Mindfulness: How To Measure Being Attentive

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Abstract

This study focuses on mindfulness and attention. The aim is not only to examine differences in mindfulness between people who meditate and people who have never meditated, but also to examine if it is possible to measure mindfulness in a more valid way with objective instruments. Subsequently, this study tries to make a contribution to research in clarifying the concept of mindfulness. A new self-constructed attention task, the Mindful Exteroception Task (MET), was used. Meditators and non-meditators didn't differ on diverse attention-tasks or in their level of exteroceptive mindfulness. However, they did differ on proprioceptive mindfulness. This means that people who meditate are better in detecting sensations of their own body. Consequently, the MET may not have an additional value in measuring mindfulness; it seems that reporting exteroceptive perceptions as measured here is not a distinctive component of mindfulness.

Mindfulness: How To Measure Being Attentive

Mindfulness

Mindfulness is a broad concept. Many researchers have defined this modern form of meditation practice with roots in Buddhist spiritual practices (Anderson, Lau, Segal & Bishop, 2007). Mindfulness is called to be the 'heart' of Buddhist meditation (Kabat-Zinn, 2003; Thera, 1962). It has been described as a process of ''bringing one's complete attention to the present experience on a moment-to-moment basis'' (Marlatt & Kristeller, 1999) and as ''the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to unfolding experience moment by moment (Kabat-Zinn, 1990, 1994, 2003). Meditation practice is simply"scaffolding" used to develop the state, or skill, of mindfulness (Kabat-Zinn, 2005).

Shapiro, Carlson, Astin and Freedman (2006) conclude that the state of mindfulness arises from simultaneous activation of the components inattention, attention and attitude (*IAA*). Through the activation of these components, a shift in perspective occurs, which is also the case in mindfulness practice. They hypothesize that multiple mechanisms are involved during this shift, including 1) self-regulation, 2) values clarification, 3) cognitive-behavioural flexibility, and 4) exposure.

Self-regulation is also an aspect of the two-component model of mindfulness consented by a group of scientists. In this model, self-regulation of attention is the first component. One is fully present and alive at the moment and can bring their attention to the here-and-now. The second component is orientation to experience, which means that a person allows each thought, feeling, and sensation that arises in the stream of consciousness to be as it is and observes them

in a curious and accepting manner. This model is constructed as an operational definition of mindfulness (Bishop et al., 2004).

Psychology has adopted mindfulness as an approach for increasing awareness and responding skillfully to mental processes that contribute to emotional distress and maladaptive behavior (Bishop et al., 2004).

Mindfulness and attention

Attention is one of the key-terms when it comes to mindfulness. Bishop et al. (2004) defined three different kinds of attention that are important when it comes to being mindful: *sustained attention, switching in attention* and *inhibition of elaborative processing.* Sustained attention refers to the ability to stay focused during current experiences over prolonged periods of time (Parasuraman, 1998; Posner & Rothbart, 1992). Skills in switching attention allow the person to bring their attention back from their thoughts and feelings if the mind wondered off (Bishop et al., 2004). It involves shifting the focus from one object to another object (Jersild, 1927; Posner, 1980). The inhibition of elaborative processing contains experiencing and observing thoughts, feelings and sensations that arise in the stream of consciousness, but not letting them distract the mind (Bishop et al., 2004).

There have been different researches that have focused on mindfulness and attention. So has previously research shown that mindfulness training can lead to better conflict monitoring, to improved orienting and to improved alerting (Jha, Krompinger & Baime, 2007). They concluded that meditation training improves someone's ability to control their attention, which leads to better orienting and/or conflict monitoring. Wenk-Sormaz (2005) looked into Stroop interference and word production in relationship to mindfulness. These attention tasks were taken after the

participants got a brief exposure to a mindful sitting meditation. The results showed that mindfulness meditation was related with less Stroop interference and more flexible word production. This suggests that even a short exposure to mindfulness meditation improves attentional control. In a study on MBSR (Mindfulness-Based Stress Reduction) and attentional control, mindfulness intervention had positive effects on awareness of the present moment (Anderson et al., 2007). Mindfulness is related to non-directed attention, which improves the awareness of present experiences, without interference of assumptions or expectations (Anderson et al., 2007). Another research aimed at performance on a sustained attention task and compared members of a Buddhist centre with a group of controls. Here it was found that the meditators were less influenced by an unexpected event. For example, if something negative happened to them, they could let it go more easily. This suggests that being mindful helps people to divide their attention so that they are more easily able to concentrate on the current moment, and thus be more aware of things in their surroundings (Valentine & Sweet, 1999).

This study focuses on mindfulness and the two named aspects of attention: sustained attention and switching in attention. Inhibition of elaborative processing is left out, because it is not possible to measure this aspect of attention with the new self-constructed Mindful Exteroception Task (MET). To be exact, during the MET the participants can say whatever they want to, even thoughts and feelings, so they don't have to hold back. There is no inhibition. Later on, there will be more explanation about the MET.

The aim of this study is to examine if it is possible to measure mindfulness with objective instruments. The reason why there is a focus on the objective instruments is because there are several methodological problems when mindfulness is measured using self-reports. First, there isn't a clear definition of mindfulness. This is because it's still not yet decided what the

conceptual and operational definition of mindfulness is. The original Buddhist meaning of mindfulness as a complex psychological construct is hard to put together in a plain definition that is suitable for western science. Even the Buddhists themselves don't always agree about the precise definition of mindfulness. Second, many of the existing mindfulness inventories have been developed by researches that have little or none experience with mindfulness meditation practices or Buddhist psychological theory. Besides that, there have been often no clear contributions from traditional mindfulness meditation experts. Therefore, mindfulness constructs may reflect only partially any original meaning. Also with the variations in current operationalizations, it's not certain that questionnaires are free from the personal bias of their creators. Another problem that can occur is a misinterpretation of the words and phrases in inventory items. This risk occurs because the acquisition of an understanding of mindfulness is predicated on practicing mindfulness meditation. So the interpretation of words and phrases depend on whether someone has ever meditated and in which degree he or she has meditated. There are also indications that even among meditators the extent of meditation experience may alter meaning of words or items. Furthermore, self-rating of mindfulness can be different from the level one actually is mindful. A person who invested lots of energy, time and money in becoming mindful might be biased in responding on mindfulness questionnaires. Last, the right population has to be chosen for the measurement. Choosing the wrong population might undermine the overall validity. Often college students are employed for mindfulness inventories, but only a small minority of these students has experience with meditation. Alternatives for self-report measures of mindfulness are qualitative assessments, based on interview data, measuring putative consequences of mindfulness practice (Grossman, 2008), but also observational methods.

The expectation of this objective manner is that mindfulness can be measured in a more valid way. Moreover, there will be examined whether the MET will have additional value above existing tasks. The existing tasks are focused on concentration, not an open attention to whatever stimuli come in, which is characteristic of mindfulness (Cahn & Polich, 2006). The MET is designed to capture this mindfulness aspect of attention.

This research aims at the differences between people who have practiced meditation, for at least one year versus a control group, who have never practiced any form of meditation. There is a focus on meditation, because practice in meditation techniques may help to develop measurable qualities of mindfulness (Brown & Ryan, 2004).

The people who have practice meditation where included when they practice mindfulness-, Zen-, Vipassana, and Transcendental Meditation or other kinds of meditation where mindfulness is an essential component. These meditative styles are singled out, because there can be two meditative styles distinguished. The first style is the mindful meditation. Thoughts, feelings, or sensations are allowed and are observed by the meditator, without judgment or analyses, but with awareness and attention. Zen, Vipassana and mindfulness meditation may be regarded as examples of this kind of meditation. The other style includes various concentrative techniques. They involve concentration on specific mental or sensory activity: a repeated sound, an imagined picture, or certain body sensations, like breathing. Examples are Buddhist Samatha meditation which focuses on the sensation of breath and yogic meditation. Transcendental Meditation practice centers on the repetition of a word or phrase, a mantra. The aim in Transcendental Meditation is to obtain a witnessing, thought-free "transcendental awareness", without much effort to concentrate (Cahn & Polich, 2006).

The people, who have never practices any form of meditation, couldn't take part in the

research when they practiced yoga, because yoga is included in the second meditative style of Cahn and Polich (2006).

In this study there will be three hypotheses tested:

1) Meditators have significantly higher scores on the attention-tasks then the control group. This concern: a) sustained attention, and b) switching attention.

2) The scores of the meditators on the new Mindful Exteroception Task (MET) are higher than the scores of the non-meditators.

3) The objective scores on the attention-tasks, including the MET-task, correlate significantly with each other and with subjective mindfulness scores.

Method

Participants

Eighty people were participants for this study, but only the data from 79 participants is used for the analyses. During the research there was a mistake made while testing 1 participant. The data of this participant were for that reason not stored well, as a result that a part of the data was missing. For this reason this test person has been left outside consideration in the analyses.

The 79 participants were divided into 2 groups: one group of individuals who have thorough experience in mindfulness-, Zen-, Vipassana, and Transcendental Meditation or other kinds of meditation where mindfulness is an essential component and one group of persons with no experience with meditation or other awareness related exercising (e.g. yoga, qi gong and tai chi). Additionally, the participants could not participate if they follow a current psychological

treatment or suffer from heart rhythm impairment or an eye or hearing disorder which limit the sight or ability to hear. The groups were matched on sex, age, and educational level.

All of the participants were informed they would take part in a research about meditation, attention and introspection. As a token of appreciation for taking part they received a coupon at the value of 20 Euros.

The participants were recruited via different ways.

Participants with experience in meditation

The people who have been practicing meditation for at least one year were recruited via diverse meditation schools and meditation trainers, who were approached by e-mail or telephone. Ex-students of mindfulness stress reduction training were approached by e-mail. A letter with information about the research was spreaded via different channels. The persons were kindly asked, if they had more than one year of ongoing experience with meditation and were practicing meditation at least 3 days a week for at least 20 minutes per session, to take part in the research.

Participants with no experience in meditation

The people who have never practiced any form of meditation where recruited mostly via participants of the other sample. They were asked to look for someone they know, with demographic characteristics about the same as their own, to take part in the research. Friends and family got a letter with information about the research and were asked, if they had no experience with meditation, if they wanted to take part in the research. There were also individuals who got the information letter somehow and were interested to take part in the research. When it was sure

that people have no experience with meditation or related practices they were kindly asked to take part in the research.

Materials

Different tasks and questionnaires were presented to the participant to measure their level of mindfulness and attention during the experiment.

Background information form

Participants were asked to fill in a form with questions concerning their demographics and other background information. This form contains questions about the participants' age, sex, education level, if a participant ever suffered from psychological problems (e.g. anxiety, depression, burn-out) and if a participant ever experienced a negative life-event which had a powerful impact in one's life.

Education level is split up in high (defined as attended high school, higher professional education or university education) and low (defined as attended exclusively elementary school, or lower secondary education or vocational education).

The Five Facet Mindfulness Questionnaire (FFMQ)

The FFMQ (Baer, et al., 2006) is used to measure the subjective view of one's mindfulness. It assesses five facets of mindfulness: observing, describing, acting with awareness, non-reactivity (to inner experience), and non-judging (of inner experience). The questionnaire consists of 39 items, all rated on a 5-point Likert-type scale ranging from 1 (never or very rarely

true) to 5 (very often or always true). The scales show an adequate to good internal consistency, with alpha coefficients ranging from .75 to .91 and relationships between the facet scales and other variables were consistent with predictions in most cases.

The Continues Performance Test (CPT)

To measure sustained attention the adapted *Continues Performance Test (CPT)* (Smallwood et al., 2008) will be used. Ten different letters will be shown one at a time on the screen in front of the participant. The letters are presented sequentially with duration of 500 msec., the fixed inter-stimulus interval is 2000 msec. The participant is asked to press a button if the letter on the screen is one of the letters: B, E, F, K, N, O, S, V or Z, and thus not a T (non-target stimulus) and to withhold if the letter on the screen is a T (target stimulus). The 10 letters were presented in 50 randomized blocks, thus the target stimulus was presented at 10% of the trails. In addition, 18 times during the task, the participant is asked whether his or her attention wandered from the task, and if so, whether he or she was aware of this fact. The participant got to chose from three options that appear on the screen to answer the question: "On-task" (fully attentive of performing the task), "Tuned out" (aware of the mind wandering away from the task at the time the thought probe was presented), and "Zoned out" (off-task but unaware of mind wandering away from the task at the time the thought probe was presented). Participants answered by pressing one of three buttons on the response box.

The Switch task

For switching in attention, the *Switch task* (Rogers & Monsell, 1995) is used. In this task four letters, displayed in a framework of four square boxes, are presented to the participant. The letters appear one by one on the screen, first on the top of the screen on the left, and move clockwise to the next square. If a letter appears on the top of the screen and has the color red, the participant has to press the red button in front of him. If the letter has the color green, the participant presses the green button. If a letter appears at the bottom of the screen the participants are told to press the button 'yes', if the letter is a vowel and to press the button 'no' when it is a consonant. This goes on for the entire task, consisting of 36 trails. Because this is a difficult task, the participants get the time to practice the task and get familiar with it.

The Mindful Exteroception Task (MET)

In the MET all three aspects of attention are involved, but attention is not focused, but mindful, receptive for different kinds of stimuli. It's a self-constructed task where the participants get to see a short movie, of a quiet forest. The movie has duration of 2 minutes. During the movie the participants have to describe what they perceive in the movie and what they experience during the movie. The instruction is: *'You will get to see a movie clip in a few seconds. Describe simply what you observe. This can both be related to the movie itself as to what you possibly feel or think. You can describe this during the movie, but you can also do this right after the movie, where you get the time to do it. There is no right or wrong in this task, it's about your experience.'* When the movie is finished, the participant gets another 2 minutes to talk about what he or she perceived and experienced, with the instruction: *'You can now for two minutes (continue to) describe what you have observed during the movie clip (including possibly*

what you were feeling or thinking). There is no right or wrong. Go ahead.' During the task the participants are recorded on camera, which was communicated to them at the start of the experiment. Afterwards the videos are watched and a transcript is typed out for analysis.

Design

The design is a between subjects design, with the meditators group and the control group as the between-subjects factors.

Procedure

An appointment is made with all participants to visit the laboratory at Tilburg University. The participants completed an extensive test battery, used for a broad research project in effects of mindfulness. First, the participants completed twelve tests in a sound-proof cabin. They start with an introspection task, which is recorded on camera, followed by the Switch task, the CPT, a Stroop task, a DotProbe task, and a mental arithmetic task, all objective measurements. After that, there are a few more tests which are also recorded at camera. These tasks are: two speech-tasks, the MET, a gradual task, a speech task which refers to positive and negative characteristics of the participant and a tea-task (a task whereby the participant has to make a cup of tea the same way they do at home). After that they filled in seven questionnaires in another room, including a questionnaire with questions about the background of the participant, the FFMQ, and several other instruments. The fulfillment of the complete test battery takes about three hours.

Data Reduction

In this study the hypotheses are tested by different analyses to investigate the difference between meditators and non-meditators. First the background information is analysed. Variables with significant differences between the groups are taken into account as covariates in analyses of variance.

MET

The reports of the MET are scored using several categories derived from content analysis. For a reliable measure, the MET will be scored via two different code tables, one code table which includes everything that is said about the movie and the other table includes everything that is not related to the movie. In the first table are in the columns the *what* (the phenomenon one experienced). This is divided into four aspects: visual movie (what is seen on the movie), visual camera (what is seen of the way it's filmed), auditive movie (what is heard on the movie) and auditive camera/cameraman (what is heard of the way it's filmed). In the rows *how* (one responded) is divided into: 1) noticing a neutral event, 2) noticing a negative or positive interpretation and 3) expressing a negative or positive interpretation. In the second table are in the columns again the *what* (the phenomenon one experienced): thought (or mental picture) about the present moment, thought about the past, thought about the future, and feelings and three physical prospects: proprioceptical sensation, sensory perceptions and bodily behavior. In the rows *how* (one responded) is divided into: 1) noticing a neutral event, 2) noticing a negative or positive interpretation and 3) expressing a negative or positive interpretation. Each statement can be placed into one of the cells. Besides these two code tables, there are ten extra categories, including two categories which monitor how often a participant switches between the different

cells. These categories will be counted during the scoring process. The first switching category is *switching between* modality. This includes switching between the categories: visual, auditive, physical prospects and thoughts. The second switching category is *switching within* modality and this contains switching within the categories: visual (movie vs. camera) and auditive (movie vs. cameraman). See appendix A for more information about these used code tables.

Four variables will be linked to the score tables. These variables are: exteroceptive mindfulness, proprioceptive mindfulness, switching in attention, and sustained attention.

Exteroceptive mindfulness focuses on stimuli from outside the body. This score will consist of the relative number of all correct exteroceptive identifications (auditory, visual, etc.) divided by the total number of scored cells. If a participant scores high on this variable, he or she has a high level of responding to outside stimuli.

Proprioceptive mindfulness contains detecting the sensation of the body. This score will consist of the relative number of all proprioceptive cells divided by the number of thoughts and expressed interpretations. The higher a participant scores on this variable, the more he or she is able to detect and response to stimuli within themselves.

The score on switching in attention is computed by counting how many times the participants switches, in the rows of: noticing a neutral, a negative or a positive event of both code tables, between what he or she sees, hears, thinks of feels physically. This score will be computed by counting the scores of the cells *switching between* (modalities) en *switching within* (a modality: only within the visual or auditory fields). If the participant scores high on this variable it means that he or she can easily shift his of hers focus from one object to another object.

The score on sustained attention is computed by counting how many neutral visual or auditory events from the movie are mentioned. For this variable, the maximum of these cells will be calculated. The higher the score, the better the participant can stay focused over prolonged periods of times on the movie itself.

The used score tables for the MET contains 66 single cells, scored by two raters. The mean between the two raters of the scores per single cell is taken into account for analysis, but not all the cells of the score tables are considered. The reason is that there is a great range in how often cells were scored, from 0 to 1806. Because there is a total of 79 participants, a minimum amount of 40 scores is determined as a criterion to include a single cell in the final score. This is equivalent to less than 1 score in less than half of the participants. This leaves 23 single cells for further analysis. The range in total scores of the included single cells is now 42 to 1806.

The transcripts of the MET were independently scored by two raters. Because of the total of 66 scores cells, it is impossible to compute a common form of inter-rater reliability on the score table. For that reason, there is chosen for a different approach to calculate the degree of agreement between the raters according to the following example. For each transcription the score table was scored by two raters. Each single cell could be scored for a certain amount of times. For example, one cell could therefore be scored 4 times by rater A and 6 times by rater B. Here we assume that rater A and B gave an amount of 4 times the same score for the same transcript. To verify for this single cell how often the same amount of scores was given, one needs to know the minimum and maximum amount of scores for each transcript. In this example the minimum is 4, and the maximum is 6 for one single cell in the transcript. Here the raters gave 66.7% of the time the same amount of scores for this single cell. By adding up the percentages

for all single cells and dividing them by the total amount of single cells a percentage of agreement is computed.

Statistical analysis

The statistical analyses were performed using the SPSS 17.0 for Windows statistical software package. For each hypotheses there will be a separate analysis carried out. An alpha level of .05 was used for all statistical tests.

Hypothesis 1: Meditators have significantly higher scores on the attention-tasks then the control group. This concern: a) sustained attention, and b) switching attention.

To investigate whether meditators have significantly higher scores on the attention-tasks then the control group, there will be a one-way between groups multivariate analysis of covariance (MANCOVA) performed. Only main effects will be taken into account.

The advantage of using a MANOVA over a series of ANOVAs (an analysis of variance) is that a MANOVA adjusts for the risk of a Type 1 error. However, therefore have to be a number of additional assumptions met. For that reason the following assumptions will be tested for this analysis: 1) sample size, 2) normality, 3) outliers, 4) linearity, 5) homogeneity of regression, 6) multicollinearity and singularity and 7) homogeneity of variance-covariance matrices.

The independent variable is experience with meditation: meditators vs. non-meditators. The dependent variables are the scores on the CPT and the Switch task. Each of these scores

consists of two variables: the response time and the percentage of good answers. So in total, there will be 2x2 dependent variables.

To control for variables that may influence the outcome of this analysis, the background information will be tested first. If one, or more, of the variables: age (continues variable), sex (categorical variable: male/female) and education level (categorical variable: high/low) shows a significant result, the variable will be added as covariate.

Hypotheses 2: The scores of the meditators on the new mindful exteroception task (MET) are higher than the scores of the non-meditators:

To investigate whether the scores of the meditators on the MET is higher than the scores of the non-meditators there will be a between groups multivariate analysis of variance (MANOVA) performed. Only main effects will be included. In this analysis the same additional assumptions will be tested as in hypothesis 1.

The independent variable is experience with meditation: meditators vs. non-meditators. The dependent variables are sustained attention, switching in attention, exteroceptive mindfulness and proprioceptive mindfulness.

Hypotheses 3: The objective scores on the attention-tasks, including the MET-task, correlate significantly with each other and with subjective scores on the FFMQ.

A Pearson product-moment coefficient will be performed to investigate if the objective scores on the attention-tasks: the CPT, the Switch task and the MET, correlate with the subjective scores on the FFMQ.

Results

Inter-rater-reliability

For the MET, the minimum and maximum amount of scores for all transcriptions is computed for the 23 cells. All minimum and maximum scores were added. The total of minima is divided by the total of maxima. A percentage of corresponding amounts of scores for each cell was computed. These percentages were added and divided by the total, resulting in an overall percentage of 62.47%. This indicates a moderate agreement between the raters.

Background information

An independent-samples t-test was conducted to compare the age for meditators and non-meditators. There was no significant difference found between meditators and non-meditators; t (78) = 0.36, p = .72 (Table 1).

To see if there was a significant difference between the level of education of both groups, a Chi-square test for independence (with Yates Continuity Correction) was performed. The test indicated a significant association between the level of education and meditation status, χ^2 (1) = 89.27, p = .002. This means that the mediators group achieved a higher level of education than the non-meditators group. With phi = -.37 this is considered a medium effect (Table 1).

A Chi-square test for independence (with Yates Continuity Correction) was also conducted to examine a difference between genders. This test showed no significant association between gender and meditation status, χ^2 (1) < .01, p = 1.00 (Table 1).

Table 1 shows more information about these results. Because there was a significant difference in the level of education, this variable is considered as a possible interfering variable and is therefore taken into account as covariate in further analysis.

Sustained attention and switching in attention

To see if the scores of the meditators are higher on the attention tasks then the scores of the non-meditators, there was a one-way between groups multivariate analysis of covariance conducted, with education as covariate. Four dependent variables were used: the response times of the tasks CPT and Switch and the percentage correct answers on those 2 tasks. The assumption of homogeneity of variance-covariance matrices was violated with a $p < .01$. There was no statistically significant difference found between meditators and non-meditators on the combined dependent variables, F (4,73) = 0.94, p = 0.44; partial eta squared = .05 (Table 2). The covariate, level of education, showed also no statistically significant results with either one of the four dependent variables ($p > .05$).

To see if the dependent variables make a difference separately, a one-way analysis of covariance was performed, with the level of education as covariate, for each of the four dependent variables. There were no statistically significant difference found between meditators and non-mediators on the variables: response time of the CPT, percentage of correct answers on the CPT, response time on the Switch task and percentage of corrects answers on the Switch task. The covariate was also not found to be significant with one of the variables ($p > .05$).

Mindful Exteroception Task (MET)

A similar analysis was performed for the MET, with education as covariate. Four dependent variables were used: exteroceptive mindfulness, proprioceptive mindfulness, switching in attention and sustained attention. The assumption of homogeneity of variance-covariance matrices was violated with a $p < .01$. There was no statistically difference between meditators and non-meditators on the combined dependent variables, F (4,73) = 1.96, p = 0.11; partial eta squared = .10 (Table 3). The covariate, level of education, showed that meditators scored higher on sustained attention than the non-meditators did.

To see if the dependent variables separately cause a difference, there was also a one-way analysis of covariance performed for each of the dependent variable, with the level of education as covariate. There were no statistically significant difference found between meditators and non-mediators on the variables: switching in attention, sustained attention and exteroceptive mindfulness ($p > .05$). There was a positive, significant difference found between the meditators and the non-meditators on the variable proprioceptive mindfulness, F (1) = 4.03, p = 0.05; partial eta squared = .05.

Correlations between scores on attention-tasks, MET and subjective mindfulness

There were multiple correlations found that were significant at the considered alpha level. All the five variables linked to the FFMQ correlated significant with each other. Except for observing and non-judging, (r=.18, p>.05). A small, positive correlation was also found between the variables exteroceptive mindfulness and observing (variable of the FFMQ), (r=.25,

$p < .05$). A small, negative correlation between the reaction time on the CPT and the percentage of good answers on the Switch task was found, (r=-.28, $p < .05$). A high, positive correlation was found between the variables reaction time on the Switch task and the percentage of good answers on the Switch task, (r=.68, $p < .01$). There was a strong, positive correlation between the variables switching in attention and sustained attention of the MET, (r=.81, $p < .01$). Switching in attention had also a medium, positive correlation with proprioceptive mindfulness, (r=.38, $p < .01$), and a small, positive correlation with the reaction time of the Switch task, (r=.23, $p < .05$). A medium, positive correlation was found between the variables sustained attention and exteroceptive mindfulness, (r=.40, $p < .01$). Proprioceptive mindfulness was also correlated with sustained attention; a small, positive correlation was found, (r=.26, $p < .05$).

Second, a partial correlation was used to explore the relationship between the objective scores and the subjective scores, while controlling for the level of education. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. The same statistically significant correlations were found as in the first correlations analysis, with one additional correlation: there was a small, positive correlation found between sustained attention and the reaction time on the Switch task, (r=.24, $p < .05$).

An overview of the correlations can be found in table 4, 5 and 6.

Discussion

Although the MET is designed to capture an open attention to incoming stimuli, this study didn't completely show that there are significant differences between meditators and non-meditators on the MET. Only the variable proprioceptive mindfulness gave a significant result,

which demonstrates that people who meditate have more attention for their own body. They can detect sensations of their body better than people who don't meditate. Exteroceptive mindfulness didn't give any significant results, even not when it wasn't divided by the number of scored cells. Concluded can be that exteroceptive mindfulness isn't a distinctive component between meditators and non-meditators when it comes to being mindful. This means that the MET hasn't got the additional value that was hoped for, but that there are promising results for further research.

Four variables, the response time of the CPT and the Switch task and the percentage of correct answers of both tasks, were used to see if there is a difference between the two groups on the attention-tasks, to measure sustained attention and switching in attention. However, the used analysis displayed no difference. This implies that meditators score the same on the attention-tasks, CPT and the Switch task, as the non-meditators do. These results match results that Anderson et al. (2007) found. They found no differences in tasks of sustained attention, inhibition, switching, and object detection before and after a Mindfulness Based Stress Reduction (MBSR) training or a wait-list control group. They did find an improved ability to detect objects in inconsistent scenes and they found improvement in reported psychological well-being after MBSR-training. In a similar study the Attention Network Test (ANP) is used to test alerting, orienting, and conflict monitoring before and after MBSR training on a meditation naive group, a 1-month intensive mindfulness retreat on a group of experienced meditators compared to a group of control participants (Jha et al., 2007). Their results suggest that training in mindfulness improves performance on specific conditions on the ANP. It is evident that results on different objective instruments for attentional control (Bishop et al., 2004) are varying.

In addition, the found results are in contrast with Moore & Malinowski (2009), who find that meditators perform better on an interference test and a concentration and endurance test than do non-meditators. An explanation for this difference can be found in the method of both studies. In both studies meditators were compared with non-meditators. The difference lays in the kind of meditation. In this research the group with the meditators consisted of individuals who have thorough experience, for at least one year, in mindfulness-, Zen-, Vipassana, and Transcendental Meditation or other kinds of meditation where mindfulness is an essential component. Moore and Malinowski (2009) recruited only Buddhist meditators from a local Buddhist centre. Most of them were enrolled in intermediate classes and had at least completed a 6-week beginner's course on meditation. Besides that, there is a slight difference in the materials that were used. Moore and Malinowski (2009) used the Kentucky Inventory of Mindfulness Skills (KIMS) to assess the level of mindfulness participants experienced, a paper–pencil version of the Stroop task to measure the degree of automatisation/deautomatisation and to further assess attentional performance and flexibility they used d2-concentration and endurance test. All of them weren't used in the present study. Nevertheless, the FFMQ that was used in this study is based on the KIMS. So it is almost impossible that the FFMQ causes the difference in the found results. So the fact that the meditators in this research didn't have a significantly higher score on the attention-tasks might lie in the form of meditation or in the other used materials. Past research that focused on a relation between mindfulness and attention support the idea that participants and their level of mindfulness can cause a difference in results (Valentine & Sweet, 1999). The relation between meditation experience and attention may be curvilinear, such that a certain level of mindfulness may be necessary before a relation between attention and

mindfulness can be observed. Future research is necessary to make a hard statement about this, and to conclude if the form of meditation indeed makes a difference.

Previous research on a part of the present sample has found a difference between meditators and non-meditators on cells of the same score tables used in this study. It concerns the cells 1: neutral thought of the present and 5: a neutral, proprioceptive feeling, of the second code table (Oomen, unpublished manuscript). Looking at these possible discriminating variables, there were no statistically significant results found for this study. An explanation for this difference, can lay in the tasks that were examined. In the previous research there were introspective tasks examined, which weren't examined in this study. The found results may be a result of those tasks.

With no control for the level of education, there were several significant correlations found between the 13 different variables. The conclusions that can be drawn from the correlations are as followed. A high score on switching in attention, is not only associated with a high score on sustained attention, but also with a high score on proprioceptive mindfulness and a longer reaction time on the Switch task. So, the participants that can switch their attention easily between different stimuli are better in keeping being attentive for a longer time, are better in detecting sensations of the body and take longer on the Switch task. This aspect is in contrast with what was thought. It was hypothesized that the people, who are good in switching in attention, would also do well on the Switch task. A possible explanation for this result might be the time-limit. The variable switching in attention is measured via the MET. There is a time-limit for the MET, but within that limit, there is no time restricted for measuring the variable switching in attention. In duration of 2 minutes participants can describe whatever they want, related to switching in attention or not. Participants thus have a longer time to score on the

variable switching in attention. This means that they possibly also score higher on this variable, which leads to the conclusion that they can switch their attention easily. This is different with the Switch task. The letters presented in that task appear repeatedly on the screen. The participant has a short time to press the button that correlates with the right answer. It can be, that a participant can switch his or hers attention easily, but has a slower responsiveness. This low responsiveness leads to a bad performance on the Switch task and thus results in a longer reaction time. A longer reaction time means that a participant can't easily switch his or hers attention. This might cause the difference between the two tasks that focus on the ability to switch attention. It could also be that the variable switching in attention of the self-constructed MET that is used here, only measures openness to extern stimuli and not the efficiency of switching. Unfortunately, there is no previous research to support this explanation.

If a participant scores high on sustained attention, the participant also scores high on exteroceptive mindfulness and on proprioceptive mindfulness. This means that the participant who can stay focused for a prolonged period of time, is also good in focusing on stimuli from outside and inside the body. These participants have a high level of attention.

A high score on exteroceptive mindfulness is related to a high score on the variable observing (variable of the FFMQ). This is explained by the fact that exteroceptive mindfulness focuses on stimuli from outside the body, thus focuses on everything that is around a person like observing does. This also means that the variable exteroceptive mindfulness is a good dimension for objective measuring. This offers potential for other research. However, the fact that the correlation between the two variables is low must be taken into account. There is a slight agreement, but further research should conclude if this agreement is sufficient to base any conclusions. The low correlation between the two variables can be caused due to the fact that

self-rating of mindfulness can be different from the level one actually is mindful. A person who invested lots of energy, time and money in becoming mindful might be biased in responding on mindfulness questionnaires.

A short reaction time on the Switch task is associated with a lower percentage of good answers on that task. This implies that the participants, who've answered quickly, did worse than the participants who took the time for the task.

With the education level taken as a covariate, the same correlations were found, with one additional correlation. A high score on the variable sustained attention is related to a longer reaction time on the Switch task. The values of the same found correlations did differ sometimes, but there were only small decreases noticed (Table 4b). This suggests that the observed relationship between the variables is not due merely to the influence of the level of education.

It should be noted that the two groups, meditators and non-meditators, were unequal. The meditator group existed of 34 participants, while the non-meditator group had 45 participants. This made matching more difficult. There were analyses performed to check for confounding factors. Looking at the results of the background information, only the level of education gave a statistically significant result. It showed that most of the participants had a high education, especially in the meditation-group. During the recruiting, it was difficult to find low educated, meditating people, which causes an unequal division over the groups. This is why only for that variable a control was executed. It takes more time and resources, to recruit people who can let this difference disappear.

The new self-constructed MET didn't live up to its expectations. Although proprioceptive mindfulness came up significant, there were no further significant results found

between the two groups on this new task and so there was no support found for the second hypothesis. This can be due to the length of the research, but also due to the instruction of the task or due to the construction of the variables. First, the instruction of the task lets participants free in what they tell, and maybe it lets people too free. The participants don't have to focus on one thing and can say things that are not relevant to the movie. So it could be that the instruction of the task is too broad. For example, participants don't know what to say, because the instruction doesn't say if they have to focus on anything or not. As a result they tell everything what rises in them and, possibly, lose sight of the aim of the task. Because of this, there are a lot of varying answers that diverge a lot. This makes it difficult to score the answers well. It is recommended to limit the instruction for further research. Second, looking at the construction of the variables, proprioceptive mindfulness gave a significant result. This shows that this variable is well constructed. The variable exteroceptive mindfulness correlates with the variable observing of the FFMQ and this displays that this variable is also well measured, although the correlation is low. It could be that switching in attention and sustained attention aren't constructed well. There was no distinguish made between switching between auditive and visually. Both modalities were scored as switching within. It could be that, in further research, a distinction must be made to achieve a significant result. Also it could be that sustained attention hasn't been measured well, due to the construction. Sustained attention is about being focused for a prolonged period of time. The variable in this study is constructed by counting how many neutral visual or auditory events from the movie are mentioned. There is no focus on interpretation of those events or thoughts that come to mind during the event, while is doesn't mean that the participant has lost focus if, for example, he says what he feels if he sees a tree. He is then still focused on that tree.

What's more, the MET is an instrument in development. The used method in content analysis needs to be further revised. The inter-rater reliability was considered to be moderate. This is due to difficulties in dividing transcripts into matching units for scoring by different raters and subsequently assigning these units to cells on the used score form. It is advised to define more global but distinctive cells in the score table, to create more clarity for the raters. This way, the construction of the variables switching in attention and sustained attention can also be revised.

It should be noted that the present study has a number of limitations. The impossibility to make stringent conclusions about causality is bound to the non-experimental research setting of this study. Participants are selected on meditation experience or meditation naivety before taking part in the research, the independent variable is therefore not manipulated or controlled in this study. Caution is necessary in interpreting results, because of possible hidden influences in group differences (Heiman, 2002).

Besides that, the results must be carefully taken into account, because of the small sample size of this study. Only 79 participants have taken a part in the research, which is not enough to make hard statements about the differences between meditators and non-meditators.

Moreover, since it is not yet clear what the exact definition of mindfulness is (Grossman, 2008), it is not sure the measured qualities really indicate mindfulness. This is a problem with the construct validity. The data of the objective instruments for measuring factors of mindfulness are compared with a self-report questionnaire for which it is not sure to be a good external referent (Grossman, 2008). So also the criterion validity is not warranted.

Another issue that may be important to consider in further research is the conceptualization of mindfulness as a state or a trait (Schmertz, Anderson & Robins, 2009). Brown and Ryan (2003) found the majority of state mindfulness variance (71%) was attributable to within person variability, in a student sample. The measurements included in the study were designed to measure trait mindfulness. There was a difference made between people who had a thorough experience with mindfulness meditation techniques and people who didn't have any experience at all. It could be that those measurements may not be sensitive enough to capture current mindful states that would be expected to be related to attention. This begs the question as to whether mindfulness may be better conceptualized as a state or trait in populations with little or no meditation experience (Schmertz et al., 2009). It might be that conceptualizing mindfulness as a state result into different effects. Future research should address differences in both state and trait mindfulness as it relates to attention ability.

In conclusion, further research should not only make sure that the groups have the right amount of participants, but also that there are equal groups, with equal demographics, so there will be no doubt about possible confounding variables. There should be paid attention to the kind of meditation participants practice and to the kind of attention tasks that will be used. Furthermore, development of the self-constructed Mindful Exteroception Task is recommended.

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Table 1. Background information

	Meditators (*n*=34)	Non-meditators (*n*=45)
Age	M=54.12	M=52.98
	SD=9.03	SD=12.75
Sex		
Male	15 (44,1%)	21 (46,7%)
Female	19 (55,9%)	24 (53,3%)
Education**[1]		
High	33 (97,1%)	30 (66,7%)
Low	1 (2,9%)	15 (33,3%)

* $p \leq .05$ ** $p \leq .01$

[1] The level of education is divided into high (attended high school, higher professional education or university education) and low (attended exclusively elementary school, or lower secondary education or vocational education)

Table 2. Results MANCOVA on sustained attention and switching in attention

Dependent variable	Meditators		Non-meditators		
	Mean	SD	Mean	SD	*F*
CPT rt	547.56	56.12	529.81	58.97	0.91
CPT %	91.84	15.11	93.17	8.94	0.54
Switchtask rt	754.06	190.57	796.67	112.18	0.87
Switchtask %	77.53	21.49	84.58	13.60	2.82

CPT rt reaction time on the CPT; *CPT%* percentage of correct answers on the CPT; *Switchtask rt* reaction time on the Switch task; *Switchtask%* percentage of correct answers on the Switch task

* $p \leq .05$

Table 3. Results MANCOVA on the Mindful Exteroception Task (MET)

Dependent variable	Meditators		Non-meditators		
	Mean	SD	Mean	SD	*F*
Switching	13.57	6.02	12.10	6.01	0.08
Sustained	27.73	12.22	24.78	12.53	0.03
Exteroceptive	2.70	8.00	0.57	0.37	2.43
Proprioceptive	0.05	0.12	0.00	0.03	0.05*

* $p \leq .05$

Table 4: Correlations between the MET and the scores on the FFMQ

	Observing	Describing	Acting	Non-judging	Non-reactive
Switching	.017	.116	-.069	-.110	.009
Sustained	-.013	.132	-.040	-.049	-.045
Exteroceptive	.236*	.178	.114	.068	.147
Proprioceptive	.166	.082	.007	.014	.070

* $p \leq .05$

Table 5. Correlations between the scores on the CPT and Switch task and the scores on the FFMQ

	CPT rt	CPT %	Switchtask rt	Switchtask %
Observing	.131	-.016	-.139	-.178
Describing	.031	-.001	-.111	-.002
Acting	.077	.011	-.048	-.105
Non-judging	.044	-.043	.008	-.040
Non-reactive	-.018	.166	.062	.019

CPT rt reaction time on the CPT; *CPT%* percentage of correct answers on the CPT; *Switchtask rt* reaction time on the Switch task; *Switchtask%* percentage of correct answers on the Switch task

* $p \leq .05$

Table 6. Correlations between the MET and the scores on the CPT and Switch task

	CPT rt	CPT %	Switchtask rt	Switchtask %
Switching	-.136	-.032	.266*	.156
Sustained	-.168	-.017	.242*	.118
Exteroceptive	-.108	.013	.036	-.042
Proprioceptive	-.087	.044	.072	.025

CPT rt reaction time on the CPT; *CPT%* percentage of correct answers on the CPT; *Switchtask rt* reaction time on the Switch task; *Switchtask%* percentage of correct answers on the Switch task

* $p \leq .05$

Appendices

Codering Mindful Exteroception Task (MET)

Categorieeën met voorbeelden:

WAT: FILM (A)

	Visueel-Warande	*Visueel-camera*	*Auditief-Warande*	*Auditief-camera(man)*
Bemerken neutraal **event**	Ik zie een berk F1	Zoemt uit F2	Ik hoor een harder wordend geluid F3	De cameraman kucht F4
Bemerken negatieve **interpretatie**	*Dat* ik het landschap saai vind F5	*Dat* ik de camerabewe-gingen slecht vind F6	*Dat* ik die trein de scène vind verpesten F7	*Dat* de filmmaker verkouden is F8
Bemerken positieve **interpretatie**	*Dat* ik het een vriendelijk landschap vind F5	*Dat* ik de camerabewe-gingen goed vind F6	*Dat* de regendruppels een muziek-compositie zijn F7	*Dat* de filmmaker aardig is F8
Uiten negatieve	Wat een lelijk landschap F9	Wat een lelijke camerabe-	Wat een lelijk geluid van de	Wat een lelijk geluid, die kuch

interpretatie		wegingen F10	trein F11	F12
Uiten positieve **interpretatie**	Wat een mooi landschap! F13	Wat een sublieme camerabe-weging F14	Wat een prachtig geluid, die regen F15	Wat een mooie kuch F16
Uiten neutrale **interpretatie**	Het is herfst F17	Wat een dronken cameraman F18	Het zal wel een auto zijn F19	Hij zal wel verkouden zijn F20

WAT: NIET-FILM (B)

	Mentaal: Gedachte / Beeld NU (abstract)	*Mentaal: Gedachte / Beeld Verleden*	*Mentaal: Gedachte / Beeld Toekomst*	*Mentaal: Gevoel*	*Lichaam Gevoel (proprio)*	*Lichaam (extero) (zintuigen)*	*Lichaam (gedrag)*	*Mentaal gedrag NU*	
Bemerken neutraal **event**	Ik zit in een experiment 1	Ik fietste gisteren door de Warande 2	Dat ik straks ga fietsen 3	Ik voel me neutraal 4	Mijn spieren zijn niet gespannen 5	Het is hier warm 6	Ik beweeg mijn voet 7	Ik richt mijn aandacht op ... 32	
Bemerken negatief **event**	Ik ben een pessimist 30	Ik werd vroeger gepest in de Warande 8	Ik krijg straks ruzie 9	Film maakt mij zenuwachtig 10	Ik ben misselijk 11	X	X	X	
Bemerken positieve **event**	Ik hoop dat hij het gezellig heeft 31	Ik won vaak; vond het amusant 12	Ik ga morgen trouwen 13	Film maakt mij rustig 14	Mijn spieren voelen fijn aan 15	X	X	X	

Bemerken negatieve **interpretatie**	*Dat* ik het een saaie bedoeling vind 16	*Dat* ik een mislukkeling was 17	*Dat* het nooit wat wordt 18	X	X	*ZIE CATEGO-RIEËN HIERBOVEN*	X	X	
Bemerken positieve **interpretatie**	*Dat* het mij goed af gaat 19	*Dat* ik goed was! 20	*Dat* het prachtig wordt 21	X	X	*ZIE CATEGO-RIEËN HIERBOVEN*	X	X	
Uiten negatieve **interpretatie**	Wat een onzin toestand 22	Gisteren was ook al hopeloos 23	Als ze straks maar niet ... 24	Gedrag zoals huilen 25	X	*ZIE CATEGO-RIEËN HIERBOVEN*	X	X	
Uiten positieve **interpretatie**	Geweldig onderzoek! 26	Gisteren was ook al geweldig 27	Dit gaat lekker! 28	Lachen (vanuit pos.) 29	X	*ZIE CATEGO-RIEËN HIERBOVEN*	X	X	

EXTRA categoriën, apart te scoren:

WAT?

	Mentaal: Gedachte / Beeld NU (abstract)	*Mentaal: Gedachte / Beeld Verleden*	*Mentaal: Gedachte / Beeld Toekomst*	*Mentaal: Gevoel*	*Lichaam Gevoel (proprio)*	*Lichaam (extero) (zintuigen)*	*Lichaam (gedrag)*
"Ik zie verder niets"[a]		X	X	X	X	X	X
Vragen naar bedoeling[b]		X	X	X	X	X	X
Moeilijk[c]		X	X	X	X	X	X
Zoeken naar iets te zeggen[d]		X	X	X	X	X	X

Onbewust gedrag[e]	X	X	X	X	X	X	
Stoppen voor het einde[f]	X	X	X	X	X	X	
Bemerkt iets maar zegt het bewust niet[g]		X	X	X	X	X	X
Loslaten[h]		X	X	X	X	X	X
Switchen between[i]							
Switchen within[j]							

a. Geuite gedachte van de persoon dat er verder niets/weinig te zien is (echter: er gebeurt weinig = 1

b. Vragen naar bedoeling, zoals Wat moet ik nou zeggen....

c. Uiten van de pp dat hij/zij het moeilijk vindt. Ook bijv.: "Wat *moet* ik nou zeggen?" of "ik hoop dat ik het goed doe/goed gedaan heb/goed zal doen".

d. Uiten van de pp dat hij/zij aan het zoeken is wat ie zal kunnen zeggen, zoals Wat zal/moet ik nu eens gaan zeggen of herhalen van de instructies: "okee, wat er dus nu door me heen gaat?"

e. Onbewust niet geuit nonverbaal eigen gedrag: (kuch, tic, krabben, verzitten, zenuwlachje...; behalve als het in functie van een handeling: de proefpersoon voelt aan zijn vinger en vertelt erbij "ik heb last van mijn vinger". Dan wordt alleen het gezegd e gescoord (in dit geval categorie 11). In principe altijd scoren behalve aan het begin (als ze voordat ze iets gaan zeggen gaan verzitten bijv.). Ook als "e" onderbroken wordt door iets, opnieuw scoren. Bij twijfel over gedrag (als niet benoemd): e

f. De pp stopt met vertellen voordat de 3 minuten om zijn

g. De pp bemerkt iets maar zegt het bewust niet, zoals Ik denk nu aan iets, maar dat zal ik jullie niet vertellen

h. De pp laat blijken dat hij/zij nu een gedachte / gevoel loslaat, bijv. .....maar ach, er zijn ergere dingen... (waarna niet direct erover door weer)

i. Switchen aandacht TUSSEN aandachtsmodaliteit: tussen grote categorieën: 1) visueel, 2) auditief, 3) lichamelijke gewaarwording, 4) mentaal (mentale gevoelens/gedachten)

j. Switchen aandacht naar ander perspectief BINNEN zintuiglijke aandachtsmodaliteit: in categorieën:

1) visueel (inhoud film versus bewegingen door cameraman), 2) auditief (film versus cameraman)

BELANGRIJK: tijdens scoring wordt dus bij deze taak wel eens dubbel gescoord: in de hoofdtabel, alsmede mogelijk i) of j) als er geswitcht wordt!