Bulletin of the Psychonomic Society
1990, 28 (3), 211-214

No difference in cerebral hemispheric asymmetry of meditators as opposed to nonmeditators

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Meditation continues to be proposed for improving people's use of their brains by changing ease of communication between cerebral hemispheres, or by changing their functional dissimilarities. We report the first tachistoscopic hemiretinae recognition test of asymmetry in meditators as opposed to nonmeditators.

Meditation's relationship to asymmetry is important, because many clinicians and lay people believe there is a link. Several people have suggested that meditation alters hemispheric lateralization, though typically they are vague about the mechanism: It has been proposed that meditation (1) increases right hemispheric influence, which regular practice can fix as a trait, (2) improves ability to use preferentially the hemisphere appropriate to any given task, (3) equalizes use of the hemispheres, (4) enhances communication between hemispheres, (5) equalizes abilities of the hemispheres, or (6) further specializes the hemispheres (e.g., Abdullah & Schucman, 1976; Boals, 1978; Davidson, 1976; Delmonte, 1987; Ikemi & Ikemi, 1986; Kubose & Umemoto, 1980; Kutz, Borysenko, & Benson, 1985; Ornstein, 1972; Pagano & Frumkin, 1977; Rossi, 1977; Tart, 1975). Despite the scarcity of empirical tests of these contentions, let alone support for them, some clinicians base therapies on the assumption that meditation changes lateralization (e.g., Abdullah & Schucman, 1976). This is a popular belief among the lay public and media (Ferguson, 1980), and it has been suggested as a connection between meditation and creativity (Kubose & Umemoto, 1980; Travis, 1979). Furthermore, substantial business and government funds are expended on human potential programs that claim to improve performance with assorted techniques, including meditation and change of lateralization (Druckman & Swets, 1988).

There is little good evidence about the asymmetry of meditators. Most studies of meditation and asymmetry have not directly measured asymmetry, but merely had subjects perform tasks popularly thought to be associated with different hemispheres: holistic for the right, analytic for the left (a recent example of use of these measures is Payne, 1988; an example of use of these measures with meditation is Warrenburg & Pagano, 1982-1983). These studies are not trustworthy, because there is no sharp holistic versus analytic task dichotomy of hemispheric specialization (Bagnara, Boles, Simion, & Umiltà, 1983; Boles, 1984).

Any changes due to meditation should persist beyond the meditative state in order to be beneficial. Direct measures of asymmetry in meditators as opposed to nonmeditators are necessary during normal activity; but there are only two such studies, and they disagree (Delmonte, 1984). Bennett and Trinder (1977) found no EEG alpha lateralization differences between meditators during meditation and nonmeditators during relaxation. But they did report that outside of meditation or relaxation, meditators had greater left hemisphere activation than did nonmeditators during left-hemispheric activities, and greater right hemisphere activation during right hemispheric activities. Others interpreted these results as support for meditation's causing improved alertness outside of the meditative state (Dillbeck & Orme-Johnson, 1987, p. 880), presumably because of better flexibility to use the hemisphere appropriate to any given task. Meissner and Pirot (1983) also showed persistent effects of meditation, but in the direction of *reducing* asymmetry, thus contradicting Bennett and Trinder. Their measure also differed: Instead of using EEG, they tested left- versus right-ear superiority for recognition of tones. On the basis of their conclusion regarding meditation's symmetrizing effect, they recommended particular clinical uses. A possible mechanism for this symmetrizing effect is the equalization of abilities of the hemispheres. Another is improved communication between hemispheres, so that the primary recipient of the stimulus more readily passes the information to the other hemisphere if the other is more adept with that stimulus type.

Discussions of the clinical utility of meditation continue to appear in professional journals (Henry, 1978; Orme-Johnson, 1987), so we think it appropriate to test the proposed underlying mechanisms. Here we report a test of the idea that Transcendental Meditators differ from non-

This article is based on Tom Dayton's thesis, which partially fulfilled the requirements for the BA in experimental psychology from New College; David Boles was faculty sponsor. We thank the members of the Transcendental Meditation organization for their cooperation, and Steve Keele, Harold Hawkins, and anonymous referees for manuscript suggestions. Tom Dayton is now at IBM T. J. Watson Research Center, Hawthorne, P.O. Box 704, Yorktown Heights, NY 10598 (via electronic mail: tdayton@yktvmh2.bitnet, or tdayton@ibm.com.csnet). David Boles is now at the Department of Psychology, Rensselaer Polytechnic Institute, Troy, NY 12180-3590 (via electronic mail: userbwwl@rpitsmts).

meditators in hemispheric asymmetry, outside of meditation. Unlike what had been done in the two previous studies of meditation and asymmetry, in our experiment, we measured asymmetry with a tachistoscopic hemiretinae paradigm: Words and pictures of faces were presented briefly in either the left or the right visual field. In previous studies (Boles, 1983; McKeever & Huling, 1971; Springer, 1977; Suberi & McKeever, 1977), words and faces have been recognized more accurately in the right and left fields, respectively, implicating respective left and right hemisphere functions. This paradigm has previously been used with success to show individual differences, in relationships of cerebral asymmetry to handedness (see Bradshaw, 1980, for review), and to field independence (Zoccolotti & Oltman, 1978).

A common, legitimate complaint of meditation proponents is that researchers use meditators who have not meditated enough to reveal meditation's potential. We were fortunate to have the cooperation of long-term, expert meditators, which gave us confidence that we would find any lateralization differences, if such exist.

METHOD

Subjects

We used 21 unpaid volunteer Transcendental Meditators, whose mean length of regular Transcendental Meditation practice was 7.3 years (ranging from 3.5 to 12.5, $SD = 2.2$). Sixty-two percent were teachers of the technique, and 86% were *siddhas*; both statuses require extensive meditation experience. Sixty-two percent of the subjects were both teacher and siddha. Also, 62% were tested while living at a *Siddha-Land*, which is something like a monastery wherein meditation is the focus of life.

Nonmeditators were 20 New College student volunteers and 1 nonstudent volunteer. They were paid for their 1 h of participation. All subjects were male, and right-handed by self-report.

Materials

A Lafayette Instruments (Lafayette, IN) Electro-Tach 40010 portable tachistoscope was used, after modification to eliminate leakage of information to the subjects. This device uses ambient light for the field containing the central fixation display. The fixation display was a pattern of 10 radiating lines surrounding a blank spot slightly larger than one of the central digits that were flashed in it.

Because of its reliability in producing strong visual field differences (Boles, 1983), the unilateral-plus-digit paradigm was used: One word or face target appeared at a time, in either the right or the left visual field, with a single digit in the center. The 16 face photographs from Suberi and McKeever (1977) were used to prepare 64 face stimulus cards. Each face was presented twice in the right and twice in the left visual field. The center of each stimulus card contained a single digit from the set of 0 through 9, inclusive.

The 10 word stimuli were BEAR, CAKE, DOVE, EPIC, FARM, GOLD, HARE, LANE, MASK, and POST; they have yielded lateralization in studies by Boles (1983) and McKeever and Huling (1971). Each word was presented three times in the right and three times in the left visual field, for a total of 60 stimulus cards. Each of these cards also contained a single central digit. The letters and central digits were 0.2 cm wide × 0.4 cm high, the words 1.5 cm long with centers 3.7 cm from the field center. The face photos were 3.6 cm wide × 4.1 cm high, their centers 2.6 cm from the field center. The subjects were allowed to choose their own most comfortable viewing distance between 21 and 66 cm from the display, because the particular angular displacement of stimuli from the display's center does not change lateralization as long as the angle is at least 0.25° (Harvey, 1978; Haun, 1978). The testing environment varied slightly for the meditators, by practical necessity. To informally balance that, the nonmeditators were also tested in several slightly different locations. All the settings had moderate-to-dim lighting and minimal distractions.

Procedure

The subjects fixed their gazes on the center of the fixation pattern; then they were given an oral ready signal, followed about 1 sec later by a stimulus card presented for 100 msec. The subjects orally reported first the central digit (which they were told was of primary importance), and then the word or face that appeared on the side (for which they were told to use their peripheral vision). They recognized the faces on a card containing all 16 alternatives, which was available outside the tachistoscope throughout the experiment; they reported a letter that identified the picture on the choice card. They were not given a choice set of word stimuli, but were told only that the stimuli were nonabbreviated English words of any length. Accuracy feedback was not given. All the stimulus cards were presented in this fashion in random order, shuffled between subjects.

At the beginning of his run, each subject was read the instructions for the entire experiment, and was asked to read and sign an informed consent statement. Then he was given two sample trials and had his questions answered. The 64 faces trials were run first, with 1-min rest breaks after the first 24 and the next 20 trials. A 5-min break separated the face from the word trials, which were run in three 20-trial blocks, with 1-min breaks between.

RESULTS

Scoring was done as percent correct for each subject, separately for left and right visual fields and separately for words and faces. If a central digit was incorrectly reported, that entire trial was deleted from further consideration, because we could not assume that the subject was gazing at the center of the field. For faces, meditators had a mean percent correct in the left visual field of 46.1 and in the right visual field of 42.7, making for a left-visual-field superiority of 3.4%. Nonmeditators were virtually identical, showing mean percent correct of 49.3 in the left visual field and 45.7 in the right visual field, for a left-visual-field superiority of 3.6%. For words, meditators had 35.6% correct in the left visual field and 50.0% in the right visual field, for a right-visual-field superiority of 14.4%. Nonmeditators once again were almost the same, with 35.4% in the left visual field and 50.2% in the right visual field, for a right-visual-field superiority of 14.8%.

We performed a three-way ANOVA on the variables of group (meditators vs. nonmeditators), visual field (left vs. right), and stimulus (faces vs. words). The analysis showed significance only for the main effect of visual field [$F(1,40) = 20.63$, $p = .0001$] and for the interaction of visual field with stimulus [$F(1,40) = 48.30$, $p = .0001$]. This interaction supports the underlying hypothesis of the tachistoscopic lateralization paradigm: Different types of stimuli requiring different types of processing are recognized better by different cerebral hemispheres. One-way ANOVAs for the simple main effects of visual field at the faces and words levels of stimuli revealed the expected visual field superiority for words [$F(1,41) = 88.25$, $p = .0001$] and, marginally, for faces [$F(1,41) = 3.21$, $p = .08$]. The rest of the comparisons, including the critical group × visual field × stimulus interaction, were all nonsignificant, with all *F*s less than 1.

DISCUSSION

The hypothesis that visual field differences would be different for meditators than for nonmeditators, both within words and within faces, was not supported by the three-way interaction. Thus, at least in the aspects measured by our procedure, Transcendental Meditators do not appear to be more lateralized than nonmeditators, contrary to the EEG results of Bennett and Trinder (1977). Nor are they less lateralized than nonmeditators, as suggested by the ear-superiority data of Meissner and Pirot (1983).

Before this conclusion can be drawn, however, it is necessary to consider alternative interpretations of the results. Lack of experience at meditation is unlikely to be a problem, first, because of the considerable experience of these meditators, and second, because, within the meditation group, correlation of meditation experience with lateralization—the latter indexed by the arithmetic interaction of visual field with stimulus [i.e., $(LVF-RVF)_{faces}$ + $(RVF-LVF)_{words}$%]—was not significantly different from 0 [$r(19) = +.14$]. Nor does the greater mean age of the meditators (31, vs. 21 for the nonmeditators) seem to be a confounding factor, because correlation of age with lateralization was nonsignificant [$r(19) = +.20$].

A possible explanation of Bennett and Trinder's (1977) positive EEG finding is the meditators' greater motivation to cooperate and perform in order to vindicate their practice. If they concentrated on the given hemisphere-specific tasks to the exclusion of distractions, they might show more activity in the appropriate hemispheres than would the less concentrating nonmeditators. Our paradigm appears to be immune to such influence, because total percent correct did not significantly correlate with lateralization as indexed by arithmetic interaction of visual field with stimulus [meditators' $r(19) = -.02$, controls' $r(19) = +.04$]. The logic of this comparison is that increased motivation should increase the total percent correct; so if motivation affects asymmetry, a correlation should be observed between total percent correct and the arithmetic interaction. That it was not suggests that motivation had no great effect on the asymmetry obtained with this procedure.

Finally, the hypothesized greater reliance on right hemisphere function in meditators (Abdullah & Schucman, 1976; Boals, 1978; Davidson, 1976; Kubose & Umemoto, 1980; Ornstein, 1972; Pagano & Frumkin, 1977; Tart, 1975) is also not supported by these data. Such an effect might have been revealed by the greater accuracy of meditators in the left visual field and with faces, and lesser accuracy in the right visual field and with words, compared with nonmeditators. There were no significant differences in these comparisons (the group × visual field and group × stimulus interactions).

Some researchers refuse to consider null results, though the faults of such prejudice have been well documented (Greenwald, 1975). Our null results seem convincing, because the meditators were as expert as one could hope. Granted, this was not a within-subjects experiment, so it is possible that people who are willing to persist in meditation for years are initially less asymmetric than are people who are not willing to meditate, and that meditation increases asymmetry to the level of nonmeditators'. The dropout rate of novice meditators is so high that it would be very difficult to make our study, with such expert meditators, a longitudinal one. Support for our conclusion of no difference also comes from the nearly exact equality of the meditators' asymmetries to the nonmeditators', compared with the absolute sizes of the asymmetries; there was plenty of room for differences to manifest, given the strengths of the overall asymmetries.

Perhaps meditation does cause cognitive change and is useful clinically, but we doubt that any change happens via alterations in use of the cerebral hemispheres. At the least, lateralization is not a sufficiently unitary phenomenon to warrant the simple generalization that meditation changes lateralization. Three different operationalizations of lateralization have yielded the three different results of increased asymmetry (EEG, by Bennett & Trinder, 1977), decreased asymmetry (auditory function, by Meissner & Pirot, 1983), and no change (visual function, by us).

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(Manuscript received July 27, 1989.)