***Original Research Paper***

# Changing Definitions of Meditation- Is there a Physiological Corollary? Skin temperature changes of a mental silence orientated form of meditation compared to rest

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**Abstract:** [Objectives] Until very recently, the U.S. National Center for Complementary and Alternative Medicine (NCCAM) defined meditation as "a conscious mental process that induces a set of integrated physiological changes termed the relaxation response". Recently the NCCAM appears to have reviewed its understanding of meditation, by including a new central feature: "In meditation, a person learns to focus his attention and suspend the stream of thoughts that normally occupy the mind", indicating a shift from a physiological ("relaxation-response") to an experiential (suspension of thinking activity) definition, more in line with traditional eastern understandings. We explore the physiological implications of this paradigmatic shift. [Design] A controlled, observational study.of acute physiological changes. N=26. Participants were asked to either meditate or rest for 10 minutes. [Settings/Location] A temperature controlled room at Swinburne University's Psychophysiology Laboratory, Melbourne. [Subjects] 16 meditators proficient at a mental silence orientated form of meditation (Sahaja yoga, SYM) and 10 non-meditators with an interest in meditation. [Interventions] A mental silence orientated form of meditation (Sahaja yoga, SYM) was compared to rest. [Outcome Measures] Palmar skin temperature and heart rate. [Results] Throughout the meditation period mean ST of the SYM group decreased while that of the Rest group increased. After ten minutes of meditation, 13 of the 16 meditators manifested a reduction in ST compared to baseline whereas 7 of the 10 participants in the control group manifested an increase compared to baseline. Chi-Square tests showed that the difference between the two groups was significant (p=.003). Heart rate changes however did not differ between the two groups. [Conclusions] The study suggests that the experience of mental silence and rest are not psychophysiologically identical despite the fact that they are overtly similar. Implications of this, and need for further evaluation, are discussed.

**Keywords: meditation, relaxation, arousal, skin temperature, controlled trial, mental silence, sahaja yoga, definition**

## 1. Introduction

Until very recently, the U.S. National Center for Complementary and Alternative Medicine (NCCAM) defined meditation as "a conscious mental process that induces a set of integrated physiological changes termed the relaxation response"[1]. Remarkably, in 2006 the NCCAM posted a reviewed understanding of meditation on its official website, describing a new central feature: "In meditation, a person learns to focus his attention and suspend the stream of thoughts that normally occupy the mind. This practice is believed to result in a state of greater physical relaxation, mental calmness, and psychological balance. Practicing meditation can change how a person relates to the flow of emotions and thoughts in the mind."[2]. The NCCAMs shift from and emphasis on the physiology of rest to the experience of "suspension of thought activity" raises an important question about whether or not this shift in conceptualization also implies a different physiological and clinical paradigm.

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Interestingly, the critical importance of the "suspension of thought activity" in meditation has been described in a number of traditional eastern treatises. Mascaro, an eminent translator of Eastern spiritual texts, summarises its metaphysical importance: "In the infinite struggle of man to know this world and the universe around him, and also to know the mind that allows him to think, he comes before the simple fact that life is above thought: when he sees a fruit he can think about the fruit but in the end he must eat it if he wants to know its taste: the pleasure and nourishment he may get from eating the fruit is not an act of thought" [3]. For example, the Upanishads are a collection of ancient spiritual writings from India which are among the first texts to deal with the subject of meditation. In the Kaushitaki Upanishad it is stated "It is not thought which we should know: We should know the thinker"[4]. In the Katha Upanishad "When the five senses and the mind are still, and reason itself rests in silence, then begins the path supreme." [5]. In Patanjali's Yoga Aphorisms, one of the first instructional treatises on yoga and meditation, it is stated "By being aware of the silent void moments pervading the emptiness between thoughts, one can glimpse and expand the skill of thought subjugation which leads to transformation.." [6]. Gynaeshawara, a 12th Century Indian mystic, describes the experience as part of yogic awakening "the imagination subsides, activity becomes calm, and the functions of the body and mind stand still" [7]. Non-thought consciousness is not unique to India; the ancient Japanese Rinzai Zen tradition also encompasses the principle, elegantly described in the Koan "What is the sound of one hand clapping?" [8] .The answer is, of course, that there is no sound and similarly the state of meditation involves no thinking activity. The aim of such a riddle is to challenge the mind into realizing the futility of rational thought, thus triggering a shift of consciousness toward the state of mental silence, described in the Zen tradition as "Satori" [9].

As the NCCAM's pre-2006 definition of meditation indicates, the scientific establishment has until recently come to define meditation in terms of the physiological changes that characterize the relaxation response: reductions in heart rate, blood pressure and respiratory rate and increases in skin temperature, skin resistance and alpha wave activity in the brain. So logically it should not be surprising that well-designed trials comparing the therapeutic effects of meditation-orientated practices to relaxation-orientated practices typically fail to demonstrate notable differences[10].

While the extant literature in the west makes it clear that the physiological changes induced by meditation are not significantly different to those of rest/relaxation we find a report on meditation by Rai, in India which offers contradictory evidence. It describes a series of small exploratory trials of meditation in which heart rate (HR), blood pressure (BP), and respiratory rate (RR) changed in the expected directions associated with reduced arousal but digital skin temperature consistently dropped by almost 2 $^{o}$C during a single meditation session. This did not occur in the comparison group, and seemed to become more prominent as meditators became more proficient[11]. The technique evaluated by Rai, called sShaja Yoga meditation (SYM), holds as its central defining feature the experience of "suspension of thought activity" or "mental silence" (Sanskrit: "nirvichara Samadhi" which when translated literally can mean "thoughtless awareness") ie the elimination of unnecessary thought activity while focusing the attention effortlessly on the "present moment" experience.

By way of contrast with Rai's report, our search of the English-speaking scientific literature yielded eight controlled trials assessing the physiology of meditation and its effect on skin temperature (ST) none of which report reductions in that variable: A group of novice TM practitioners showed increases in ST while paradoxically more experienced TM practitioners showed no such change when compared to a group trained in relaxation [12]; "biofeedback-supported respiratory meditation" led to an increase in digital ST[13]; a significantly larger increase in digital ST occurred during "mantra meditation" than a resting control [14]; when progressive relaxation was compared to a Christianity-based "devotional meditation" within-group increases were reported but no significant difference between the two groups is described[15]. Four other studies reported no significant changes in skin temperature: Ananda Marg [16]; a modified Transcendental Meditation (TM) technique[17]; the Relaxation Response[18]; Clinically Standardised Meditation and biofeedback [19]. Importantly, there are no reports in the western literature describing reductions in ST as a result of meditation. It should also be noted that we were unable to find any controlled studies that have assessed the effects of either mindfulness or mental silence styles of meditation on ST.

Recently, Manocha et al. (2002) conducted a randomized, controlled trial that was specifically

directed at detecting the therapeutic differences between "mental silence" orientated meditation versus relaxation. Here, SYM was used as a "mental silence" orientated intervention and compared to a standard stress management program matched for expectancy and other nonspecific effects in 59 people with moderate to severe asthma. At post-intervention the meditation group demonstrated significant improvements in mood state, aspects of asthma-specific quality of life, and, importantly, airway hyper-responsiveness (AHR), a relatively objective measure of patho-physiological severity. The change in AHR was both clinically and statistically greater in the meditation group, suggesting a differential effect detectable in both objective and subjective dimensions[20]. This contrasts with the only other published RCTs of meditation for asthma: In the first, conducted in 1975, TM was applied as part of the management of 25 asthma sufferers, but no between group comparisons were reported[21] while in the second, conducted in 1998, a multimodal yoga intervention that included meditative practices was compared to a waiting list control for 17 asthma sufferers. No between-group differences were found at post-intervention[22]. Looking beyond the confines of meditation, a systematic review of RCTS of relaxation therapies for asthma (including progressive relaxation, hypnotherapy, autogenic training, and biofeedback, but not meditation) concluded that there was no evidence for a positive effect on asthma management[23]. Manocha proposed that the findings of this trial may have resulted from fundamental differences between traditional eastern meditative practices, which strictly distinguish meditation as an experience of mental silence from the popular, more loosely defined westernized ideas of meditation as a method aimed at reducing physiological arousal.

Reflecting the notion that a traditional, mental silence-orientated conceptualization of meditation might have effects distinct from simple reduction of arousal, a well-designed EEG study by Aftanas of established mental silence meditators demonstrated that, first, the practice is associated with reproducible patterns of brain electrical changes and, second, that these patterns meaningfully correlated with participants' self –rating of the specifically-defined subjective experience[24].

Summarizing, it can be argued that the NCCAM's shift in definition reflects the contrast between traditional eastern ideas of meditation as a state of transcendent, thought-free awareness and contemporary western scientific ideas of meditation as a form of relaxation. In this context, Manocha's and Aftanas' findings are notable because, first, they use a traditional eastern, mental silence orientated form of meditation which is conceptually and experientially distinct from the contemporary western understanding of meditation, second, Aftanas' reports that the subjective experience correlates highly with specific patterns of CNS activity, and third, Manocha reports significant therapeutic differences in a well-designed RCT comparison of this form of meditation versus a relaxation-orientated comparator. Since there is evidence to suggest that the conceptual differentiation implied in the NCCAM's changing stance might reflect a biological distinction, further, more direct comparative exploration of these different conceptualizations is certainly warranted. Therefore in this exploratory study, since Rai appears to have identified change in ST as a potentially distinguishing factor, we compare ST changes during mental silence orientated meditation and rest.

## 2. Materials and Methods

We compared advanced meditators with a convenience sample of non-meditators of similar age and gender who had strong interest in meditation and were willing to participate in a study about the effects of relaxation and meditation.

Sixteen SYM practitioners with between 1 and 25 years of experience of daily meditation and 10 novices with no experience of meditation were recruited by advertisement in university newsletters. Exclusion criteria included regular alcohol, tobacco or recreational drug consumption, history of mental illness, current physical illness of any kind, a history of major physical illness and consumption of any regular prescription medication. In order to control for the most important factor, motivation, the novices were specifically selected for a high interest in learning meditation. Potential participants were promised that after the study they would be given a series of free instructional lessons in meditation.

Participants sat in a moderately sized, quiet, climate-controlled room in a comfortable chair. The subjects were connected to the various sensors and then allowed to be become acquainted with the environment for 30 minutes, after which time a research assistant asked them if they were ready to commence the data collection session. When the participants indicated that they were ready, the lights were dimmed and the volunteers commenced either meditation or relaxation by closing their eyes.

They were asked to either meditate or relax as best they could for the next 10 to 15 minutes. This time frame was selected because our preliminary trials found that meditators had difficulty sustaining the mental silence state for much longer in the laboratory

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environment. At the end of the meditation or rest session, participants opened their eyes to indicate that they had finished.

ST was measured with a thermistor sensor affixed to the palm of the nondominant hand. The thermistor was calibrated and accurate to 0.10°C. HR was measured by a standard WR413 pulse oximeter. The change in skin temperature from baseline at each 60 second interval was calculated. Pulse oximeter with sensor placed on the middle finger of participants' dominant hands. HR was recorded every 7 seconds and ST every 60 seconds.

Subjects were asked to give a general rating with regard to how they relaxed they felt at the beginning and at the end of the relaxation/meditation session using a linear analog scale. For the meditators the minimum value on the scale equated with normal thinking activity and the maximum value equated with profound mental silence.

## 3. Results

Between the two groups There were no statistically significant differences in age, relative proportion of males/females or baseline ST and HR (**Table 1**).

As the meditation session progressed mean ST of the two groups changed such that the rest group's mean ST progressively increased compared to baseline whereas the SYM's mean ST decreased compared to baseline (**Fig. 1**).

**Table 1 Baseline Values. Age in years, HR in beats per minute, skin temp in degrees Celsius**

| | Controls | Meditators | P value |
|---|---|---|---|
| Mean Age (sd) | 28.5 (7.8) | 29.0 (8.2) | P=.887 (t=.144, df=25) |
| Sex (% male) | 63.6% | 62.5% | P=.952 ($\chi^2$=.004, df=1) |
| HR (sd) | 69.9 (15.2) | 72.3 (9.5) | P=.635 (t=.481, df=23) |
| ST (sd) | 31.8 (1.4) | 30.9 (2.4) | P=.290 (t=1.08, df=24) |

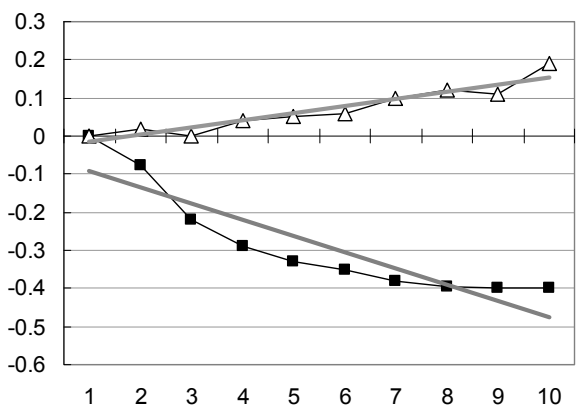


**Fig. 1 Skin Temperature Change Compared to Baseline During Meditation**
X axis= time in minutes, Y axis= change degrees Celsius compared to baseline, triangle=rest group, square=SYM group

As this was an exploratory study the primary aim of analysis was to determine the direction of ST change that each subject manifested and whether or not there was any difference between the two groups in terms of this. Therefore we compared the number of subjects whose ST increased or decreased compared to baseline in each group at the end of the meditation session ie. Time (T)= 10 minutes.

At T= 10 minutes, 13 of the 16 meditators manifested a reduction in ST compared to their baseline value and 3 manifested an increase. Whereas in the rest group only 2 manifested a reduction, 7 manifested an increase in ST and 1 manifested no change.

In line with our hypothesis, and to facilitate statistical comparison, we classified subjects whose ST decreased during the meditation session as one category (ie comprising those whose ST changed in the opposite direction to that predicted by the reduced arousal model of meditation) and subjects whose a ST either increased or did not change as the opposing category (ie comprising those whose ST changed in the same direction predicted by the reduced arousal model of meditation, and the extant literature). We then compared the relative proportions of subjects in each of these categories between the two groups. 81.3% of meditators manifested a decrease in ST whereas only 20% of rest subjects manifested a decrease in ST. Statistical comparison using Chi-Square tests between these two categories and between the two groups showed that the difference between the two groups was significant (p=.003). (**Table 2**)

**Table 2 Cross tabulation of Group by Difference**

| Group | N who manifested ST decrease | N who manifested ST increase |
|---|---|---|
| SYM | 13 (81.3%) | 3 (18.8%) |
| Rest | 2 (20.0%) | 8 (80.0%) |

HR did not change consistently in any direction in either of the groups.

All subjects in both groups indicated that they felt more relaxed/meditative at the end of the session compared to the beginning. Degree of mental silence on the linear analog scale correlated significantly with degree of ST reduction in the meditator group ($r=0.65$, $p<.05$). Degree of relaxation experience did not correlate significantly with the degree of ST increase in the rest group.

## 4. Discussion

Early studies of meditation suggested that basic physiological parameters could change quite dramatically in a single meditation session[25], and this triggered considerable enthusiasm for meditation as a potentially unique self-control strategy. Later, however, high quality experimental physiological studies demonstrated minimal differences between meditation and other methods of reducing arousal, and researchers became much more cautious in their enthusiasm for this intervention [26, 27]. Similarly, randomized, controlled, clinical trials of meditation have demonstrated minimal differences between meditation and appropriately selected controls, implying that while meditation may be clinically useful, it has no consistent features compared to rest/relaxation[28]. Despite the scientific establishment's disaffection, surveys [29] and media attention [30] clearly show that the community's enthusiasm for meditation continues to grow.

Yet in this study, both groups of subjects performed tasks that ostensibly resembled relaxation and that would be conventionally explained as conducive to reducing arousal. Moreover, both groups reported subjective experiences which are consistent with reduced arousal. The reduced arousal model, and indeed empirical evidence, predicts that both groups should manifest similar physiological changes, with ST increasing. Our study found that ST moved in opposite directions despite the fact that the HR changes in the two groups did not differ across the duration of the task; The resting group's skin temperature changes were consistent with reduced arousal, but the mental silence group's were not. Thus, the changes produced by the meditation seem to reflect a pattern of selective arousal/de-arousal that is distinct from simple rest.

Importantly, the findings of this study are in agreement with Rai's report. Therefore both this study and Rai's report are in contradiction with the extant scientific literature, counterintuitive at least from a western scientific perspective and are not easily explained in terms of simple, global reductions in arousal. They suggest that a mental silence orientated meditation may be physiologically distinguishable from rest

In this context, the findings of Manocha's asthma trial warrant more detailed consideration. There are a number of theoretical difficulties associated with conventional understandings of meditation and relaxation, its influence on the autonomic nervous system (ANS), and its role in asthma management. For instance, relaxation strategies, in which meditation is conventionally included, are thought to reduce sympathetic tone and increase parasympathetic tone (i.e. reduce physiological arousal). Theoretically, however, reduced sympathetic tone should antagonize bronchodilation and, therefore, worsen symptoms and yet the experience of clinicians and scientific evidence suggests that stress (and other arousal increasing factors) often worsens asthma symptoms [31, 32]. The notion that, since clinical experience has found that stress worsens asthma symptoms, stress reduction strategies should improve asthma symptoms is a consensus logic that is also challenged by the evidence. For instance, a comprehensive review of relaxation therapies for asthma by Huntley found that there was no clinical advantage in adding any form of relaxation to the management regime. Yet, despite all these contradictions Manocha reports significant changes not only in symptomatology but also in direct measures of disease severity when using a mental silence form of meditation. Perhaps a selective activation/deactivation of the ANS may better explain both the clinical and physiological phenomena associated with this approach to meditation and its effects in asthma.

The health benefits of meditation are frequently associated with traditional Eastern ideas of yogic physiology such as chakras, nadis and energies like kundalini. The founder of SYM explains the phenomenon using a similar "yogic physiology" paradigm [33]. Rai asserts that these ideas correlate closely with modern physiological understandings of the Autonomic Nervous System but that SYM somehow elicits a unique pattern of activity within this system[34].

EEG studies suggest that different approaches to meditation have different neurophysiological bases. For example, a study of advanced Tibettan Buddhist meditators reported large increases in 40Hz gamma power in the meditative state[35] and it is also advanced Tibetan meditators whom Benson described as manifesting considerable increases in ST. Whereas Aftanas's EEG study of advanced mental silence meditation practitioners [36] reported that midline alpha-theta power, rather than gamma power, increased strongly in direct positive correlation with self reported meditative experience and negative

correlation with thought appearance rates.

Mental silence is the defining feature of SYM and arises as a result of the meditator's ability to not only avoid initiating thoughts that may arise as a reaction to events (as in mindfulness [37]) but to completely eliminate even the "background mental noise". In other words, mindfulness may be defined as a state in which one passively observes the ebb and flow of thoughts while not getting involved with them, the SYM practitioner seeks to unite their awareness with the "space between the thoughts" and then expand this dimension of the meditative experience, reaching a unique clarity of awareness. Hence the definition of SYM is orientated around a specific state of consciousness and is therefore "experience-orientated" rather than "attention-orientated" (as in mindfulness) or "relaxation-orientated" ( as in Benson's Relaxation Response[38]). It is important to note here that we are not suggesting that any particular technique is superior to any other, merely the possibility that the mental silence definition might provide a convenient framework to categorise various techniques as we search form meaningful ways to understand this particular independent variable.

Goleman posits the notion that meditative styles might be classified into two types, mindfulness and concentrative, depending on how attention is directed during meditation 39 while Andresen suggests that these two categories might be better understood as two poles on a continuum upon which most other meditative techniques can be positioned[40]. On the other hand Cahn acknowledges the limitations of this taxonomy and raises the possibility that a different way of categorizing techniques may be according to the underlying experience that the various techniques aim to elicit[41]. In this context mindfulness and mental sielnce may belong to similar places on the physiological and clinical spectrum whereas relaxation orientated methods might belong to an entirely different part of that spectrum.

In general, meditation's mechanism of action is thought to primarily involve its ability to reduce stress. There are two main theories about how meditation reduces stress: First, by reducing somatic-arousal[42], thereby reducing reactivity of the individual to environmental stressors, and , second, by altering the individual's cognitive appraisal of and perceived self efficacy with regard to stressors [43], [44]. The mechanisms by which the mental silence experience exerts its purported clinical effects are unclear. Notably, practitioners of SYM consistently report that the state of inner silence spontaneously gives rise to concomitant phenomena such as a natural focusing of attention, a sense of mental wellness and therefore elimination of negative affect and improved physical health. Although mental activity has been eliminated it can be initiated at any time with the added advantage that the "background mental noise" no longer hinders cognitive activity. The idea that this constellation of changes might occur "spontaneously" implies that involuntary pathways are at least partly involved even at the higher function level. By completely eliminating background mental noise, the meditator probably increases internal and external awareness and therefore somehow achieves more veridical perception, reduce negative affect and improve vitality and coping, as is hypothesized with mindfulness [45]. Given that the mental silence experience may be associated with a specific pattern of activity in both the CNS and ANS, more complex, as yet unknown mechanisms may await discovery.

Assume for argument's sake that the physiological differences apparently demonstrated here between SYM and rest reflect the conceptual differences between meditation as mental silence and meditation as relaxation. This may then support Manocha's explanation for the significant outcomes reported in the asthma trial previously mentioned while also explaining why other trials of meditation, relaxation and biofeedback did not generate similar outcomes for the same condition. One might therefore speculate that the difficulties faced by researchers trying to identify a consistent difference between meditation and rest may be related to western scientists' (mis)understanding of the phenomena as a method of inducing the relaxation response (the NCCAM's pre-2006 definition) rather than as a specific experiential state, the traditional eastern idea of "mental silence" (more or less implied in the NCCAM's new definition). Thus, although eastern and western ideas of meditation may seem externally similar (as might meditation and relaxation) and may initially share a number of physiological similarities, a measurable physiological distinction may occur in association with the onset of the mental silence experience. The degree to which this physiological distinction explains the differing clinical effects between traditional and contemporary ideas of meditation and relaxation remains to be determined. Manocha's asthma trial however clearly suggests that the distinction may have considerable clinical relevance.

Perhaps popular perceptions of meditation as being good for health are based on traditional eastern notions of the practice involving the mental silence experience, which have formed the basis of traditional anecdote and folklore, whereas the contemporary scientific understanding of meditation is based on the

western notion of psychophysiological equivalence with rest/relaxation. Does the lack of emphasis on the mental silence experience in contemporary scientific understandings of meditation offer an explanation for its poor performance in experimental conditions and hence the discrepancy between popular perception and current scientific facts?

Practitioners of this technique described a subjective sense of cooling of the hands during meditation. The objective ST measures appear to support this. While the skin temperature changes appear real, to what degree are they the result of suggestion/self regulation as opposed to meditation specifically? A review by King [46] reported that biofeedback has been shown to induce both increases and decreases of skin temperature. Although the changes induced by biofeedback are generally small and more commonly involve increases in skin temperature, reductions in skin temperature are also consistently achievable. In addition, the empirical evidence for reducing skin temperature by self regulation (unassisted by biofeedback), although less consistent, also suggests that such changes might be achievable. The fact that the meditators in this trial were long-term practitioners raises the possibility that they may be a subgroup highly selected for their ability to voluntarily induce such changes. On the other hand, regarding techniques that are similar but not labeled as meditation, Credidio (1982)[47] attempted to produce a patterned biofeedback response that mimicked the multiple changes associated with reduced physiological arousal. The study failed to produce a combined electromyograph (EMG) reduction and ST increase, suggesting that the achievement of the full constellation of changes in multiple parameters reported in the trials of Rai, Manocha and Aftanas would be very difficult to achieve.

## 5. Conclusion

Perhaps because of the rising popularity of techniques such as mindfulness and the more eastern ideas about meditation that it embodies, in 2006 the NCCAM revised its definition to include the idea of "suspension of usual thought activity" and to de-emphasize the significance of relaxation, raising important questions about whether or not this shift in conceptualization may also imply a different biological paradigm as well. This study is unique as it compares the physiological differences between the two conceptually different taxonomies of meditation that the NCCAM's change in definition implies. It provides preliminary support for a distinction between mental silence orientated meditation and rest with promising implications for the field of meditation research.

Further research is necessary to determine whether or not this distinction might have practical implications for health professionals. Larger studies with both multiple control groups and multiple measures are needed to further assess, first, whether or not the changes in ST are a specific effect relating to the experience of mental silence, and, second, the precise relationship between these physiological changes and the apparent therapeutic effects reported in other studies of mental silence orientated meditation.

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