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Time perception, mindfulness and attentional capacities in transcendental meditators and matched controls

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ABSTRACT

Only a few studies have investigated the sense of time in experienced meditators. In the current case–control study, we investigated whether 20 practitioners in transcendental meditation (TM) showed differences in the perception of time as compared to 20 matched controls. Perception of time was assessed with a battery of psychophysical tasks including duration reproduction and time estimation tasks in the milliseconds-to-minutes range as well as with psychometric instruments related to subjective time and assessments concerning the subjective passage of time. Attentional capacities were measured with the Attention Network Test. Trait-mindfulness was assessed with the Freiburg Mindfulness Inventory. Results indicate that the TM meditators performed more consistently in the duration reproduction tasks in the multiple seconds' range and responded more accurately in the time estimation tasks in the minutes' range as well as in the duration discrimination task than controls. Self-rated mindfulness was more pronounced in meditators, while attentional capacities did not differ. In conclusion, experts in TM performed more accurately in psychophysical time perception tasks and had higher mindfulness than non-meditating controls. Whether these differences are causally related to the practice of meditation should be investigated in future studies.

1. Introduction

The sense of time is fundamental for perception, action, and decision-making (Wittmann & Paulus, 2008) and it is related to emotional wellbeing (Lamotte, Chakroun, Droit-Volet, & Izaute, 2014).

Recently, evidence has accumulated showing that body signals may play an important role in time perception in the seconds' range (Craig, 2009; Wittmann, 2013). That is, subjective time might be created through perceiving the embodied self at the present moment (Wittmann & Schmidt, 2014).

For individuals practicing mindfulness meditation, subjective time is often perceived as slowing down (Kabat-Zinn, 2005) which might be explained by various functional components or correlates of mindfulness such as attention regulation, enhanced episodic memory load, body awareness and emotion regulation (Hölzel et al., 2011; Sauer et al., 2012; Wittmann & Schmidt, 2014). In a recent study with students, self-attributed mindfulness levels were associated with more accurate time estimation abilities in the milliseconds and multiple-seconds range (Wittmann et al., 2014). Moreover, differences in judging the subjective passage of longer time intervals were found between experienced mindfulness meditators and non-meditating controls (Wittmann et al., 2015). Several investigations add to these findings by showing how judgments of duration in the milliseconds-to-seconds are prolonged after a short meditation session or after prolonged practice (Berkovich-Ohana, Glicksohn, & Goldstein, 2011; Droit-Volet, Fanget, & Dambrun, 2015; Kramer, Weger, & Sharma, 2013).

A very popular and intensively researched meditation technique is transcendental meditation (TM). Practitioners aim to reach a calm, peaceful mental state of extended awareness using a so-called mantra, a series of syllables without any linguistic meaning, which serves as a vehicle for calming down cognitive processes (Jevning, Wallace, & Beidebach, 1992). In several studies, physiological changes consistent with a state of restful alertness were found in individuals practicing TM (Anderson, Liu, & Kryscio, 2008; Benson, Rosner, Marzetta, & Klemchuk, 1974; Schneider et al., 2012; Wallace, 1970).

Several longitudinal studies suggest that in contrast to control subjects, individuals practicing regularly TM are improved in various cognitive functions and show positive effects on psychosocial distress, especially trait anxiety (Canter & Ernst, 2003; Cranson et al., 1991; So & Orme-Johnson, 2001). Furthermore, mental qualities appear to be more strongly developed in advanced TM practitioners than in non-

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meditating controls, for example the integration of the self with other individuals and the environment, self-actualization, and creativity (Alexander, Rainforth, & Gelderloos, 1991; Gelderloos, Goddard, Ahlstrom, & Jacoby, 1987; Vegors, 1999). Considering these outcomes, one can assume that TM practitioners are more mindful than non-meditating individuals in the sense of having a more mindful attitude in daily life. Moreover, given the overall similarity in mental well-being and self-control as found in mindfulness meditators one could opine that TM meditators have a similar sense of time as mindfulness meditators (see studies above).

In this study, we compared experienced TM meditators and matched controls regarding several aspects of time perception as well as mindfulness levels while controlling for relevant factors known to be related to individual time perception. We hypothesized that TM meditators would show a better performance in (1) psychophysical timing tasks as well as in (2) attention tasks, (3) higher mindfulness levels and (4) differences in subjective time perception in comparison to matched controls.

2. Materials and methods

2.1. Design

We performed a cross-sectional study comparing experienced TM meditators with matched controls. The controls correspond to the control cohort in the Munich part of a different case–control study (Wittmann et al., 2015) but were also individually matched to the TM group. The study was approved by the Ethics committee of the University of Munich. All subjects signed an informed consent and received €20 for participation.

2.2. Participants

Twenty experienced transcendental meditation practitioners and 20 matched controls without any meditation experience were recruited by advertisement in meditation centres, on online platforms of the Munich universities, and by word of mouth. Meditators were included when practicing regularly transcendental meditation (at least 2 h/week over the last 8 weeks) for at least 3 years. Control subjects were supposed to not have practised any form of meditation including Yoga or Tai-Chi. The matching criteria were gender, age (±5 years) and education (±1 level of 5). Age range was constricted to 21 to 50 years in order to avoid age-related effects in the psychophysical tasks (data not presented). As assessed with a detailed screening form, all participants reported an actual state of good health, no known somatic or psychological problems, and no regular drug intake.

2.3. Instruments

We applied two inventories to control for actual physical and mental condition. The amount of physical activity over the last week was assessed by the German version of the International Physical Activity Questionnaire (IPAQ) (Ainsworth et al., 2000). The Short Questionnaire on Current Burden (SQCB) (Müller & Basler, 1993) served to assessed actual emotional burden (and resulting stress levels).

2.3.1. The Barratt Impulsiveness Scale (BIS-11)

The German version (Preuss et al., 2008) of the BIS-11 (Barratt, Stanford, Dowdy, Liebman, & Kent, 1999) consists of 30 4-point items ranging from 1 (rarely) to 4 (almost always). The resulting subscales are planning impulsivity ("I do not plan tasks carefully"), motor impulsivity ("I do things without thinking about consequences"), and attention/cognition impulsivity ("I do not concentrate easily").

2.3.2. The Attention Network Test (ANT)

The processing efficiency of the three attention networks of (1) alerting, (2) orienting, and (3) executive attention as well as an overall reaction time score and an index of accuracy were estimated by using the ANT (Fan, McCandliss, Sommer, Raz, & Posner, 2002).

2.3.3. Freiburg Mindfulness Inventory (FMI)

The FMI (Kohls, Sauer, & Walach, 2009) contains 14 items, which evaluate mindfulness on the basis of a two-dimensional structure utilizing a 4-point item scale format. These dimensions are "presence" as ability to attend to the present moment ("I am open to the experience of the present moment") and "acceptance" as non-judgmental attitude ("I am patient with myself when things go wrong").

2.3.4. Zimbardo Time Perspective Inventory (ZTPI)

We used the German version (Brandler & Rammsayer, 2002) of the ZTPI (Zimbardo & Boyd, 1999) containing 56 5-point items ranging from 1 (very untrue) to 5 (very true). The individual focus on different time perspectives is represented by the five subscales "past-negative" ("I often think about the bad things that have happened to me in the past"), "present-hedonistic" ("I take risks to put excitement in my life"), "future" ("I am able to resist temptations when I know that there is work to be done"), "past-positive" ("Happy memories of good times spring readily to mind"), and "present-fatalistic" ("Because things always change, one cannot foresee future").

2.3.5. Subjective time questionnaire

The subjective time questionnaire (Wittmann & Lehnhoff, 2005) consists of two parts. The first one includes questions concerning the subjective experience of the passage of time in the present, past and future as assessed by visual analogue scales with the poles "very slowly" and "very fast." In the second part, participants evaluate statements concerning subjective judgments of time with assigned values of 0 = strong rejection to 4 = strong approval referring to the feeling of time pressure (5 statements, e.g., "I often think that time is running out") or to the feeling of time expansion (5 statements, e.g., "My time is not filled"). We calculated mean values for the five statements on "time pressure" and "time expansion."

2.3.6. Time estimation and time production

Participants had to estimate the duration of two different computerized number reading tasks (compiled by the MS Office Power point Presentation software) while reading aloud numbers showing up on the screen with jittered pause intervals of 4, 6, or 8 s. In the first (time estimation) task, subjects had to estimate the duration of a number reading session of 80 s. In the second (time production) task, subjects were requested to press a button when they felt that 1 min of a number reading session had passed. In a third task without any number presentation, participants had to estimate the duration of a period of 40 s.

2.3.7. Visual and auditory duration reproduction — long

In two computer tasks running on Psychtoolbox for Matlab, participants were asked to reproduce the duration of visual and auditory stimuli with intervals of 8, 14, and 20 s duration. The order of the two tasks was counterbalanced. In each trial, first a green square/sinus tone of 440 Hz (encoding interval) was presented for one of the three durations. After a pause of either 4.5, 5 or 5.5 s duration a second yellow square/sinus tone of 500 Hz (reproduction interval) was. Participants had to press the space bar when they felt that the second stimulus had reached the duration of the first stimulus. We asked participants not to use mental strategies such as inner counting but to solely rely on their subjective feeling of elapsed time. To further prevent mental counting, a secondary working-memory task was conducted (Meissner & Wittmann, 2011). We calculated the mean accuracy and precision of duration reproduction for the three intervals of each task.