ABSTRACT: The aim of this investigation was to examine the immediate effects of meditation on cognitive performance. Twenty-seven experienced meditators and twenty-seven non-meditators were tested and compared for differences in cognitive performance immediately following either a short meditation session (meditators) or a relaxation session (non-meditators). Meditators were hypothesised to perform significantly better than non-meditators on a battery of seven tests of cognitive function. However, meditation was not found to be more effective than relaxation on any of the test measures. Even though there is evidence that meditation provides immediate emotional and physiological benefits, results from the present study suggest that these benefits do not extend into the realms of cognition to any significant degree.

KEY WORDS: meditation; short term meditation; long term meditation; cognition; cognitive functioning; cognitive performance; relaxation.

Research evidence supports the claim that meditation provides considerable emotional and physiological benefits to those who practise the art (Davidson, et al., 2003; Delmonte, 1984; Travis & Wallace, 1999). Over the past forty years, several hundred studies have investigated the effects of meditation in the psychological and physiological domains with encouraging results (e.g., Canter, 2003; Davidson, et al., 2003; Haimerl & Valentine, 2001). In addition, investigations of long term effects of meditation on cognitive performance have obtained positive results (Cranson, et al., 1991; Dillbeck, 1982; Dillbeck, Assimakis, Raimondi, & Kember, 1985; Orme-Johnson, & Rowe, 1986; So & Orme-Johnson, 2001; Yucel, 2001). It is thus reasonable to inquire whether meditation can provide immediate cognitive benefits, a possibility that has received little attention.

Meditation has been practised for at least 2,500 years, over which time divergent approaches have evolved that aim to converge upon a similar goal (Naranjo & Ornstein, 1971; West, 1979). The process of meditation offers a wide variety of attentional control and relaxation techniques that may be broadly categorised into three main groups (Carrington, 2003; Naranjo & Ornstein, 1971): reductive/concentrative approaches (e.g., Transcendental Meditation), receptive/expressive approaches (e.g., Shamanism) and expansive/mindfulness approaches (e.g., Insight Meditation). Concentrative approaches instruct the meditator to restrict focus of attention to a single stimulus such as a word, symbol, sound, object or sensation. It is an outer-directedness approach that aims to interiorize an external form (a symbol, for example). There is a relinquishing of spontaneity insofar as the meditator is
encouraged to draw focus back to the single stimulus if attention wanders while ignoring the nature of any distraction. In contrast, an inner directedness typifies the receptive/expressive approach whereby attention is receptive or open to promptings of the meditator’s inner thoughts. It is an expressive process, the aim of which is to relinquish expectations and preconceptions so as to develop a spontaneity free from external influences such as traditional or societal belief systems. The meditator learns to be open to his inner experience through undistracted receptivity. These two orientations may be contrasted with the expansive/mindfulness approach that encourages neither an inner nor outer directedness, but a ‘self emptying’ through not identifying with anything that is perceived. This style of meditation aims to develop stillness of mind, detachment from psychological acting, non-judgmental observation of internal and external stimuli as they arise, and a minimization of goal directed mental activity. These aims are taught with the idea of leading the meditator to insight through a detached observation of experience (Baer, 2003; Naranjo & Ornstein, 1971).

Traditionally, the principal aim of meditation has been to become ‘fully conscious’, or ‘enlightened’, a state of heightened awareness meditators believe is attained by the experience of direct knowledge of an absolute such as God, Being, Unity, Brahma or ‘The One’ (West, 1979). In order to achieve this level of awareness, the practitioner aims to alter his or her state of consciousness. Hence, meditation is often described as an altered state of consciousness (Tart, 1975) or a ‘wakeful hypometabolic state’ (So & Orme-Johnson, 2001). However, it is worth noting that anesthesia, hallucinogens, and hypnosis also produce similarly altered states (Tassi & Muzet, 2001). Thus, to define meditation merely in terms of an altered state is insufficient. For this reason, investigation of subjective reports may provide further useful insight and assist in distinguishing the meditative state. Many individuals report powerful subjective experiences while meditating. Common subjective reports describe the experience in terms of peace and tranquility, ‘uncommunicability’, transcendence of sense modalities, absence of specific content such as images and ideas, and feelings of ‘unity with the ultimate’ (Shapiro, 1983). Other descriptions of the meditative experience include clarity of thought, feelings of timelessness, and awareness beyond thought, sensation, emotion, desire, and memory (Chopra, 1993).

While subjective reports are important to the individual, there is difficulty in experimentally validating these experiences. More objective approaches to the study of meditation have thus focused on the measurement of physiological effects. Such research may help explain the changes described in subjective reporting, and may also indicate where and why particular benefits may accrue to an individual, including those within the cognitive realm. State effects of meditation include a slowing of respiration and heart rate, an increase in basal skin resistance, decreased metabolism, higher electroencephalogram (EEG) amplitude, higher alpha and theta coherence and increased cerebral blood flow (Newberg et al., 2001; Orme-Johnson, 1995; Travis, 2001; Travis & Wallace, 1999). An increase in EEG alpha and theta activity is reported to be associated with increased mental alertness (Orme-Johnson & Haynes, 1981; Travis & Wallace, 1999). Alpha levels have also been shown to persist after meditation (Williams & West, 1975). Other changes include significant increases in left side anterior activation, a pattern previously associated with positive affect, and an increase in antibody titers, a measure of immune functioning.
In addition, Ritskes, Ritskes-Hoitinga, Stodkilde-Jorgensen, Baerentsen, and Hartman (2003) examined eleven experienced Zen meditators while they were moving from normal consciousness to a meditative state, via functional magnetic resonance imaging (fMRI) scanning. They found an increase in activity in the prefrontal cortex, which is associated with problem solving, and basal ganglia, which is associated with motor control. Ritskes, et al. (2003) also reported deactivation of the anterior cingulate, which is associated with ‘will’. Cortisol levels have been found to decrease during meditation, remaining somewhat low afterwards, which may assist the inhibition of memory decay (Jevning, Wilson, & Davidson, 1978). Finally, meditation has also been associated with a stronger orienting and recovery response to stressors (Delmonte, 1984).

Although cognitive benefits have not traditionally been associated with meditation, the ubiquitous character of physiological changes suggests that some benefit might occur. So and Orme-Johnson (2001), in a longitudinal study, found evidence to suggest that regular transcendental meditation developed general cognitive abilities. A comprehensive battery of six tests of cognitive ability was administered and experimenter bias was controlled for by test administrators, who were not aware to which condition participants belonged. Participants were drawn from a Taiwanese student population (14–18 year olds) and the transcendental meditation technique was taught at a cost to the school or student. Three experiments were conducted, with the second (females only) and third (males only), being replications of the first (males and females). Results were similar across all three experiments regardless of gender, age, school type (public or private), geographical location, or cost. However the variables on which transcendental meditation had the strongest effects were creativity, practical intelligence, and field independence. Results were also promising when another longitudinal study by Cranson et al. (1991) suggested that participation in their ‘special university curriculum’ of twice-daily transcendental meditation improved performance on intelligence-related measures. Comparisons were made with another university freshman student body over a two year period. IQ scores increased an impressive nine points when transcendental meditation was tested for its longitudinal effects on cognitive style and cognitive ability over a three to five year period (Dillbeck et al., 1986). Kember (1985) added further evidence to link cognitive performance and long term meditation when he found that transcendental meditation improved academic performance over a six month period. Even the elderly have been reported to benefit cognitively from meditation. Yucel (2001) found that transcendental meditation improved cognitive functioning in long term elderly meditators, compared to a control group matched for age and gender. It was concluded that transcendental meditation may provide a buffer to cognitive aging.

Not all of the evidence in relation to long term effects of meditation is positive. For example, two longitudinal studies have reported no effect of meditation on cognitive functioning. Carsello and Creaser (1978) found no significant differences when grades of 70 matched pairs of students were analysed. All data were collected retrospectively from records available between 1973 and 1976. Half the participants were trained in transcendental meditation over a three month period with grades collected after three and six months post-training. Carefully matched participants substantially insulated the data from longitudinal methodological problems. Nonetheless, a lack of random allocation may still have posed an expectancy of
enhanced performance for the transcendental meditation group compared to the control group. Furthermore, Yuille and Sereda (1980) found no significant differences when the effects of two types of meditation (transcendental meditation and 'savasana') on cognitive functioning were compared to a pseudo-meditation control and a standard control. Considerable effort was taken to reduce participant and experimenter expectancies with the inclusion of a pseudo-meditation control and blind test administration. A large sample size (136 participants), randomly assigned to each condition, was assessed via a battery of ten tests. Training was conducted over a three month period following pre-testing. Post-testing followed after a lapse of a further three months. There was an unexpected 60% drop out rate of predominantly younger people spread evenly across the groups. To account for the drop out rate, it was suggested that meditation was not always a positive experience and, further, that positive experiences or even the capacity to achieve a meditative state may be limited to a minority. Although the final analysis was compromised by the drop in numbers, there remained sufficient strength in the experimental design to permit persuasive conclusions. Of the remaining participants, novice meditators were as likely to show improvements as experienced meditators. In addition, pseudo-meditators showed as many improvements as the savasana and transcendental groups. Yuille and Sereda (1980) report that these mixed findings, together with the few significant effects found, provide sufficient evidence to suggest that the practice of meditation had no systematic effect on the test measures in their study.

These two studies with negative findings urge closer examination of the longitudinal investigations that present evidence to the contrary. A six to twelve month lapse between pre and post-test in the So and Orme-Johnson (2001) study posed typical longitudinal research issues of controlling for confounds such as time effects, maturation effects, and history effects. This presents the problem of being able to confidently isolate meditation as the variable that affected performance on cognitive measures. The use of a control group, however, contributed toward moderating such confounds. Dillbeck’s et al. (1986) results should be viewed with some caution as researchers recruited participants already committed to the transcendental meditation program and longitudinal research problems were not moderated by the use of a control group. Kember (1985) used nine pre-test examinations and twelve post-test examinations, suggesting that pre-test examinations may well have been different in content to post-test versions.

Despite negative findings, the preponderance of positive results in relation to long term effects on cognitive functioning suggests the possibility that there may also be short term benefits. That is, it is possible that some aspects of cognitive function may be better immediately after a meditation session. There is, however, a paucity of research into the short term effects of meditation on cognition. Only Dillbeck (1982) has attempted to assess the immediate benefits of meditation. A reduction of conceptually driven mental activity was reported during the transcendental meditation technique, resulting in improved flexibility of visual perception but not verbal problem solving. Dillbeck’s hypotheses were based on Norman’s model (Lindsay & Norman, 1977), an interesting theoretical perspective which suggested that meditation reduced conceptually driven processes. He argued that this reduction of habitual patterns of activation would subsequently allow more effective and flexible application of schemata to new information and less distracting mental...
activity during performance. Short term (immediate) and longer term effects (two weeks) produced similar results. Participants were selected according to their interest in learning transcendental meditation. A control group consisted of those who showed no interest and an experimental group consisted of those who were interested in learning the technique. All experimental participants had not learnt transcendental meditation previous to their instruction and subsequent two weeks of twice-daily practice. A letter identification task was used in order to measure the immediate effects of a single experience of transcendental meditation. Results indicated an improvement in performance for the transcendental meditation group, although relaxation appeared to have an immediate effect similar to transcendental meditation in improving identification for the word-like letter sequences. The immediate effects of transcendental meditation, however, resulted in improvement for both conditions (random and word-like sequences). Longer term effects were found to improve performance on perceptual tasks (card and letter identification), but not on verbal problem-solving tasks (anagrams).

In summary, most of the literature has investigated the effects of meditation on cognitive performance with longitudinal studies, addressing only long term effects and leaving short term effects seriously under-explored. Therefore, the aim of the present study was to assess short term effects of meditation via a battery of tests of cognitive functioning to clarify the question of whether short term meditation for experienced meditators does provide a benefit to cognitive functioning over and above that provided by relaxation. Specifically, it was hypothesised that short term meditation would improve cognitive performance when compared to the effects of relaxation alone. The present study set out to test two groups, a meditation group who practised mindfulness meditation and a relaxation group, on a wide range of cognitive functions using a variety of psychometric tests.

**METHOD**

**Participants**

Fifty four participants (27 meditators and 27 non-meditators) were recruited from two sources. Murdoch University provided twenty seven students who did not practise meditation as well as seven who were experienced mindfulness meditators. Twenty members of the wider community participated in the study as experienced mindfulness meditators. Murdoch University students recruited from the School of Psychology subject pool received credit to fulfill a course requirement. Meditators from the wider community volunteered their participation time. The meditator group constituted 10 males and 17 females whose mean age was 42.2 years (SD = 18.4, range = 18–76). The mean number of years practising meditation for the meditator group was 10.8 years (SD = 8.8, range = .33–32). The non-meditator group constituted 8 males and 19 females whose mean age was 25.4 years (SD = 8.6, range = 19–51).

**Psychometric Measures**

The following seven paper and pencil tests of cognitive functioning were administered, each with a parallel version for post-testing. In addition, a projector
and 42 slides were used to present the targets for the Visual Patterns Test, the spatial component of the short term memory task. The following tests were carefully selected not only for their particular strengths as measures of cognitive function but for their ease of group administration.

**General Intelligence.** This was assessed by the Standard Progressive Matrices (SPM) (Raven, Raven, & Court, 1998). The test was divided evenly into two, with parts A, C, and odd numbered E items as pre-test and the remaining items as post-test. Estimates of the reliability of the Standard Progressive Matrices based on internal consistency for the timed version of the test range from .76 to .88 (Raven, Raven, & Court, 1998) and are comparable with other reported reliability data of the Standard Progressive Matrices (see Foulds & Raven, 1948; Raven, 1948; Stinissen, 1956). Estimates of the validity of the Standard Progressive Matrices based on correlations between performance on the timed version of the Standard Progressive Matrices and the Jenkins Non-Verbal Test, ACER test of reasoning, ACER Word Knowledge Tests range from .43 to .76 (Raven, Raven, & Court, 1998). In addition, Rogers and Holmes (1987) found reliable correlations between performance on SPM and WISC–R. with a range from .83 to .92.

**Verbal Fluency.** Based on the Controlled Word Association test (CWAT), participants were asked to list as many words as possible beginning with the letters C, F, then L at pre-test, on three separate pages. One minute was allowed per letter, with a five second interlude between letters as the next answer page was turned. The letters P, R, then W were treated similarly, post-test. These letters were selected on the basis of the frequency of English words beginning with these letters (Benton & Hamsher, 1989). The score was the sum of all correct words produced in the three one-minute trials. Ruff, Light, Parker, and Levin (1996) assessed the degree of internal consistency that existed among C, F, and L. Coefficient alpha was calculated by using the total number of words generated for each letter as individual items and was found to be high (r = .83). Test-retest reliability tends to be high (above .70) for both short and long intervals (Basso, Bornstein, & Lang, 1999; Dikmen, Heaton, Grant, & Temkin, 1999). Correlations among phonemic fluency tasks (e.g. FAS and CFL) range from .85 to .94 (Cohen & Stanczak, 2000; Lacy, Gore, Pliskin, & Henry, 1996; Troyer, 2000). In addition, it is not surprising that correlations between .44 and .87 have been reported between phonemic fluency and verbal IQ (see Henry & Crawford, 2004, for a review) as phonemic fluency was initially developed as a measure of Verbal IQ (Thurstone, 1938).

**Spatial Reasoning.** This was assessed by the Group Embedded Figures Test (GEFT) (Witkin, Oltman, Raskin, & Karp, 1971), an eighteen-item test containing tasks involving relatively complex figures. Participants were required to identify the hidden figure by tracing the outline of a simple form embedded in a more complex one. The number of correctly identified simple forms within the complex figures was the participant’s raw score. The test was divided into two equal parts for pre and post-test purposes. Reliability coefficients range from .8 to .85 for college students (Witkin, Dyk, Faterson, Goodenough, & Karp, 1962). In addition, correlations between the nine-item First Section scores and the nine-item Second Section scores of the Group Embedded Figures Test were estimated to be .82. These figures compared favourably with the parent test Embedded Figures Test (EFT). Validity
has been evaluated in terms of Group Embedded Figures Test’s relationship to EFT, Rod and Figures Test (RFT) and the ABC scale as applied to the assessment for degree of body differentiation articulation (Faterson & Witkin, 1970; Witkin et al., 1962). Correlation coefficients ranged from $-0.39$ to $-0.82$ (r’s for EFT and RFT should be negative because the tests are scored in reverse fashion) (Witkin, Oltman, Raskin, & Karp, 1971).

**Memory – Spatial.** This was assessed using a figure from the Rey-Osterrieth Complex Figures Test (CFT-RO) (Osterrieth, 1944). Participants copied this figure freehand, without time restriction. After twenty minutes of interpolated activities, they were asked to reproduce the figure. Scoring was calculated in accordance with the score guide (Osterrieth, 1944). A complex figure, based on the scoring units of the pre-test version, was designed by the author for the purpose of post-testing. Test-retest reliability correlations using alternate forms (Rey-Osterrieth Complex Figures Test, Complex Figures Test-Taylor) were in the .60 to .76 range (Berry, Allen, & Schmitt, 1991; Delaney, Prevey, Cramer, & Mattson, 1988). Internal reliability of the Rey-Osterrieth Complex Figures Test was evaluated by treating each detail as an item and computing split-half and alpha coefficients (Berry, Allan, & Schmitt, 1991; Fasteneau, Bennett, & Denburg, 1996). Both coefficients were greater than .60 for the copy condition (immediate recall) and .80 for the delayed recall condition of 20 or 30 minutes. Data from correlational and factor analytic studies support the validity of the Rey-Osterrieth Complex Figures Test as a measure of visual-constructional ability (copy) and memory (recall and recognition). Correlational analyses show scores on the Rey-Osterrieth Complex Figures Test are moderately related to performance on visual-spatial subtests of the Wechsler Intelligence Test (e.g., Poulton & Moffitt, 1995; Tombaugh, Schmidt, & Faulkner, 1992). In addition, scores on the Rey-Osterrieth Complex Figures Test CFT-RO were moderately related to the Perceptual Organisation factor of the WAIS-R (Sherman, Strauss, Spellacy, & Hunter, 1995).

**Memory – Verbal.** Participants recorded a list of fifteen common words, read out by the experimenter at a rate of one second per word. After a delay of twenty minutes they were asked to reproduce as many of these words as possible in any order. The score recorded was the number of words correctly recalled. List A and B from the Auditory-Verbal Learning Test (VL) (Rey, 1964; Taylor, 1959), constituted the pre and post-test words. Test-retest reliability coefficients ranged from .60 to .70 (Mitrushina & Satz, 1991). In factor analytic studies, learning measures of Auditory-Verbal Learning Test correlate significantly with other learning measures with ranges between .50 to .65 (Macartney-Filgate & Vriezen, 1988; Ryan, Rosenberg, & Mittenberg, 1984).

**Short Term Memory – Verbal.** This was assessed by the Digit Span (DS) subtest of WAIS-III (The Psychological Corporation, 1997; Wechsler, 1981). Random strings of two to eight digits were presented successively. Each string was announced at a rate of one digit per second with a maximum ten second pause for recall after each string. Instructions preceding the digit strings included a sample of three strings. The assigned score was the number of strings of digits correctly recalled irrespective of order. Reliability coefficients for the digit span subset are high. Internal consistency coefficients were found to be greater than .90 and test-retest
coefficients between .80 to .89 (The Psychological Corporation, 1997). Digit span is considered to have ample subtest specificity indicating that it is a feasible representation of the unique abilities attributed to the subtest. In addition, moderate to high intercorrelations between the subtests provide some evidence of convergent and discriminant validity of indexic (The Psychological Corporation, 1997). Correlations with other measures of intelligence, including the Standard Progressive Matrices, the Stanford-Binet-IV (The Psychological Corporation, 1997), the GAMA (Martin, Donders, & Thompson, 2000), the Dementia Rating Scale (The Psychological Corporation, 2002), and the WASI (Axelrod, 2002; The Psychological Corporation, 1999), range from .6 to .92.

**Short Term Memory – Spatial.** This was assessed on a Visual Patterns Test (VPT), in parallel forms, a version based on the Della Sala, Gray, Baddeley, Allamano and Wilson (1999) test. Participants were presented with checker-board patterns which were designed to be difficult to decode verbally. A visual pattern was created by filling in half the squares in a grid. The grids progressed in size from the smallest, a $2 \times 2$ matrix (with two filled cells) to the largest, a $5 \times 6$ matrix (with fifteen cells filled), complexity being steadily increased by adding two more cells to the previous grid. The level of complexity of a pattern was defined as the number of filled cells in a grid, and thus ranged from a minimum of two (for the $2 \times 2$ matrix) to a maximum of fifteen (for the $5 \times 6$ matrix). In each set of patterns there were three patterns at each level of complexity, carried in three grids of the same size and shape. The patterns were displayed in a series of stimulus slides, numbered sequentially. Each slide was presented to participants for three seconds. The order of the patterns was carefully preserved. Participants were asked to reproduce the pattern by marking squares in an empty grid of the same size as the one bearing the pattern just presented. The score was the number of correctly filled matrices. The test-retest reliability of the original Della Sala, Gray, Baddeley, Allamano, and Wilson (1999) Visual Patterns Test Form A and Form B was .75 and .73, respectively. Parallel forms reliability was found to be .81.

**Procedure**

The seven tests outlined above took about three hours to administer, requiring two separate 1.5 hour testing sessions. Testing was divided in this way to provide maximum opportunity for the effects of meditation to be captured. The duration of the pre-test and post-test periods was 35 minutes with a 20 minute intervention of either relaxation or meditation in between pre and post-testing. During the intervention period the non-meditation group relaxed quietly while the meditation group meditated. Meditators were instructed to proceed to meditate with the aim of obtaining as deep a meditative state as possible. All meditators used the mindfulness meditation technique. Non-meditators were instructed to match the physical attitude of the meditation group by sitting upright in silence with eyes closed. Relaxers were instructed to resist falling asleep. All participants remained at their testing desks during the intervention period. Post-testing followed immediately after the intervention in order to take full advantage of any effects of meditation or relaxation. All participants were administered both pre and post versions of the paper and pencil test measures in the order: Visual Patterns Test, Verbal Learning, Standard Progressive

*Short Term Effects of Meditation* 207
Matrices, and Auditory-Verbal Learning Test in the first session, and Digit Span, Complex Figures Test – Rey-Osterrieth, Group Embedded Figures Test, Controlled Word Association Test, and Group Embedded Figures Test in the second session. All test measures were administered post-test in either a parallel form or as one half of the same test, as outlined above. Group testing prohibited the presentation of these tests in reverse order for half the participants in the same session. Sessions were presented in the morning on consecutive days, or as close together as possible in order to control for confounds associated with the passage of time.

RESULTS

Analyses of Performance on Individual Tests

Seven separate analyses of variance were performed on the pre-test and post-test scores shown in Table 1, each based on a mixed design featuring meditators/relaxers as a between-groups factor and the relevant test measure in each case as the within-groups factor. There were no significant main effects for group in any of the analyses, indicating that meditator and non-meditator (relaxer) samples were well-matched on the abilities measured on each test. The main effect of test measure was significant for Visual Patterns Test ($F[1,52]=46.05; MS = 715.59; p < .001$) and Group Embedded Figures Test ($F[1,52]=4.52; MS = 11.02; p = .038$). As Table 1 shows, post-test scores were higher than pre-test scores on these measures for both groups. While the increase in Group Embedded Figures Test scores may have represented a genuine improvement, the increase in Visual Patterns Test scores may have been due to practice effects. Even though the post-test was a different, parallel version of the pre-test, a technique of how best to capture the patterns in the matrices may have been learnt during the pre-test. Nevertheless, both tests represent an improvement in spatial reasoning, although there was no improvement in Complex Figures Test – Rey-Osterrieth, a test of spatial memory. The main effect of test

Table 1
Comparison of pre-test and post-test mean scores and difference scores for meditation and non-meditation groups, using raw scores for each measure

<table>
<thead>
<tr>
<th></th>
<th>Non-Meditation group</th>
<th></th>
<th>Meditation group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td>Post-test</td>
<td>Diff score</td>
<td>Pre-test</td>
</tr>
<tr>
<td>VPT</td>
<td>26.11</td>
<td>30.96</td>
<td>4.85</td>
<td>22.55</td>
</tr>
<tr>
<td>VL</td>
<td>6.07</td>
<td>6.00</td>
<td>-0.07</td>
<td>6.92</td>
</tr>
<tr>
<td>SPM</td>
<td>24.89</td>
<td>23.70</td>
<td>-1.19</td>
<td>23.85</td>
</tr>
<tr>
<td>DS</td>
<td>12.19</td>
<td>12.19</td>
<td>0.00</td>
<td>12.26</td>
</tr>
<tr>
<td>CFT-RO</td>
<td>24.39</td>
<td>23.56</td>
<td>-0.83</td>
<td>25.30</td>
</tr>
<tr>
<td>GEFT</td>
<td>6.26</td>
<td>7.13</td>
<td>0.87</td>
<td>5.33</td>
</tr>
<tr>
<td>CWAT</td>
<td>40.22</td>
<td>41.63</td>
<td>1.41</td>
<td>39.56</td>
</tr>
</tbody>
</table>

Note:
VPT: Visual Patterns Test
VL: Auditory-Verbal Learning Test
SPM: Standard Progressive Matrices
DS: Digit Span—subtest of WAIS III
CFT-RO: Complex Figures Test – Rey Osterrieth
GEFT: Group Embedded Figures Test
CWAT: Controlled Word Association Test

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measure was also significant for Standard Progressive Matrices (F[1,52] = 11.13; MS = 42.81; p = .002). Unexpectedly, Standard Progressive Matrices post-test scores were lower than pre-test scores, as reflected in the negative difference scores for this measure in Table 1. It is possible that the post-test for this measure was more challenging than the pre-test. Parts A, C, and odd numbered questions of E were used for the pre-test, and the remaining parts constituted the post-test. A finer-grained division of material, such as distributing all items on the basis of an odd/even split, might have produced more closely equivalent versions of Standard Progressive Matrices pre- and post-test.

In the context of the aims of the present study, however, the most critical result to emerge from the above analyses was the absence of an interaction effect in relation to any of the seven test measures. As the difference scores in Table 1 illustrate, changes in performance across the meditation/relaxation experience were very similar for each group. These results clearly suggest that meditation does not differ from relaxation in short-term effects upon the cognitive processes underlying the measures used in this study.

The next step in the analysis was to examine the data for significant differences across a combination of the seven test measures for the two groups. A multivariate analysis of variance (MANOVA) was performed, using difference scores for each group. No significant multivariate effect was found for group on a linear combination of the seven test measures (Pillai’s Trace = .983, p > .05). Therefore there were no significant differences in the performance of the groups when all the test measures difference scores were combined and compared. Meditation made no significant difference to performance across the combination of test measures.

Finally, correlational analyses involving the calculation of the coefficients between number of years meditating and scores on the dependent variables were performed to examine the relationship between years of experience meditating and the mean scores for each of the seven test measures, for the meditation group only. This relationship was significant for Standard Progressive Matrices (r = -.34, p = .043) and Group Embedded Figures Test (r = -.52, p = .003), but in a negative direction. Age may have been a confounding factor in this respect, as it is well known that cognitive performance declines with age (Wilson, Beckett, Barnes, Schneider, Evans, & Bennett, 2002). No other significant relationships were revealed in this analysis. Partial correlations were subsequently performed to examine the relationship of years of experience meditating and performance on mean scores for Standard Progressive Matrices and Group Embedded Figures Test while controlling for the variable age. As suspected, age was found to influence mean test scores for both Standard Progressive Matrices and Group Embedded Figures Test. When the variable age was controlled, no significant relationship between years of experience meditating and mean scores were revealed for Standard Progressive Matrices and Group Embedded Figures Test.

**DISCUSSION**

The present study shows very clearly that meditation does not produce a short term improvement in cognitive performance. No differences were found between the
Meditation did not heighten cognitive performance any more than relaxation. Indeed, both meditation and relaxation conditions did little to improve cognitive performance as scores on only two of the seven test measures (Group Embedded Figures Test and Visual Patterns Test) showed significant improvement for both groups. Interestingly, these tests represented spatial reasoning (Group Embedded Figures Test) and spatial short term memory (Visual Patterns Test) (although Complex Figures Test – Rey-Osterrieth – spatial long term memory – showed no improvement). Such results suggest that the relaxation attribute of both conditions may serve to improve spatial aspects of cognition. In addition, one test measure (Standard Progressive Matrices) actually scored worse post-test. However, there is some doubt about the equivalence of pre and post-test versions of the test. The post-test version may have been more difficult.

Despite the apparent clarity of the present results in demonstrating the absence of short term effects of meditation on cognitive function there are some alternative explanations that deserve consideration. Failure of this study to support the hypotheses could be attributed to (a) the meditator group not achieving similar altered states to that of the transcendental meditators in previous research, (b) the test measures being insensitive to the changes that meditation induced, and (c) the test measures being unable to capture the changes due to a rapidly diminishing effect of short term meditation. In terms of the first possibility, it was very difficult to determine whether each of the meditators was reaching any significant meditative state. Some of the meditators did report not being able to obtain their usual ‘depth’, but subjective reporting can be an unreliable measure, particularly when comparing levels of meditative states. The meditative experience is described as ineffable (Frank, 1977); thus, comparing one person’s ‘depth’ to another is virtually impossible. Furthermore, twenty minutes may not have been long enough to produce sufficiently altered states. Further research would be needed to ascertain an ideal time period in order to determine whether this was a problem in the present study. It is also possible that transcendental meditation (the dominant method applied in most previous studies, but not in the present study) may be a more effective way of quickly achieving a meditative state. Nevertheless, when various methods of achieving the meditative state were compared by Yuille and Sereda (1980), no differences were found. In addition, it is unlikely that meditators in the present study, with their extensive experience of meditation (mean = 10.8 years), would not be effective meditators. In fact, one would imagine they would be very capable meditators compared to the samples used in most of the past studies, in the majority of which experimental participants were taught from scratch and then tested some weeks or months later.

The second problem concerns the question of whether the test measures were capable of capturing any short term cognitive changes that meditation might have produced. In this respect, however, it is important to note that a broad and comprehensive battery of standard psychometric measures was selected for use in the study. While it was not expected that meditation would affect all of these measures, it difficult to see how meditation, if in any way effective, could fail to affect any of the measures. Thus, the absence of any improvements in performance on these tests, relative to the control group, suggests that it is unlikely that the measures themselves were at fault.
A third possibility to account for a failure to support the hypotheses is that the test measures were unable to capture changes due to a rapidly diminishing effect of short term meditation. This possibility is supported by other evidence that short term effects of meditation decay rapidly (Williams & West, 1975). The large number of measures used in the present study may have involved a test period that was too long to capture short-lived meditation effects. There was, however, no evidence to suggest that participants performed any better in tests performed immediately after meditation than in those performed later on. Nonetheless, physiological evidence shows that changes that occur during meditation are profound but drop off rapidly afterwards, suggesting that any benefits to be observed may only be captured during meditation itself. If so, it begs the question of the relevance of short term meditation to cognitive function. In other words, even if such fleeting effects could be shown to exist, they would be little more than a theoretical curiosity, with few practical implications.

The present study was motivated by the apparently encouraging results in relation to the long term effects of meditation. The failure, however, to find any evidence of short term effects at least raises the possibility that the long term findings are illusory. There are a number of factors associated with long term studies that may influence results. Firstly, the longitudinal study immediately introduces various confounds. Through the passage of time, many variables may contribute to improved performance. It can therefore be difficult to conclude that any significant result is due to meditation alone, especially when a control group has not been utilised (e.g. Dillbeck, et al., 1986).

Secondly, in the literature supporting a positive effect of meditation on cognitive performance, problems with the choice of test measures can be found. For example, Kember (1985) used university course examinations as his test measures to claim improvements. One would expect students to improve as they progress through their academic years. As such, it can be argued that meditation may not necessarily be responsible for improvement in these results.

Thirdly, it may be seen as problematic that most of the research into the effects of transcendental meditation on cognitive performance has been produced by the Maharishi organisation. Research results that relate to a practice upon which an institution is founded need to be confirmed by independent researchers. It is noteworthy that the only two studies that found no effects of meditation on cognitive functioning had no affiliation to the Maharishi organisation. Yuille and Sereda (1980) found no evidence to support a positive relationship while employing a strong experimental design. In a retrospective study, Carsello and Creaser (1978) also found no relationship. All 70 participants were carefully matched by sex, grade-point average, the college attended, and first letter of last name, thus ameliorating the longitudinal problem of isolating meditation as the variable of influence. These studies suggest the need for further tightly controlled, carefully matched, longitudinal studies to assess the status of the positive results found in some previous research. If the positive results can be replicated, it may be that while long term meditation affects cognitive function positively, short term meditation may not. If the results cannot be replicated, evidence to support a rejection of the notion that meditation improves cognitive performance becomes even more compelling.
In any case, further exploration into short term effects would be useful. There are a number of factors of potential interest that might be examined. These include the use of alternative measures of cognitive function, choice of meditation technique, duration of meditation, assessment of depth of meditation achieved, and personality variables. Although the present study revealed no evidence that meditation has any immediate effect upon cognitive function, the possibility that meditation may be able to induce some improvement in cognitive function on a short term basis cannot be ruled out until such factors have been properly explored.

REFERENCES


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