a serious injury." These items were scored categorically as "yes" or "no" responses.

Analysis. Participants were divided into consistent-handedness and mixed-handedness groups. Consistent-handedness participants did not do anything better with the non-

[1] To our knowledge, there is no published data on the concordance between multi-item handedness inventories and single-item assessments of handedness consistency. Dr. Chemtob's laboratory collected both types of ratings in a single group of subjects as part of a larger study on phobias, and the results are presented above.

writing hand. Mixed-handedness participants reported doing something better with the nonwriting hand. As our hypothesis addressed mixed-handedness rather than handedness per se, both right- and left-handed writers were included in both groups.

Results

Hand Use. A total of 201 participants reported on the hand that they used to write. Of those, 172 classified themselves as right-handed, and 25 as left-handed. Four participants reported using either hand to write and were excluded from further analysis. There was no effect of gender on the reported percentages of consistent and mixed hand use ($F[1,184] = .034$, $p > .05$). Among the male subjects, 69.4% were consistent handers, whereas 30.61% were mixed-handed. Among the female subjects, 72.92% were consistent handers and 27.1% were mixed-handed.

Severity of Exposure. A total of 32.5% of participants feared for their own life during Hurricane Iniki, and 60.9% were fearful for a family member. To evaluate whether the two-handedness groups differed in severity of exposure, a possible confound, we conducted chi-square analyses on our dichotomous exposure measures. A chi-square analysis showed that the two handedness groups did not differ in the percentage of participants fearing for their own lives during the hurricane (mixed handed = 37.9%; consistent handers = 33.3%; chi-square = .367, $df = 1$, $p > .05$). Likewise, the two handedness groups did not differ in the percentage of participants who were fearful that a family member or loved one might die or be injured during the hurricane (mixed handed = 59.3%; consistent handers = 64.6%; chi square = .48, $df = 1$, $p > .05$).

Impact of Events Scale. The data were analyzed by MANOVA. Gender (male, female) and consistency of handedness (consistent, mixed) were entered as independent factors, and the IES intrusion, avoidance, and total scores were dependent variables. There was a main effect of consistency of handedness for the IES intrusion score ($F[1,171] = 8.86$, $p = .003$) and the IES total score ($F[1,171] = 6.4$, $p = .013$) but not for the IES avoidance score. Participants with mixed handedness had significantly higher IES intrusion scores (mean = 5.8, SD = 5.4) than did participants with consistent handedness (mean = 3.2, SD = 7.4). Participants with mixed handedness also had significantly higher IES total scores (mean = 13.33, SD = 15.2) than did participants with consistent handedness (mean = 8.55, SD = 11.0).

There was also an effect of gender on the score for avoidance, with female subjects scoring significantly higher on this component of the IES (IES avoidance: female subjects = 7.33, SD = 7.99; male subjects = 5.14, SD = 7.63; $F[1,171] = 4.43$, $p < .05$).

CES-D. Depression index scores were entered into an ANOVA with total score as the dependent variable, and gender and handedness consistency as independent variables. There was a significant effect of handedness consistency on total depression scores ($F[1,172] = 4.41$, $p < .05$). Participants who were mixed-handed had significantly higher total CES-D scores (mean = 17.05, SD = 10.8) than participants with consistent handedness (mean = 13.88, SD = 9.5). There was no significant effect of gender ($F[1,172] = 1.34$, $p > .05$).

Discussion

Disaster-exposed adolescents with mixed handedness had significantly higher IES intrusion and IES total scores than did adolescents reporting consistent handedness. Although the present study focused on trauma symptoms rather than on posttraumatic stress disorder (PTSD) diagnosis, our findings are consistent with the results of Spivak et al. (1998), who showed increased susceptibility to PTSD in mixed-handed individuals. Notably, avoidance scores on the IES were not related to participants' consistency of hand use. This suggests that further investigations of the relationship between mixed-handedness and PTSD should evaluate these components of PTSD separately. It should be noted that because the IES does not measure the arousal symptoms associated with trauma and PTSD, we could not evaluate the relationship between mixed-handedness and arousal dysregulation.

The results of the CES-D scale also indicate that as a group, the mixed-handers had high levels of depressive symptomatology compared with the consistent handers. The mean total score for the mixed handers was above 16, considered the cut-off for high levels of depressive symptomatology (Sayetta and Johnson, 1980), whereas the mean score for the consistent handers was significantly less.

There are some limitations of the findings. First, we used a single item to assess mixed-handedness. However, our results are consistent with the findings reported by Spivak et al. (1998) and Chemtob (1999), who both employed multi-item measures to assess lateral preference and consistency of handedness. Second, Spivak et al. (1998) and Chemtob (1999) studied whether mixed handedness was associated with PTSD. In contrast, our participants were not drawn from a clinical population and most did not experience trauma symptoms in the clinical range as a consequence of their disaster exposure. The present results address disaster-related trauma symptoms and cannot be generalized to disaster-related PTSD.

Finally, the results may have reflected a generalized response bias on the part of the mixed-handed participants to give more extreme responses. However, because the two groups did not differ on either the IES avoidance scores or on their report of the intensity of exposure to the disaster, the results do not appear to be the result of such a response bias. Rather, it appears that the mixed-handed participants had selectively greater depressive and intrusive thought symptomatology as the result of disaster-exposure than did the consistent handers.

The finding that mixed-handedness is associated with increased susceptibility to trauma symptoms is important because mixed-handedness is a marker for degree of hemispheric specialization and therefore may suggest that risk for PTSD is related to cerebral asymmetry. Preliminary reports utilizing PET have found an increase in right hemisphere

(RH) amygdala, insula, medial temporal lobe, and right visual cortex activity as well as a decrease in left hemisphere (LH) speech area (Broca's area) activity in PTSD patients relative to control participants (Rausch et al., 1996; Shin et al, 1997a, 1997b). Aside from the PET studies showing LH hypometabolism and RH hypermetabolism, other testing modalities suggest some disruption in RH activation, perhaps due to an increased sensitivity and sensitization of the noradrenergic system (Southwick et al., 1994). Using evoked potentials, Schiffer et al. (1995) found greater RH than LH activity during the recall of traumatic memories.

Future studies should extend these findings by measuring the pattern of differences in activation levels between the hemispheres (*i.e.*, cerebral activation asymmetry) in PTSD. Such data on the relative activation levels of various regions within the cerebral hemispheres could show more clearly which information processing systems may be disrupted in PTSD.

Conclusions

A previous study has shown a relationship between the presence of mixed handedness and increased prevalence of PTSD among Israeli combat veterans (Spivak et al., 1980). The present study found similar results in a nonclinical population of adolescents who had experienced a potentially life-threatening natural disaster. For these adolescents, those with mixed handedness had higher Impact of Events ratings and more depression symptoms than did consistent-handers. The association of mixed-handedness and increased trauma symptomatology suggests that the pattern of cerebral specialization for trauma emotional processing and memory may differ as a function of handedness consistency. However, this proposal remains highly speculative. Direct evaluation of this hypothesis would elucidate whether the relationship between consistency of handedness and increased trauma symptoms is related to hemispheric specialization of function.

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Claude M. Chemtob, Ph.D.[2]
Kristen B. Taylor, Ph.D.[2,3]
Lia Woo, B.A.[2]
Marc N. Coel, M.D.[3]

[2] National Center for Posttraumatic Stress Disorder, Pacific Islands Division, Honolulu, Hawaii. Send reprint requests to Dr. Chemtob, National Center for PTSD, Pacific Islands Division, 1132 Bishop St., Suite 307, Honolulu, Hawaii 96813.

[3] Queen's/Hamamatsu PET Imaging Center, Queen's Medical Center, Honolulu, Hawaii.

Evaluating the Tolerability of the Newer Mood Stabilizers

Bipolar affective disorder involves periodic episodes of mania or hypomania. It affects about 1% of adults world wide, and up to 80% of patients with a first episode of mania are likely to have one or more subsequent episodes (Gelenberg and Hopkins, 1993). The recurrent nature of the illness may have a cumulative detrimental effect both on functioning and treatment of such patients. Traditionally, the treatment of bipolar disorder has involved the use of lithium and carbamazepine. However, monotherapy with these agents often fails (Solomon et al., 1996). There are significant side effects associated with them. Lithium carbonate has a narrow therapeutic range and may cause abnormalities of the thyroid gland and impaired functioning of the kidney (Kaplan and Sadock, 1998), whereas carbamazepine may cause agranulocytosis (Sobotka et al., 1990). To improve treatment outcome, clinicians have been using other antiepileptic medications as adjunctive mood stabilizers (Botts and Raskind, 1999). These medications, sodium valproate,