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"Is Attaining Mindfulness Child´s Play? Exploring the Potential of Colouring Mandalas to Induce Mindfulness and to Modulate Attention"

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Contents

1 Introduction

Over the last four decades, the concept of mindfulness has steadily gained popularity in the scientific fields of psychology, neuroscience, and clinical therapy, and has attracted much attention from the media and lay communities (Chiesa & Serretti, 2010; Keng, Smoski, & Robins, 2011; Derbyshire, 2014). Although originating as a central principle of Buddhist philosophy (Schmidt, 2011), the Western conceptualization of mindfulness, coined by Jon Kabat-Zinn, a pioneer of Western mindfulness practices, has been defined as "paying attention in a particular way, on purpose, in the present moment, and non-judgementally" (Kabat-Zinn, 1994, p. 4). For many, the practice of mindfulness has in turn become a method to achieve self-improvement, mental stability, enhanced physical health, and well-being.

Mindfulness practice has also been the target of recent empirical research, indeed verifying many of its claims for physical and mental improvement. Mindfulness has been connected to the effective treatment of disorders, such as anxiety (Chiesa, & Serretti, 2010; Hofman, Sawyer, Witt, & Oh, 2010), depression (Hofman, Sawyer, Witt, & Oh, 2010), substance abuse (Bowen et. al.,2006), eating disorders (Tapper, Shaw, Ilsley, Hill, Bond, & Moore, 2009), chronic pain (Chiesa & Serretti, 2010; Grossman, Tiefenthaler-Gilmer, Raysz, & Kesper, 2007), as well as in the reduction of psychological symptoms in cancer patients (Ledesma & Kumano, 2009; Shennan, Payne, & Fenlon, 2011) and in patients with borderline personality disorder (Lynch, Trost, Salsman, 2007). There is strong evidence for mindfulness practice´s positive impact on physical health (Carlson, Speca, Faris, & Patel, 2007), stress levels (Chiesa & Serretti, 2009) and overall life quality (Godfrin & van Heeringen, 2010; Kuyken et. al.,2008).

Interdisciplinary approaches, including neuroscience along with cognitive behavioural approaches, continue to contribute to filling the gaps in our understanding about the mechanisms underlying the effect of mindfulness (Chiesa & Serretti, 2010; Chiesa, Brambilla, & Serretti, 2011; Chiesa, Calati, & Serretti, 2011; Fox et. al., 2014; Tang, Hölzel, & Posner, 2015). By virtue of this continuously strong positive scientific support, Western adaptations of mindfulness techniques seem to offer a welcoming alternative to traditional clinical approaches.

As a means of evoking mindfulness for either personal or clinical practice or for empirical study, a number of techniques have been adapted. Beginning in the late 1970´s (e.g., by Jon Kabat-Zinn, a molecular biologist and zen-practitioner at the *University of Massachusetts Medical School*) with the *"Mindfulness-Based Stress Reduction Program – MBSR"* (Kabat-Zinn, 1982), a variety of standardised mindfulness-based interventions have

been developed. These most often involve mindfulness exercises such as sitting meditation, walking meditation, or mindful actions/movements (Kabat-Zinn, 1990) combining essential mindfulness meditation techniques with Western psychological practice (Gu, Strauss, Bond & Cavanagh, 2015).

Most recently, programs such as, Mindfulness-based cognitive therapy (MBCT; Segal et. al., 2002), Dialectical Behaviour Therapy (DBT; Linehan, 1993), and Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson,1999), also share common aspects fundamental to mindfulness meditation. In addition to meditations, these involve cultivating awareness and non-judgemental acceptance of one´s present experience (Kabat-Zinn, 2003).

A shared feature of all mindfulness techniques is the emphasis on the role of attention (Jha, Krompinger, & Baime, 2007). Considered widely as a form of mental training (Bishop et. al., 2004), mindfulness mediation, centres around the self-regulation of attention, a cognitive skill to be developed in order to positively shape one´s experience of the present (Bishop et. al., 2004; Holas & Jankowski, 2013; Kang, Gruber, & Gray, 2012; Shapiro, Carlson, Astin, & Freedman, 2006). Empirical research investigated mindfulness meditation´s potential effect on attentional performance (Valentine & Sweet, 1999; Jha, Krompinger, & Baime, 2007; Hodgins & Adair, 2010; van den Hurk, Giommi, Gielen, Speckens, & Barendregt, 2010; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010) and a review by Chiesa, Calati and Serretti (2011) indicated that experienced meditators indeed show for significantly higher attentional abilities than matched controls and, more importantly, there was indication for even brief mindfulness training´s ability to enhance such.

Most recently, and in light of the above attentional and psychological/health benefits, attempts have been made to integrate the benefit of mindfulness meditation into daily life or simple activities that can be done alone, by an individual. A number of short relaxation techniques have emerged. These often use a similar structure as clinical programs, however involving one specific task or focus, and with the assumed—although not always empirically verified—argument that these would also evoke mindfulness and its health benefits.

One such emerging exercise involves mandalas. Mandalas—Sanskrit for “circle” or “centre” and again tied to Buddhist roots (Henderson, Rosen, & Mascaro, 2007)—are commonly known, as a spiritual symbol found in many religions. Based on the work of C.G. Jung (1985), they became a commonly applied medium/tool in (art) therapeutic contexts. Specifically, within recent mindfulness practice, colouring mandalas, are circular designs with a structure of symmetrical shapes inside the circle, that can be coloured in by the individual.

Compilations of such colouring mandalas are available for sale as colouring books and are enjoyed among young and old outside of the clinical context (Krug, 2016).

Mandala exercises are marketed at especially healthy, busy adults, since the colouring activity is said to provide a break from daily routine, where the emotionally stressed individual may relax and ease tension by diverting their attention and offering a respite from their thoughts. These claims are in part founded on a strong belief that is shared by scientific and lay community alike - that mandalas possess an inherit meditative quality (Belchambre, 1997; Curry & Kasser, 2005; Van der Vennet & Serice, 2012; Carsley, Heath, & Fajnerova, 2015) and are therefore "thought to promote psychological healing and integration when created by an individual" (Henderson, Rosen, & Mascaro, 2007, p. 149).

Writers go as far as to consider mandalas as connected to the construct of mindfulness, suggesting that it represents a form of mindful art making (e.g. Curry & Kasser, 2005, Carsley, Heath, Fajnerova, 2015). Literature offers support for the notion that colouring mandalas has a mood regulating effect (Curry & Kasser, 2005; Van der Vennet & Serise, 2012), and, in some cases, healing qualities (Henderson, Rosen, & Mascaro, 2007).

Nevertheless, despite this popular interest, to the author´s knowledge there are no studies that actually offer empirical support for the hypothesis that colouring mandalas are effective in inducing a mindful state or impacting the attentional, physiological, or cognitive factors tied to mindfulness. This raises an important research question both involving pragmatic/clinical application and involving the better understanding of mindfulness itself, as well as the role of mandalas and act of art-making or colouring. Namely, does mandala colouring result in a mindful state, which might be detected by self-report, the assessment of related constructs or abilities (i.e., mood regulation or attentional abilities), or neurological assessments (i.e., EEG or fMRI imaging). Relatedly, does colouring mandalas, if coupled with mindfulness, lead to changes in other aspects of participants´ awareness or physiology? Do these aspects show difference from other colouring or concentration activities—i.e., is the mandala special in its mindfulness evoking ability? Is there anything particularly special about the mandala itself?

This topic is also important for recent mindfulness research. Facing a spreading optimistic stance towards mindfulness, it is important to be wary of premature assumptions. Systematic scientific review of existing theories as well as meticulous testing of new hypotheses is of essential importance in the face of the growing popularity of and psychological interest in the concept of mindfulness.

1.1 Present Study

This study therefore, seeks to investigate the question of, whether colouring mandalas can induce a meditative state of mindfulness. This will be accomplished by both assessing the construct of mindfulness directly via a self-report questionnaire, in form of the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013), and by checking for effects on cognitive skills commonly related to mindfulness practice, namely attentional abilities, using a version of the Attentional Network Test (ANT; Fan, McClandiss, et. al., 2002). By including the latter in the investigation, we will try to verify if such a type of short mindfulness induction is a result of similar mechanisms at play during conventional mindfulness meditation, applying the self-regulation of attention as its pivotal feature, and whether it provides some of the benefits of traditional mindfulness meditation. If that is the case, based on existing literature, we would expect enhanced attentional abilities for individuals within the colouring mandala condition. Finally, this study´s empirical component also included an assessment of differences in brain activity, recorded via electroencephalography (EEG). However, for time reasons, results will not be included in the present master thesis but might be addressed in a later journal paper. Nevertheless, theoretical and procedural aspects of this component will be discussed in the theoretical background and method, as it contributes to the reader´s understanding of the topic at hand and explains certain aspects of the experimental outline.

This study will also begin with a brief review of the mindfulness literature, as well as that on mandalas, and the theoretical basis for mindfulness as it may or may not manifest in colouring activities. We end with a discussion of the results in terms of implications for future research.

2 Theoretical Background

2.1 Mindfulness Definition and Mechanisms

Earliest conceptualizations of mindfulness itself, which we will not further discuss, can be found in traditional Buddhist scriptures, as part of a philosophical concept and system of practices, necessary in the pursuit of a greater ideological goal (Keng, Smoski, & Robins, 2011). On the other hand, mindfulness, detached from its spiritual context and as practiced in the West, has become “a technique of remaining aware and noticing the salient features of present experience while refraining from evaluative processes, conceptual elaboration and mind wandering” (Kabat-Zinn, 2003 quoted in Berkovich-Ohana, Glicksohn, & Goldstein, 2014, p. 1616). Mindfulness practices are considered a form of mental training (Bishop et. al., 2004) that can be taught independently of their spiritual origins (Kabat-Zinn, 1982).

In their attempt to provide an operational definition of the construct, Bishop et. al. (2004, p. 234) recognize mindfulness as "a process of regulating attention in order to bring a quality of non-elaborative awareness to current experience and a quality of relating to one´s experience within an orientation of curiosity, experiential openness, and acceptance." In their opinion, this process eventually leads to "gaining insight into the nature of one´s mind and the adoption of a de-centred perspective… On thoughts and feelings so that they can be experienced in terms of their subjectivity (versus their necessary validity) and transient nature (versus their permanence)." Isbel & Mahar (2015) compared other current models of mindfulness (e.g., Bishop et al., 2004; Holas & Jankowski, 2013; Kang, Gruber, & Gray, 2012; Shapiro, Carlson, Astin, & Freedman, 2006), and pointed out that differences within conceptual definitions of mindfulness remain, with the possibility of a common factor. They deduced that the intentional self-regulation of attention towards present experience represents the foundation of mindfulness practices, emphasizing the crucial role of attentional faculties. Subsequently, Isbel & Mahar (2015) and Bishop et. al. (2004) concurred in their opinion that the specific cultivation and regulation of attention results in decentring – a detached perspective towards one´s thoughts and emotions (Isbel & Mahar, 2015), enabling enhanced meta-cognitive monitoring and control of cognitive processes (Bishop et. al., 2004), and representing a favourable change in perspective in the therapeutic process.

In contrast, mindfulness is the opposite of behaving in a "mindless" fashion, meaning, to be attentionally unfocused or distracted and preoccupied with memories, fantasies, plans, or rumination (Brown & Ryan, 2003). It also entails reacting automatically instead of reflectively to one´s internal and external experience (Brown & Ryan, 2003).

In the scientific context, the term mindfulness can describe either a psychological trait, forms of training aiming to cultivate mindfulness, a mode or state of awareness, or a psychological process as long as it´s meaning is clarified and stated in advance (Germer, Siegel, & Fulton, 2005). It should be stated that this degree of arbitrariness has not been helpful in achieving a uniform definition of mindfulness (Davidson, 2010). Throughout this study it will always be specified which meaning is intended.

To summarize, according to the literature, mindfulness can be experienced as state or mode (Germer, Siegel, & Fulton, 2005) cultivated via cognitive training (Bishop et. al., 2004), fundamentally through the self-regulation of attention (Bishop et. al., 2004). Training exercises involve a variety of forms (e.g. sitting meditation and walking meditation; Kabat-Zinn, 1990) that are characterized by the cognitive mechanisms at play, rather than relying on one specific activity, therefore allowing for some creative implementations. As a result of mindfulness

meditation, individuals are more likely to adopt a more detached and more objective perspective towards their experience, allowing for enhanced metacognitive monitoring and an enlarged spectrum of experience (Bishop et al., 2004; Isbel & Mahar, 2015). For the purpose of the present study, we will focus on mindfulness as a state. It is to be tested whether said state can be evoked by creative activities - such as the colouring of a mandala -, whether such a change of perception entails the application of the same cognitive mechanisms as common mindfulness practices, and whether it is marked by similar neurophysiological correlates as would be expected based on existing literature.

2.1.1 Mindfulness Questionnaires

As a product of attempts to operationalize the construct of mindfulness, and in respect to its various meanings, an array of measuring tools in the form of questionnaires have been developed. The questionnaires differ from each other according to the specifics of their quantitative definition of mindfulness. In an overview, Chiesa (2013) distinguished between those who quantify mindfulness as a trait (e.g. Mindful Attention Awareness Scale; MAAS; Brown & Ryan, 2003) or a state measure (e.g. Toronto Mindfulness Scale; Lau et al.,2006).

The latter form, is based on Bishop et. al.´s (2004) initial proposal to consider mindfulness rather a mode or a state than a trait, since achieving or activating it entails moment to moment voluntary guidance of attention. This led to the development of new or modified versions of existing questionnaires (e.g. State – Mindfulness Awareness Attention Scale; S-MAAS; Brown & Ryan, 2003; or the Toronto Mindfulness Scale, TMS; Lau et al., 2006), that are designed to "assess the subjective experience of a mindfulness state retrospectively" (Chiesa, 2013, p. 261). Theses typically use a number of questions such as "I was finding it difficult to stay focused on what was happening" or "I was doing something without paying attention" rated by the subjects from "not at all" to "very much" to indicate the degree to which the statement describes their past experience.

For the present study, we will use the more recent State Mindfulness Scale (SMS; Tanay & Bernstein, 2013), which also allows for participants to retrospectively evaluate their subjective experience during task activity. It comprises twenty-one statements (e.g. "I noticed pleasant and unpleasant emotions") that are to be rated according to a five-point Likert-type scale (1=not at all; 5 = very well). The raw score is calculated and used for interpretation. The SMS is structured according to a higher order two-factor solution, wherein the two first-order factors are related to the objects of mindful awareness: mental events (e.g. thoughts and emotions) and physical sensations. Consequently, the SMS is divided into two sub-scales,

termed the mind subscale and the body subscale, which compromise questions specifically targeting aspects of experience like thoughts, emotions and bodily sensations.

According to the authors the SMS distinguishes itself from the S-MAAS (Brown & Ryan, 2003) and the TMS (Lau et al., 2006) in several aspects. Unlike the S-MAAS, the SMS is not only designed to measure mindfulness in daily activities but is also suitable for activities and exercises specifically aimed at inducing a state of mindfulness. Since colouring mandalas have already established a reputation for being a potentially meditational activity, this is a precautionary consideration. More importantly, the S-MAAS omits distinct assessments of individuals´ awareness of physical (e.g. body sensations) and mental aspects (e.g. thoughts and emotions) of their experience (Tanay & Bernstein, 2013). Tanay & Bernstein (2013) go on to explain that this means neglecting a central point of mindfulness. Furthermore, Bishop et al. (2004) theorized that mindfulness, through suspension of secondary elaborative processing of thoughts, feelings and, sensations, frees limited attentional capacity (Shiffrin & Schneider, 1977), and therefore enables the processing of information otherwise unnoticed (e.g. sensations, thoughts and emotions), thus broadening personal experience. If this is true, we would expect individuals who are more mindful to be more aware of these aspects. As a conclusion, we see the use of the SMS in advantage over the S-MAAS since it provides a more complete and detailed assessment of the experience that constitutes mindfulness and the corresponding construct we try to investigate.

Similarly, the TMS has been criticized for incorporating decentring as part of the construct of mindfulness. As seen above, decentring is considered to be an outcome of mindfulness practices (Bishop et al., 2004), and it is argued that it should not be confounded with a core aspect of mindfulness (Fresco, Segal, Buis, & Kennedy, 2007; Tanay, Lotan, & Bernstein, 2012). Our study does not intend to include decentring in the assessment, and rather narrows the focus to the most basic definition of the construct, assuring content validity.

To summarize, we expect that, if colouring inside a mandala has indeed the potential to induce a state of mindfulness within participants, this should be reflected by higher scores in the SMS compared to the other conditions.

2.2 Mindfulness and Attention

A sub-goal of this study is again to investigate whether a colouring mandala, as a form of mindful-art-making provides some of the benefits of traditional mindfulness meditation. As such, we theorize that attentional abilities should be positively influenced by this mindful-art-making task.

Within Buddhist tradition mindfulness translates into *bare attention* (Thera, 2005). In line with this, Isbel and Mahar (2015) delineated the major popular operational definitions that have been proposed for mindfulness (Bishop et al., 2004; Holas & Jankowski, 2013; Kang, Gruber, & Gray, 2012; Shapiro, Carlson, Astin, & Freedman, 2006) and deduced that, as a common factor, attention, or the regulation of such must be the pivotal feature in mindfulness meditation. Concordantly Jha, Kompinger, and Baime (2007) consider mindfulness techniques to be designed as a form of attentional training where the role of attention is emphasized, and attentional abilities cultivated.

The idea of a mental training that is focused on, and reliably capable of enhancing attentional abilities is intriguing, and has prompted several investigations examining potential beneficiary effects and possible underlying cognitive mechanisms (e.g. Valentine & Sweet, 1999; Lutz, Greischar, Rawlings, Ricard, & Davidson, 2004; Jha, Krompinger, & Baime, 2007; Lutz, Slagter, Dunne, & Davidson, 2008; van den Hurk, Giommi, Gielen, Speckens, & Barendregt, 2010; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010). So far, the bulk of the collected evidence supports the hypotheses that long term mindfulness meditators show significantly higher attentional abilities than control groups (Valentine & Sweet, 1999; van der Hurk, Giommi, Gielen, Speckens, & Barendregt, 2010) and that mindfulness mediation - even a brief training period - can improve different sub-faculties of attention (Valentine & Sweet, 1999; Jha, Krompinger, & Baime, 2007; Chiesa, Calati, & Serretti, 2010; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010).

When discussing underlying cognitive mechanisms involved in any type of meditation it is important to remain aware of specific differentiations within their paradigmatic framework. In the case of mindfulness practices, they are considered to combine both common styles of focused attention meditation and open monitoring meditation (Lutz, Slagter, Dunne, & Davidson, 2008). The former has been described as “voluntary focusing attention on a chosen object in a sustained fashion”, and the latter as “nonreactively monitoring the content of experience from moment to moment…” (Lutz, Slagter, Dunne, & Davidson, 2008, p. 163). Therefore, it is also said to affect two distinct forms of attention—"concentrative” and “receptive” attention (Brown, 1977). The distinct terminology is not only based on procedural differences in meditational styles but also supported by consistent findings in neuropsychological literature that emphasize the correlation between mindfulness practice and attentional networks (Ivanovski & Malhi, 2007).

Corbetta and Shulman (2002) distinguish a dorsal attentional system, regulating voluntary (top-down) faculties of attention, and a ventral attentional system regulating

"stimulus-driven" (bottom-up) faculties of attention. The assumption has been made, that the dorsal system described in this model is related to concentrative attention, and the ventral system related to receptive attention (Jha, Krompinger, & Baime, 2007). The dichotomic model proposed by Corbetta and Shulman (2002), also shows striking parallels to the "tripartite model of attention" by Posner and Petersen (1990). Neuroimaging studies have found that, when comparing both models, brain activity during specific tasks was significantly overlapping for areas attributed with similar functions (Fan McCandliss, Fossella, Flombaum, & Posner, 2005). The model of Posner and Petersen (1990) describes an interplay of three functionally and anatomically distinct neuronal networks: the alerting, orienting and conflict monitoring network. "Alerting is defined as achieving and maintaining a state of high sensitivity to incoming stimuli; orienting is the selection of information from sensory input; and executive attention involves mechanisms for monitoring and resolving conflict among thoughts, feelings, and responses" (Posner & Rothbart, 2007, p. 7).

Subsequently, the attentional networks can be connected to subcomponents of attention: the alerting network regulating sustained attention, the orienting network regulating attention switching and selection, and the executive attention network regulating monitoring faculties (Isbel & Mahar, 2015). According to Lutz, Dunne, and Davidson (2007), these subcomponents are involved in the practice of concentrative meditation, which meditators are not only instructed in but also are inclined to practice first (before receptive meditation; Kapleau, 1965; Lutz, Slagter, Dunne, & Davidson, 2008). Especially novice mindfulness meditators are expected to be primarily concentrated on remaining focused on an object of choice and practice extensive monitoring to notice when their mind wanders off (Lutz, Slagter, Dunne, & Davidson, 2008; Chiesa, Calati, & Serretti, 2011). This stands in comparison to experienced meditators, who are less occupied with focusing and monitoring, having reached a high level of sustained attention (Chiesa, Calati, & Serretti, 2011), and who remain more attentionally open to their present experience (e.g. receptive attention; Lutz, Dunne, & Davidson, 2007). A review by Chiesa, Calati, and Serretti (2010), further supports this theory, showing that in general, even a short introduction into mindfulness meditation can have a significant positive effect on selective attention, potentially reflecting advanced practice of disengagement and redirection of attention, and on executive attention, due to pronounced focus on deviating thoughts. Though assumed to be related to later stages in meditation experience, even sustained attention proved to be slightly improved after a brief practice period – although to a notably lesser degree. Practitioners therefore differ in their involvement of attentional faculties and their level of skill depending on their experience (Chiesa, Calati, & Serretti, 2010).

To sum up, past research especially on beginning mindfulness practitioners has suggested that novices are to practice concentrative meditation first (Kapleau, 1965), therefore primarily utilizing and training sub-components of attention, such as sustained attention, attention switching/selection, and conflict monitoring (Lutz, Slagter, Dunne, & Davidson, 2008). In line with this, literature indicates that novices are more likely to show for enhanced abilities in selective attention and conflict monitoring during early stages of practice (Chiesa, Calati, & Serretti, 2010). These subcomponents are respectively reflected by the orienting and conflict monitoring network within the tripartite model of Posner and Petersen (1990). Notably, it has been shown that even very brief mindfulness introduction can have a significant positive effect on attentional abilities related to the orienting and conflicting network, and to a lesser degree also on the alerting network (Chiesa, Calati, & Serretti, 2010). Following this, we hypothesized that if colouring mandalas represent a mindfulness inducing technique, attentional abilities should be positively influenced accordingly by this mindful-art-making task.

2.2.1 Attention Network Test

To assess the above attention hypotheses, attentional abilities will be measured by a short version of the original Attention Network Test (ANT) by Fan, McClandiss, Sommer, Raz, and Posner (2002), henceforth labelled the ANT-S. This is based on the theoretical framework of the network model by Posner and Petersen (1990). According to the original developers, Fan, McCandliss, Sommer, Raz, and Posner (2002), the test is designed to individually assess the efficiency of alerting, orienting and conflict monitoring functions within subjects, quantified by reaction time measures, which are expected to vary according to the properties of the different conditions. The test is commonly presented in a computerized form and combines Posner´s cued reaction time task (Posner, 1980) and the flanker task by Eriksen & Eriksen (1974). A more detailed description of the procedure and elements included will follow below.

In light of the presented theoretical background, we hypothesize that if the colouring mandala can be considered a mindfulness inducing technique, attentional abilities should be affected, similarly to common mindfulness meditation. Therefore, we expect an increase in select attentional functions after the colouring activity. We do so, specifically for the subcomponents of selective and executive attention, since these abilities have been shown to be initially cultivated among novice mindfulness meditation practitioners. Changes within abilities will be measured and expressed by the efficiency scores for alerting, orienting and conflict monitoring functions assessed within the ANT-S. Further analysis may also show whether comparable creative activities provide analogous effects.

2.3 Mindfulness, Neuroscience and Electroencephalography

Another important component of the present study will involve tracing mindfulness to activity in the brain. Although meditation research is still barely scratching the surface, neuroscientific investigations have succeeded in providing important insights into how mindfulness meditation, can affect our brain.

The present study will explore a short activity's potential to induce a mindful state in people with no meditational experience, while recording brain activity patterns via electroencephalography (EEG).

There is sparse literature on the effects of short mindfulness exercises on brain activity in a similar context and in a corresponding population. However, combined collected data by brain imaging techniques, most frequently involving functional magnetic resonance imaging (fMRI), shows that long-term mindfulness meditation practice results in, both structural (Fox et. al., 2014) and functional cerebral modifications (Tang, Hölzel, Posner, 2015) as well as changes in post-synaptic brain activity (Chiesa & Seretti, 2010), and that there is growing evidence of both the short- and long-term nature of changes in mindfulness meditators (Cahn & Polich,2006). Specifically, imaging studies have found heightened activity in Vipassana meditation practitioners, a meditational style including mindfulness meditation as a component (Ahir, 1999) in the rostral anterior cingulated cortex (ACC) and the dorsal medial prefrontal cortex (dmPFC) in both hemispheres (Hölzel et al., 2007) According to the authors this might be indicative for enhanced attention regulation in experienced meditators enabled by improved attentional abilities stemming from long time practice (Hölzel et al., 2007). Indeed, although there are divergent findings about the effects of mindfulness meditation in long-term practitioners, particularly the association between mindfulness practice and attentional networks has been consistently found in neuroimaging literature (Ivanovski & Malhi, 2007, Lutz, Slagter, Dunne, & Davidson, 2008; Manna et. al., 2010). When Dickenson et al. (2012) investigated the neural mechanisms at play during a focused breathing exercise, a common technique of mindfulness meditation (Kabat-Zinn, 1990) among novice meditators, using fMRI, they found that this activity also recruited areas such as the anterior cingulate, insula and frontal-parietal regions –areas most commonly referred to as part of an attentional network. This is again an indication for the role of neuronal mechanisms involving attentional networks, but also shows that said mechanisms may be at play even at the beginning of practices and within individuals with no prior training (Dickenson et al., 2012).

While fMRI is useful for whole brain analysis, focus on subcortical structures, and provides good spatial resolution, it also suffers from limitations involving low temporal

resolution and difficulty in use in ecologically valid—sitting, quiet, or colouring—activities. Therefore, EEG has also shown promise with measuring meditation. EEG is generally recognized as a useful and reliable objective measure of differences in meditational state and ability (Ahani et al., 2014). EEG measures summed post-synaptic electrical activity within an area of the cortex (Chiesa & Seretti, 2010). The electrical signals recorded by the EEG are regularly described in terms of frequency bands, that are categorized according to their pattern, being delta (0,5-3,5Hz), theta (4-7Hz), Alpha-1 (7,5-9,5H), Alpha-2 (10-12Hz), Beta-1 (13-23 Hz), Beta-2 (24-34 Hz) and Gamma (35-45Hz) as defined by conventional IFCN guideline (Nuwer et al., 1999).

Alpha activity (8-12 Hz), characterized by large rhythmic waves, is typically found during periods of relaxation, and the absence of cognitive processing. In return, cognitive tasks result in the cessation of alpha activity (Stern, Ray, & Quigley, 2001). Moreover, synchronization of higher alpha bands is indicative of internal attention, as opposed to desynchronization which points toward cognitive processing and external attention (Shaw, 1996). Alpha activity can be distinguished as either slow or fast, the latter reflecting task related activity and the former non-task-related cognitive processing (Shaw, 1996). In contrast, theta activity (4-8 Hz) is a distinct indication of an alert and attentive state, as well as cognitive and perceptual processing (Stern, Ray, & Quigley, 2001). It has been shown to be associated with orienting, working memory and affective processing (Aftanas & Golocheikine, 2001; Basar, Basar-Eroglu, Karakas, & Schürmann, 2001) with frontal theta activity seen as an indicator for concentrative effort (Ivanovski, 2007). Gamma activity (35-40 Hz) is associated with higher-order demanding cognitive tasks and integration of stimuli to create a coherent conscious perception (Stern, 2001). Delta (0.5-4 Hz) frequency waves are commonly found during sleep (Stern, Ray, & Quigley, 2001).

In general, alpha, theta and delta frequency bands have been repeatedly linked to various meditation styles and states (Cahn & Polich, 2006; Ahani et. al., 2014; Kaur & Singh, 2015), with an occasional report of changes in gamma activity (Lutz, Greischar, Rawlings, Ricard, & Davidson, 2004; Jaseja, 2010). Chiesa et. al. (2010) observed that theta activity was more pronounced among expert meditators and therefore hypothesized that greater experience might be related to a "higher ability of self-induced deep relaxation" (Chiesa & Serretti, 2010, p. 1245). Jaseja (2010) reported high frequency gamma bursts during deep meditation, a state more likely reached by expert meditators (Lutz, Greischar, Rawlings, Ricard, & Davidson, 2004). Focusing exclusively on mindfulness meditation, a systematic review of existing literature by Lomas, Ivtzan, and Fu (2015) found that only increases in alpha and theta power

could be reliably associated with mindfulness meditation, whereas no statistically significant patterns could be found for other frequency bandwidths. It is important to note that similar activity was observed in both novice and experienced meditators (Lomas, Ivtzan, & Fu, 2015). Therefore, these bands will also be the main focus of our investigation.

Taking into consideration, that this study will feature a short mindfulness inducing technique, one recent EEG study by Bing-Canar, Pizzuto, and Compton (2016) provided meaningful insight into the influence of a brief mindfulness induction on alpha activity. Complete meditation novices performed a one time mindfulness-of-breathing exercise. The data showed that, during meditation, overall alpha power increased significantly. Participants were also asked to perform a modified version of the Stroop test (Compton, Hofheimer, & Kazinka, 2013), and further analysis of recordings during task performance showed improved self- monitoring. These findings not only represent preliminary evidence of brief mindful interventions´ influence on alpha activity and brain activity in general but, according to the author, consolidate existing proof of impact on attentional control (Bing-Canar, Pizzuto, & Compton, 2016) as will be shown further down. To once again summarize, we hypothesize that if such a mindful state can be induced, EEG recording should reflect this. According to existing literature, such a state should be characterized by heightened alpha and theta activity.

2.4 Mindfulness, Mandalas, Circles, Colouring and Art

Finally, we briefly consider the different aspects and components of the colouring mandala or other related colouring/art tasks, and their potential role in the context of mood regulation, and mindfulness induction. This will primarily involve tangible aspects that are controlled via different tasks in this study - e.g. the circle and the structural component- but also include the mandala´s image as a spiritual object.

2.4.1 The Circle

Henderson, Rosen, and Mascaro (2007) describe the mandala in its simplistic archetypical form of a circular design as a meditative tool. According to their general assessment, it is “thought to promote psychological healing and integration when created by an individual” (Henderson, et al., 2007, p. 149). This notion is primarily grounded on the works of C.G Jung, the mandala´s most famous advocate, who sought to investigate and make use of it´s positive influence on the psychological constitution during times of his own personal need for “centring himself” and “silencing his inner dialogue” (Bair, 2003 quoted in Van der Vennet & Serice, 2012, p. 87). In C.G Jung´s opinion, the circular form of the mandala is a representation of the “wholeness and unity of the archetypal self” (Jung, 1985). Based on his

research, C.G Jung (1973) postulated that the mandala, due to its formal appearance, possesses a soothing and calming effect and the ability to aid psychic integration of conflicting cognitive material, providing a healing effect when individuals are allowed to freely express themselves inside the circle. This would seem to imply the importance of the circle.

Since Jung´s early explorations, the mandala has become an established tool in art psychotherapy (Slegelis, 1987). The definition of a mandala within this art therapeutic context is rather broad and includes "any art form that is executed within a circular context" (Henderson, Rosen, & Mascaro, 2007, p. 149). Other artistic activities, including free drawing, painting and clay sculpting also represent common tools of art therapy (Abbott, Shanahan, & Neufeld, 2013) that have proven to favourably affect the therapeutic process (Oster & Gould, 1987). Existing literature points toward the fact, that art making in general seems to possess a mood enhancing (Dalebroux & Goldstein, & Winner, 2008) and stress reducing effect (Curl, 2008; Sandmire, Gorham, Rankin, & Grimm, 2012; Abbott, Shanahan, Neufeld, 2013). Yet a few studies suggest that the mandala´s effect on the creator differs somehow from other artistic tasks.

Slegelis (1987) compared a drawing task where individuals either drew inside a circle or inside a square, those who drew inside the circle experienced more positive affect. In a similar study it was found that the circle condition additionally proved to be superior in the reduction of negative mood, as assessed by the Profile of Mood States (McNair, Lorr, & Droppleman, 1971), a tool measuring the degree of psychological distress (Babouchkina & Robbins, 2015). The reason for these differences is still up for debate, but one argument is based on the premise that the mandala may possess an intrinsic meditative quality (Jung 1973). This assumption has also been extended to so called "structured mandalas" or "colouring mandalas", which also consist of circular designs but additionally comprise a symmetrical pattern that can be coloured in (Henderson, Rosen, & Mascaro, 2007).

2.4.2 The Structural Component

The affiliated activity of colouring within a therapeutic context gave rise to the term of "colouring therapy," coined by Belchambre (1997). Belchambre (1997) argues that by engaging in the activity of colouring, people become so involved in what they do, that they refrain from mind wandering, therefore also preventing rumination and accompanying excessive negative emotions, and are provided with a positive and profitable experience. Since the mandala allows individuals to express themselves by choosing the colours, while also providing an opportunity to calmly regulate and limit attention through an artistic activity, structured mandalas are

considered to combine elements of art therapy and meditation (Curry & Kasser, 2005; Semple & Lee, 2011). This has been dubbed *mindful art making* (Carsley, Heat, & Fajnerova, 2015). When debating what characterizes *mindful art making*, Greenberg and Harris (2012) stressed the importance of a structured component as a feature of a mindful activity, theorizing that it permits to intuitively focus and regulate attention, which is a hallmark of meditation (Smith, 1975). It is further theorized, that through the limitation of one´s attention and suspension of task-unrelated thought, cognitive resources are freed up (Martin, 1997) and allow for processing information that otherwise may have gone unnoticed (Kiken & Shook, 2011). We speculate that this may lead to an altered mode of perception similar to the experiential openness referred to by Bishop et. al. (2004).

Curry and Kasser (2005) investigated the effect of colouring a pre-structured drawing on anxiety reduction, comparing a pre-structured mandala, a symmetrical pattern of equal complexity and free drawing condition. Results indicated that colouring the mandala was indeed significantly more effective in reducing anxiety than the free drawing task. Interestingly, they also found that colouring a plaid design was equivalently effective and therefore deduced that, in accordance with Greenberg and Harris´ (2012) theory, that colouring tasks including a structured component may induce a meditative state. In a replication study, Van der Vennet and Serice (2012) found comparable results, with both the mandala and pattern condition more effective than the free drawing condition. Evidence differed from the original study in so far as, the mandala condition proved to reduce anxiety to a significantly higher degree than the pattern condition. Therefore, while supporting the mandala´s general ability to reduce anxiety, results proved inconsistent with the statement about its structured component´s relevance.

2.4.3 The Spiritual Image of the Mandala

One could also ask whether the pre-existing idea of the mandala as a spiritual or religious symbol plays a key role. Small (2006) assumed that the mandala´s perception as a spiritual object may represent an important factor. To test this hypothesis, a fourth condition was added to the original experimental outline of Curry and Kasser (2005), which consisted of colouring a structured mandala after a brief description of its spiritual background. The mandala colouring condition including the briefing didn´t show to be significantly more effective than the other conditions. Surprisingly, there was overall no significant difference in anxiety reduction among the four conditions.

A survey shows that data concerning the mandala´s potential for mood regulation and the role of its various components is far from conclusive. Nevertheless, overall evidence mostly supports the mandala´s effect on emotion regulation.

For this study, the registration of any effect on emotion regulation elicited by the different conditions is not a declared objective. Unlike in the studies of Curry and Kasser (2005) or Van der Vennet and Serice (2012), participants´ emotional state will not be actively manipulated in order to measure specifically for any differences in regulation. Nevertheless, the emotional aspects accompanying the different creative tasks is deemed a relevant component to be included in data collection, since they also represent a core element of experience (as well as thoughts and bodily sensations) to be monitored and accepted during mindfulness meditation according to common instructions (Kabat-Zinn, 1990). For this purpose, the German version of the Positive and Negative Affect Schedule (PANAS; Krone, Egloff, Kohlmann, & Tausch, 1996) will be applied. The PANAS consists of twenty items in form of single words describing emotions (e.g. “afraid” or “enthusiastic”) that are to be rated on a five-point Likert scale (1 = not at all; 5 = very much) in respect to the subject´s experience. The scope of the assessment will be limited to whether the tasks were experienced as rather positive or negative in their valence but will exclude statements on which specific emotions were experienced. Collected data will be used to control for the influence of affect on the subjective state of mindfulness experienced during task activity.

Within the research of mindfulness, investigations sometimes rather focus on changes in abilities, states and traits commonly correlated with the experience of mindfulness, instead of measuring the construct directly since it can be very subtle and theoretically unclear (Kingsland, 2016). Considered in this light, the effect of mindful-art-making on emotion regulation as indicated by existing literature, speaks in favour of the mandala´s theorized ability to induce a mindful state as mindfulness is positively correlated with emotion regulation (Roemer, Williston, & Rollins, 2015). Still, although the outcome is related to mindfulness meditation, there is no evidence for it involving any of the proposed mechanisms in meditation literature, remembering that advanced emotion regulation in mindfulness practices is considered to be the result of self-regulation of attention and subsequent decentring (Bishop et. al., 2004). Therefore, if evidence for the mandala´s ability to influence attentional capabilities were to be found and considered in combination with already existing data on its influence on emotional experience, the argument could be made, that colouring or drawing within mandalas may not only provide similar effects as mindful meditation, but also involve a similar process.

2.5 Research Questions and Hypotheses

In summary, we will adopt a combination of already tried and tested approaches in an attempt to add to existing literature and to fill in some of the gaps noted above. To assess whether the activity of colouring mandalas can induce a mindfulness state within individuals we formulated four research questions: 1.) Does colouring a mandala create a subjective experience of mindfulness? 2.) Does colouring a mandala affect attentional abilities? 3.) Does colouring a mandala produce neuronal activity, as recorded by EEG, equal to the state of mindfulness? 4.) Does the colouring mandala differ from other creative tasks to do so?

To answer these, based on previous work by Curry and Kasser (2005) and Van der Vennet and Serice (2012), the colouring mandala will be compared in reference to two other task conditions, as well as a baseline data.

The two alternative creative conditions consist of an empty mandala (composed of only a circle), within which individuals are allowed to draw freely, and a free drawing activity on a blank paper sheet. The plaid design condition, as seen in the studies by Curry and Kasser (2005) and Van der Vennet and Serice (2012) has been replaced by the free drawing mandala condition, wherein participants are asked to express themselves freely within a circular design otherwise blank, using the provided tools. This is based on the rationale that it represents an activity more frequently encountered in art therapy and our interest lies more in how methods compare that are used in the same context.

The experiment will also include a minor mindless drawing activity at the very beginning of the procedure, which only serves the purpose of recording brain activity during a manual task, lacking all other crucial elements of the following creative tasks, therefore enabling the filtering of motoric activity during later EEG data processing. This activity is not to be considered a proper condition for itself but rather necessary for the collection of the data representing our baseline.

We hypothesize that the colouring mandala condition will show for a significant increase in the level of state mindfulness, as well as attentional abilities connected to it, and will be characterized by a distinct difference in brain activity, when compared to the baseline data. Additionally, we expect the three active conditions to differ in their ability to evoke a mindful state, as indicated by the aspects mentioned above, with the colouring mandala condition being most effective. Although it is not this study´s explicit purpose to pinpoint what differences in characteristics between conditions are responsible for the effect, results may allow for further suggestions for future studies.

In order to compare conditions in respect to the relevant aspects within this study, we will apply a number of different measurement tools. Participants will be asked to complete the SMS by Tanay and Bernstein (2013), a state mindfulness questionnaire, after each condition, to retrospectively rate their subjective experience of mindfulness during task activity. Note that this was also not done in the above-mentioned studies. For our purpose, the questionnaire was translated into German. In combination with the SMS, we will also try to gauge subjects´ emotional state after each condition, asking them to complete the PANAS (Krone, Egloff, Kohlmann, & Tausch, 1996).

We understand that the issue of an absence of an unequivocal definition of mindfulness, and the construct of mindfulness´ subtlety create a certain degree of ambivalence regarding questionnaires´ reliability in providing adequate measurements. We address this complication in two ways. Firstly, according to a suggestion by Chiesa (2013), the choice of the questionnaire was based on its accordance with both the conceptualization of mindfulness and its purpose within this study. Secondly, we concluded that, if a mindfulness state can be induced in any of the conditions, we would expect this to be reflected in data not affected by subjectivity as well.

To gather said objective data we rely on two additional methods. Firstly, participant´s brain activity will be registered using EEG along the entire duration of the experiment. Collected data will be subjected to a time frequency analysis to determine the bandwidths of neuronal activity. Changes in the mental state of individuals during the conditions should be reflected in the recordings. These will be compared to the commonly expected brain activity within a state of mindfulness, produced by regular mindfulness meditation techniques (e.g. mindful breathing) as indicated in existing literature to be characterized by an overall rise in alpha activity and frontal theta activity.

Secondly, participants will be asked to complete the ANT-S, a short form of the ANT (Fan, McCandliss, Sommer, Raz, & Posner, 2002) to evaluate changes in attentional abilities as related to the attentional tripartite model by Posner and Petersen (1990). An increase in attentional abilities would be in conformity with previous results indicating even short periods of mindfulness training´s effectiveness to do so (Valentine & Sweet, 1999; Jha, Krompinger, & Baime, 2007; Chiesa, Calati, & Serretti, 2010; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010). Based on these findings, we expect changes to primarily occur for the orienting and conflict monitoring network scores, as they represent the attentional abilities of selective attention and executive attention (Chiesa, Calati, & Serretti, 2011). Positive findings, would not only provide evidence for another beneficiary effect closely tied to mindfulness

meditation evoked by colouring mandalas, but also indicate that there may be similar cognitive processes at play involving the regulation of attention.

As general point of reference, the experiment will include a series of assessments, constituting our baseline data. Participants will be asked to complete a short form of the Freiburg Mindfulness Inventory (FMI; Heidenreich, Ströhle, & Michalak, 2006) a trait mindfulness questionnaire, as well as all other quantitative measurements already mentioned above –e.g. EEG recording, SMS, PANAS, and ANT-S (in that order) –at the beginning of the procedure. This baseline data will be collected before the first task condition and should reflect the participants initial emotional and mental state, attentional abilities and brain activity as assessed by the individual measurement tools, as well as account for pre-existing baseline differences within the construct of mindfulness as a trait.

These research questions and procedures lead to the following postulated hypotheses:

H1: The colouring mandala condition is marked by higher scores in the SMS, than the baseline condition

H1.1: The colouring mandala condition is marked by higher scores in the SMS, than the free drawing mandala condition or the free drawing condition.

H2: Participants will achieve better scores in the ANT after the colouring mandala condition, than after the baseline condition.

H2.1: Participants will achieve better scores in the ANT after the colouring mandala condition, than after the free drawing mandala condition or the free drawing condition.

The study further enables the testing of the following hypotheses, which are not included in this thesis.

H3: The EEG recordings for the colouring mandala condition differ from those of baseline condition

H3.1: The EEG recordings for the colouring mandala condition differ from those of the free drawing mandala condition or the free drawing condition.

3 Methods

3.1 Participants

A sample of 32 healthy participants took part in this study (15 male, 17 female; Mage = 27,13; SD= 5,62; range = 21 to 40). Three participants had to be excluded from data evaluation, due to reasons listed further below, leaving a final 29. The majority of participants were students, recruited via personal contact, e-mail invitation, or social networks. Participation was on a voluntary base. In one case, participation was rewarded by participation credits. Only right-handed individuals and those with normal to corrected vision were included. For reasons stated above, only meditation novices with no prior experience in common meditation practices (e.g. Vipassana, Zen, etc.) were allowed. Furthermore, only participants who had not received any formal art training and didn´t consider themselves as artists from their subjective standpoint were eligible. This decision was based on the fact, that artistic training is an important factor regarding changes in brain activity during art making (Belkofer, Van Hecke, & Konopka, 2014). Both, meditational and artistic, experiential background checks were conducted prior to the procedure. All participants gave their written consent.

3.2 Stimuli Material

Like precursory studies (Curry & Kasser, 2005; Van der Vennet & Serice, 2012) the present experiment comprised three different task conditions marked by three different creative activities: colouring a pre-structured mandala, freely drawing/colouring within a circle (rudimentary mandala) and freely drawing/colouring on a sheet of paper. For each of the drawing/colouring conditions participants were given 20 differently coloured felt tip pencils. The pre-structured mandala (Figure 1) in this study was the same used in the studies of Curry and Kasser (2005) and Van der Vennet and Serice (2012), originally acquired online (Freeman n.d.). The circle, representing a rudimentary form of a mandala (Figure 1) matched the pre-structured mandala in diameter, but was left blank otherwise. The sheet of paper representing the third condition was also mostly blank but, additionally depicted a small cue in the form of several random lines (Figure 1). These were constructed to possess no semantic meaning but to merely give participants creative incentive and reduce the time it took individuals to start drawing/colouring (Pelowski, Markey, Goller, Förster, & Leder, in press). Aside from the paper pencil version of the short Freiburg Mindfulness Inventory (Heidenreich, Ströhle, & Michalak, 2006), questionnaires and tests were presented on a 19-inch CRT monitor, with a resolution of 1,280 by 1,024 pixels and a screen refresh rate of 85Hz. Participants sat approximately 50cm away from the monitor and were asked to respond either using the keyboard or the mouse.

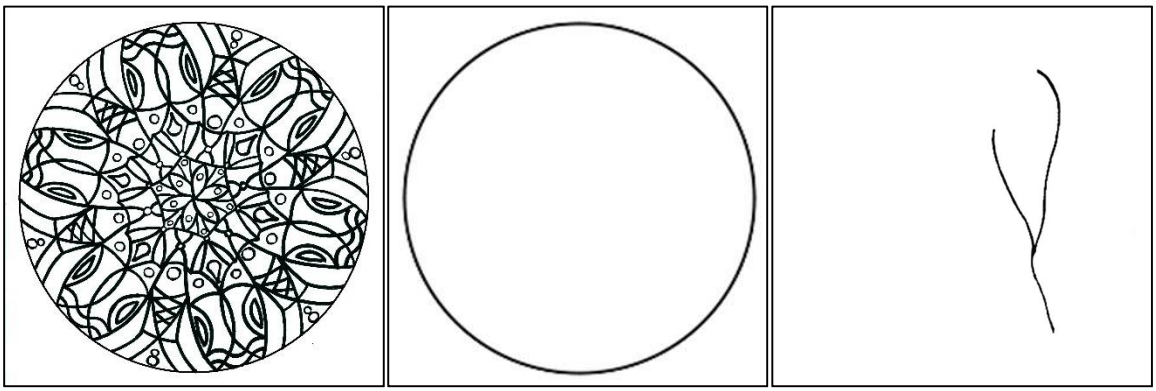

Figure 1. Illustrations showing the colouring mandala template, the circle and the cue used for the blank sheet condition.

3.3 Survey Instruments

Freiburg Mindfulness Inventory (FMI):

To assess mindfulness as trait, the German short form of the FMI by Heidenreich, Ströhle and Michalak (2006) is designed as an instrument to measure the construct of mindfulness as a personality trait. The questionnaire consists of 14 items, in form of statements, such as "I pay attention to what´s behind my actions" ("Ich achte auf die Motive meiner Handlungen" in German), and are to be rated on a four-point Likert-type scale from one ("rarely") to four ("almost always"). The 14 item-version has shown to be internally consistent (alpha = .84) and construct validity has been sufficiently verified (Heidenreich, Ströhle, & Michalak, 2006). A summary score is to be calculated and used for interpretation. A high score would be indicative of a high degree of trait mindfulness. The authors especially recommend the use of the short form for individuals possessing no general knowledge of the constructs theoretical background (Walach, Buchheld, Buttenmuller, Kleinknecht, & Schmidt, 2004).

State Mindfulness Scale:

To assess changes in state mindfulness, we used the State Mindfulness Scale by Tanay and Bernstein (2013), which is designed to quantify and measure the experience of mindfulness as a state or mode as seen in the contemporary conceptual model of Bishop et al. (2004).

Respondents are questioned retrospectively about their perceived level of awareness and registered aspects of experience during a specific period of time (in our case ten minutes). The scale consists of 21 items, in form of statements, such as "I was aware of different emotions that arose in me" ("Ich war mir verschiedener Emotionen bewusst die in mir aufkamen" in German), and are to be rated on a five-point Likert-type scale, ranging from one ("not at all") to five ("very well"), according to how well they describe the subject´s experience. Once again,

a summary score is to be calculated and used for interpretation and a high score would be indicative of a high degree of state mindfulness experienced during the time period in question.

For this study, items were translated from English to German by a party fluent in both languages, and again back-translated by another party with native speaking level in both languages.

Positive and Negative Affect Schedule:

To assess mood changes in affect, we used the German version of the Positive and Negative Affect Schedule (PANAS; Krone, Egloff, Kohlmann, & Tausch, 1996). This again is a self-report survey used to assess positive and negative affect, both representing opposite dimensions of the mood spectrum (Krone, Egloff, Kohlmann, & Tausch, 1996). Items include 20 descriptor words, such as "exited" ("freudig" in German) or "ashamed" ("beschämt" in German), and participants are instructed to rate the words in regard to how well they describe their current experience. Words are rated on a five-point Likert-type scale ranging from one ("very slightly or not at all") to five ("extremely). A high positive score would indicate a high prevalence of positive affect and a high negative score would indicate a high prevalence of negative effect (Watson, Clark, & Tellegen, 1988). The two main factors of positive and negative affect are generally negatively correlated, entailing that when one score is high the other should be low (Watson, Clark, & Tellegen, 1988). Both scores were treated as dependent variables.

Attentional Network Test – Short version:

To assess the efficiency of attentional functions, the ANT-S is a short version of the original Attention Network Test (ANT) by Fan, McCandliss, Sommer, Raz, and Posner (2002). The ANT-S is designed to assess the efficiency of three distinct attentional functions connected to three corresponding independent attention neural networks as proposed by Posner and Petersen (1990). The three functions are: alerting, orienting and conflict monitoring (Posner & Petersen, 1990).

These are assessed by first showing a cue cross and then a target which appeared either above or below the fixation cross, and came in the form of five arrows, with the goal of indicating whether the central arrow is pointing right or left by pressing the corresponding mouse button as quickly as possible. Conditions vary mainly in the type of cue provided. In the spatial cue condition, the cue indicates whether the target will appear below or above the fixation cross. The centre cue condition only alerts for the immediate appearance of the target but provides no indication as to where it will appear. Unlike the original ANT, the ANT-S does not include a

double cue condition. In the no cue condition, there is no indication of the target´s spatial location or time of appearance. Lastly, in the style of a classic flanker task (Eriksen & Eriksen, 1974), the central arrow (main target) is presented accompanied by two additional arrows to each side, representing one of two flanker conditions. In the congruent condition, all arrows point in the same direction. In the incongruent condition, the flanker arrows point in the opposite direction of the target arrow. In this aspect, once again, the ANT-S differs from the original ANT, in as far as it doesn´t include a neutral flanker condition to shorten the overall duration of the test.

3.4 Procedure

The experiment was conducted in the EEG laboratory of the Faculty of Psychology at the University of Vienna. Experimental outline only allowed for one participant per testing session. Participants were subjected to a minor pre-screening, checking for exclusion criteria relevant for EEG procedures (e.g. handedness, neurophysiological damage etc.), but also for any individuals possessing an artistic or meditational background for reasons indicated further above. All participants met the criteria, thus, all participants were kept for the study.

After giving their informed consent, participants were asked to complete the 14 items of the FMI, for an assessment of mindfulness as a personality trait, and provide basic demographic information (i.e. age and gender).

The EEG equipment was then fitted (using standard procedure, not further explained here) and the participant seated in front of the screen inside the testing room. Participants were then asked to perform the mindless drawing activity, which consisted of monotonously doodling lines on a blank sheet of paper with a provided black felt tip pencil (no free choice of colour). This activity was designed to be purely motoric but not creative in any way and to demand a minimum of attentional resources in order to leave participants uninfluenced in their mental state or activity. Participants were instructed to perform this activity for two minutes. This was done to allow for the collection of a baseline EEG recording that could be used during later data processing to filter out motoric activity.

Following this, we continued our collection of baseline data and participants were asked to complete the SMS, PANAS, and ANT-S (in that order). Since the items of the SMS are to be answered in reflection of a prior period of time, only for this first assessment, we asked participants to consider how accurately the statements described their day so far. In later assessments of the SMS, participants were always asked to rate the statements in reflection of the period during the previous task condition. For the PANAS, participants were consistently instructed to respond according to how they felt at the moment.

To complete the ANT-S, participants were presented with a fixation cross at the beginning of every trial. They were instructed to focus on this until the onset of the target, which appears either above or below the fixation cross, and came in the form of five arrows, and again with participants asked to indicate whether the central arrow is pointing right or left by pressing the corresponding mouse button. The fixation cross is presented in the centre of the screen at all times. Duration until the onset of a cue or the target is set at 400 ms. Cues are presented for 100 ms, with 400 ms between cue onset and target onset. The maximum allowable RT is set to 1700 ms. The ANT-S consists of 12 practice trials and 192 test trials. The test trials are split into two blocks of 96. During practice trials participants receive feedback (correct or incorrect answer) after each trial, but not during test trials. Participants are allowed to take a short break after the practice block and after the first test block. The order of cue conditions within blocks was randomized. Participants were instructed to try to respond as quickly and accurate as possible, since efficiency estimates are based on reaction time measures.

After the first run of all measurement tools to collect for baseline data, participants were asked to complete three task conditions, comprising: the colouring of a pre-structured mandala, the free colouring/drawing within a circle, and the free colouring/drawing on a blank sheet of paper. The order of task conditions was counterbalanced within participants to control for sequence-effects. Three numerated envelopes, each containing material for one task condition, were laid out ready for the participants. On-screen instructions informed the participants of which task was to be completed next (indicated by the number on the envelope). They were also given basic information on what to do with the provided materials, but instructions were kept to a minimum, allowing for a maximum of creative freedom. Accordingly, instructions included the broad phrasing of the activity as “drawing/colouring”, so participants wouldn´t focus exclusively on either drawing or colouring. Participants were provided with an assortment of coloured felt tip pencils that they were allowed to choose from freely during task conditions. The only limitation consisted in the area in which participants were allowed to draw/colour for the pre-structured mandala and circle condition, as far as they were not permitted to colour/draw outside the circle. Participants were given 10 minutes to work on each task but were expressively told that they were not expected to finish their work within the given time, nor would their work be evaluated in any way, and that they could keep it after the experiment on request. This was done to avoid creating any stress or pressure. Immediately, after each task condition, participants were asked to complete the SMS, PANAS and ANT-S, representing one complete run. In summary, every participant completed three

runs, plus the baseline assessment, amounting to a total of three task conditions and all tests four times.

After completing all trials, participants were debriefed about the study goals. Participants were briefed about procedure and duration of the experiment but were not informed of the purpose of the study beforehand.

4 Results

All 32 participants completed every task condition once and a total of four assessments of the SMS, PANAS and ANT-S. After further consideration and analysis of the collected data, three participants were excluded from evaluation. Two participants were excluded by reason of an obvious misunderstanding in instructions that lead to incorrect processing of task conditions or tests. One participant had to be excluded because of technical problems with the EEG. For the individual focal aspects of mindfulness and attentional functions our analysis of the remaining 29 data-sets provided the following results.

4.1 State Mindfulness

Sample characteristics overall correspond to expectations based on existing literature. Results of the FMI, which was included to check for pre-existing differences between individuals show for a mean score of 40.00 (SD = 5.217) which is a plausibly average outcome in normal healthy populations with no to moderate meditational training (Collard, Avny, & Boniwell, 2008; Parkin et al., 2014). Results for the baseline assessment of the SMS, with a mean score of 74.59 (SD = 2.368) were equally similar to baseline findings in other studies with comparable samples (Tanay, Lotan, & Bernstein, 2012; Roche, Barrachina, & Fernandez, 2016; Luberto & McLeish, 2018).

All SMS scores, both total and for the subscales, were normally distributed. A one-way ANOVA with repeated measures was conducted for mean total SMS scores. When sphericity was not met, a Greenhouse-Geisser correction was applied. Results showed that mean total scores didn´t differ significantly between conditions [$F(3, 84) = 1{,}147$, $p = .335$, $\eta^2 = .039$], therefore suggesting against hypothesis H1.1 that tasks differ in their ability to create a mindful state (see Table 1). Pairwise comparison, in form of multiple paired t-test using Bonferroni correction, did not show significant differences ($p = 1.000$) between mean scores of the baseline and the colouring mandala condition, nor for any other conditions. It should also be noted that, in opposition to the expected direction of effects, mean scores surprisingly went down by an average of 4.586 points from the baseline to the colouring mandala condition, hinting that individuals were actually less mindful during the task condition than during the baseline

assessment. Interestingly, this was the case for each task condition when compared to the baseline, with the circle condition averaging 4.345 points less, and the blank sheet condition averaging 4,586 points less.

For further information we considered each subscale of the SMS and conducted another set of repeated measures ANOVA. In case of the mind subscale, results again showed that scores didn´t significantly differ between conditions [$F(3, 84) = 0.66$, $p = 0.978$, $\eta^2 = .002$], and there was no trend recognizable for mean scores within pairwise comparisons. This indicates that individuals didn´t differ in their awareness of mental elements such as thoughts and emotions across conditions. Results for the body subscale, in contrast, showed that there was a significant difference in mean scores between conditions [$F(2.101, 58.832) = 6.376$, $p = .001$; $\eta^2 = .185$]. When compared individually, both the body score for the colouring mandala and the blank sheet condition were significantly lower than for the baseline ($p < .05$). Although not significant, the body score for the circle condition was also lower than for the baseline. Pairwise comparison of active task conditions compared to each other showed for no significant differences or notable trends. The results of the body subscale of the SMS, indicate that individuals were less aware of bodily sensations as part of their experience during task conditions when compared to the baseline assessment, even significantly so during the colouring mandala and the blank sheet condition.

Table 1.

SMS Scores for the different conditions

	Condition					
Measure	**Baseline**	**Mandala**	**Circle**	**Blank Sheet**	**F**	**η^2**
SMS Total	74.59 (12.75)	70.00 (15.08)	70.24 (12.61)	70.00 (13.21)	1.147	.039
SMS Mind	53.86 (9.58)	53.10 (10.51)	52.97 (9.5)	53.17 (9.94)	0.66	.002
SMS Body	20.72 (4.02)	16.9 (5.33)	17.28 (4.68)	16.83 (5.54)	6.376	.185

Note. Standard deviations appear in parentheses below means.

Finally, we also considered whether trait mindfulness might itself play a role in the results. FMI and total SMS scores were positively correlated to a large degree [$r(27) = .516$, $p < .01$]. To control for possible interactions with the SMS score, we decided to split FMI scores into two contrasting groups: scores above or equal the median value, and scores below, and enter this as a between subject factor. Results showed that there was no significant interaction [$F(1,27) = 3.644$, $p = .067$, $\eta^2 = .119$). We therefore deduced that individuals with a high FMI score didn´t differ from those with a low score in respect to their change in state mindfulness across conditions.

4.2 Attentional Functions

To calculate the scoring for the attentional functions, the main measures for overall mean RT, percent errors and the three network scores are calculated as follows: The efficiency for the alerting function is calculated by subtracting the mean RT of the centre condition from the no-cue condition. The efficiency for the orienting function is calculated by subtracting the mean RT of the spatial cue conditions from the mean RT of the centre cue. The efficiency for the executive control function is calculated by subtracting the mean RT of all congruent flanking conditions, from the mean RT of incongruent flanking conditions. (Fan, McCandliss, Sommer, Raz, & Posner, 2002)

Baseline mean reaction times, which represent the basis for efficiency scores calculation, were compared to prior findings in literature to verify the ANT finding´s general validity. Reaction times for the no cue condition (M = 527.02ms; SD = 51.31) were overall higher than for the centre cue condition (M = 497.1ms; SD = 49.61, and lowest for the spatial cue condition (M = 429.26; SD = 49.61). Results therefore resemble those of Fan, McCandliss, Sommer, Raz, and Posner (2002) in value and follow the same rationale that reaction time was negatively correlated with the sum of information (e.g. temporal and spatial) that the cue provides. As expected, task accuracy was very high with an overall success rate of 97,78% (SD = 2,4).

Network scores were normally distributed. All three attention network scores (e.g. alerting, orienting, executive) were subjected to separate ANOVAs with repeated measures to investigate for differences between task conditions. Once again, whenever sphericity was not met, a Greenhouse-Geisser correction was applied.

In the case of the alerting network, results showed that there were no significant differences in efficiency across tasks [$F(2.282, 63.883) = 1.124$, $p = .337$, $\eta^2 = .039$]. Findings were equally non-significant for the orienting network [$F(1.08, 30,245) = 1.219$, $p = .283$, $\eta^2 = .042$] and the executive network [$F(1.657, 46.396) = .810$, $p = .430$, $\eta^2 = .028$], therefore rejecting hypothesis

H.3 and H3.1 (see Table 2). Even when specifically contrasting scores at baseline and after the colouring mandala, there were no trends recognizable, further underlining H.3`s untenability. In summary, results indicate that there was no beneficiary influence on attentional functions by any of the task conditions.

Table 2.

ANT Network Scores for the different conditions

Measure	Condition				F	η^2
	Baseline	Mandala	Circle	Blank Sheet		
Alerting	33.52 (23.95)	41.16 (21.68)	39.80 (23.74)	41.89 (19.45)	1.124	.039
Orienting	67.88 (31.02)	89.69 (113.59)	64.47 (24.45)	64.51 (22.70)	1.219	.042
Conflict Monitoring	94.35 (27.19)	91.71 (19.76)	88.98 (22.36)	91.98 (24.12)	.810	.028

Note. Standard deviations appear in parentheses below means.

4.3 PANAS

Scores for the PANAS were calculated for the subscales of positive and negative affect. Across task conditions, results showed for a mean positive affect score of 31.19 (SD = 5.02) and a mean negative affect score of 12.72 (SD = 2.48). For task conditions, the SMS score and positive affect were not significantly correlated. Positive affect score, also did not significantly differ between conditions [$F(3, 84) = .848$; $p = .472$, $\eta^2 = .029$]. Investigations of negative affect scores, on the other hand, indicated that there were significant differences between post-task measurements [$F(2.196, 61.484) = 5.420$; $p = .005$, $\eta^2 = 0.162$], with pairwise comparisons further revealing significant differences of mean scores between the baseline (M = 14.103) and the colouring mandala condition (M = 12.207, $p = .041$), as well as the baseline and the free drawing condition (M = 11,724; $p < .001$), both marking a reduction of negative affect. Task conditions didn´t not differ significantly from each other (see Table 3).

Table 3. *PANAS Scores for the different conditions*

Measure	Condition				F	η^2
	Baseline	Mandala	Circle	Blank Sheet		
Positive Affect	32.14 (5.68)	30.48 (6.864)	30.52 (6.869)	31.62 (6.619)	.848	.029
Negative Affect	67.88 (31.02)	89.69 (113.59)	64.47 (24.45)	64.51 (22.70)	5.420	.162

Note. Standard deviations appear in parentheses below means.

5 Discussion

The colouring mandala´s image is built around the premise that it possesses an inherently meditative and even mindfulness inducing quality, which in turn is based on preliminary theoretical explanations, with only sparse empirical support. This study is one of the first attempts to directly address the question: are colouring mandalas really able to produce a mindful state?

In response to our main research question, our findings indicated, “No”. The colouring mandala did not induce a mindful state in meditation novices both in comparison to a baseline and when contrasted against other colouring or drawing conditions. Similarly, the mandala, and other drawing/colouring tasks, also failed to create significant changes in attention. When asking why this might be, the work of Mantious and Giannou (2018), published during the final phase of our study, may offer a valid explanation. They too investigated the colouring mandala´s potential to increase mindfulness in individuals unexperienced in meditation and found results identical to those of the present study. They bring to attention that, with the right instructions, any activity can adapt the character of a mindfulness meditation (see Hanley et al., 2015, for an example) and, more importantly, so can also every task be performed in a mindless fashion. The later scenario may be applicable to the present study, since people weren´t provided any additional information on how to approach the colouring task. Underscoring their notion, Matious and Giannou (2018) indeed went on to demonstrate that, when subjects were provided with adequate instructions and guidance while colouring, a pre-structured mandala could, to some degree, increase mindfulness - even though their findings also turned out to be not significant.

At the same time, although this may be the case, it does go against any inherent importance in mandalas themselves or their efficacy, per se, as a short mindfulness-inducing task. We point out the fact that neither this study nor theirs was able to find evidence for an increase in mindfulness when individuals were not given instructions, therefore preliminarily defying the image of the colouring mandalas´ presumed inherent meditative quality that is expected to favour an effortless transition into a mindful and meditative state.

Surprisingly, both the present study and the study by Matious and Giannou (2018) also found that (when not given instructions) mindfulness actually tended to decrease during mandala colouring. In our case, this was the direction of effect for all artistic tasks. Mantious and Giannou provided an equally plausible explanation for this in the concept of flow (Csikszentmihalyi, 1990) which would mean that participants were simply too absorbed by their activity to notice any task irrelevant objects of experience. Analysis of the SMS´s subscales showed that this was predominantly the case for bodily sensations.

On the other hand, the mandala task did show a significant change in mood, suggesting that these tasks did have some effect on individuals (albeit not attentional or mindfulness related). The PANAS was added to our investigation to check whether tasks that were experienced as more pleasant, or involved more positive affect, were also experienced as more mindful. Our results indicate that there was no significant correlation between the two variables. However, further analysis showed that each artistic task was marked by significantly less negative emotions than the baseline assessment. This in itself is not surprising since art making in general is considered to have a stress reducing and mood enhancing effect (Sandmire, Gorham, Rankin, & Grimm, 2012; Abbott, Shanahan, & Neufeld, 2013). Remarkably, the colouring mandala did not differ from other tasks in its ability to reduce negative affect in this study. This is contrary to previous findings that supported the colouring mandala´s superior mood regulating quality, arguably due to its incorporated structured component (Curry & Kasser, 2005; Van der Vennet & Serice, 2012). Although, it is important to note, that in this study there was no active mood manipulation (e.g. anxiety induction), in order to investigate the mandala´s effect on regulation, as was the case in the studies of Curry and Kasser (2005), and Van der Vennet and Serice (2012). This itself may also suggest some importance of colouring tasks.

This study also clearly comes with needs for future research. The small sample size followed a pragmatic issue; hence results need to be interpreted with caution. We would also propose one other hypothesis for the lack of effects, tied to methodology. In both studies the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013) was employed. We concurred with

the questionnaire´s authors´ claim that all elements of experience play a crucial role in mindfulness meditation. Nevertheless, there are two aspects to consider. Firstly, mindfulness meditation is considered to include elements of both concentration and open monitoring meditation styles (Lutz, Slagter, Dunne, & Davidson, 2008). Secondly, especially early stages of training are primarily characterized by remaining focused on an appointed object, with open monitoring given priority in later stages (Lutz, Dunne, & Davidson, 2008; Chiesa et. al., 2011). This means that within mindfulness practices the meditational focus can range between concentration and open monitoring, depending on the applied technique and the practitioners level of experience. In retrospection we realized that the SMS may rather represent a tool to assess the open monitoring nature of mindfulness meditation, focusing on the broadness of experience, which is more likely to be encountered in trained meditators. Considered in these relative terms, results may indicate that all three task conditions in our study were equally counterproductive for open monitoring meditation but provide only limited information on their ability to support concentration meditation. Therefore, considering both the colouring mandala´s attributed ability to intuitively focus and regulate attention (Greenberg & Harris, 2012), the SMS may not have been the optimal tool within this type of context and for this level of meditational experience within participants. Subsequently, possible approaches for further studies could be to use assessment tools that are better suited to investigate the mandalas potential to support or induce focused attention meditation.

Within the context of focused attention meditation, the involvement and improvement of attentional abilities represents a much-discussed topic. In the present study, efficiency scores for attentional functions, as measured by the ANT-S, showed that neither the colouring mandala nor the other tasks had any influence on attentional functions - e.g. alerting, orienting & conflict monitoring. Past research shows that positive changes within these subcomponents of attention have been the result of short-term mindfulness meditation introductions (see Chiesa, Calati, & Serretti, 2010, for a review). Therefore, within the argument structure of this study, an absence of beneficiary effects, was considered as preliminary evidence against granting colouring mandalas the equal status of a mindfulness inducing technique. It further provides indication that colouring mandalas may differ from mindfulness techniques in their underlying cognitive processing or mechanisms involving attention – the cornerstone of mindfulness meditation (see Isbel & Mahar, 2015, for a review). However, conclusions should be treated with caution. Findings on mindfulness techniques´ effect on subcomponents of attention are not conclusive, with not all studies being able to confirm the effect (Chiesa, Calati, & Serretti, 2011). Additionally, research on a one-time mindfulness induction´s effect on discussed

subcomponents of attention does not exist. All hypotheses were based on investigations involving short-term mindfulness introductions of more than one session (e.g. Zeidan, Johnson, Diamond, David, & Goolkasian, 2010).

Therefore, future studies should investigate the effect of a prolonged and systematic use of colouring mandalas, or similar mindful-art making activities, to further explore and test their potential effect on attentional abilities, and how they compare to conventional mindfulness techniques.

Further above, we already established the need for a deeper and clear understanding of the concept of mindfulness within the experimental setting when choosing an appropriate assessment tool. In the end, the present study´s struggle in this aspect, may be traced back to the yet uncertain limitations of existing questionnaires, the absence of an unequivocal definition of mindfulness and the complexity of the construct itself. As another offshoot of this conceptional problem, there´s the issue of disentangling mindfulness from possibly related concepts, such as flow. Future studies could focus on flow in the context of creative activities involving a structured component. Resulting findings could help to narrow down definition of both concepts and help our understanding of structured creative task´s effects on the individual.

Another possible starting point for future studies could be the measurement of mindfulness during colouring activity by different assessment tools. Notably, it may be that the EEG data could show some effects not detected.

Alternatively, investigations could focus on the colouring mandala´s effect on trait and state mindfulness, as well as attentional functions, following a number of sessions as seen in mindfulness-based intervention programs.

6 Conclusion

In summary, the present study provided no evidence for the colouring mandala´s mindfulness inducing quality. Results indicate that the colouring mandala neither did improve the mindful quality of subjective experience, nor did it have any effect on attentional abilities. Additionally, overall measurements showed no difference in effect between the colouring mandala and other artistic tasks that involve no structured component.
We furthermore found that all creative tasks produced a decrease in negative affect to a similar degree.

Although our main hypothesis was not supported by our findings, we realized that the question about art making´s influence on individuals´ mental state, cognitive processes and behaviour is more nuanced than expected. Future studies, as well as the continuation of this present study,

utilizing our already collected EEG data, will have to show whether there is any legitimacy to the mandala´s meditative nature.

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APPENDIX

A Abstracts

Mandala colouring has been theorized to represent a meditative and mindfulness inducing activity. However, so far this has not been the subject of empirical research. The present study therefore investigates whether colouring mandalas can increase mindfulness in individuals unexperienced in meditational practices and whether this activity is characterized by the improvement of attentional abilities basic to mindfulness techniques, as well as marked by similar neurological activity. To this end, participants´ subjective experience of state mindfulness is assessed retrospectively using a self-report questionnaire, and the efficiency of attentional functions is measured and quantified by reaction time measures. Also, brain activity is recorded via EEG, but according results are not part of the present work. To check if the effect is unique to its properties, the colouring mandala is compared to two other creative tasks. Prior investigations have shown that short mindfulness-inductions were reliably able to increase mindfulness and that even brief introductions into mindfulness meditation positively affected cognitive abilities. The results of the present study show no change in state mindfulness or attentional abilities following any of the tasks. In summary, present findings provide no evidence for the colouring mandala´s ability to induce mindfulness nor their effect on subcomponents of attention.

Keywords: Mindfulness; Mandala; Colouring; State Mindfulness; Attention Network Test

Es existieren Theorien welche besagen, dass das Ausmalen von Mandalas eine meditative und Achtsamkeit-induzierende Aktivität darstellt. Dies wurde jedoch noch nie empirisch geprüft. Die vorliegende Studie untersucht daher ob das Ausmalen von Mandalas, in Individuen ohne Erfahrung in Meditationspraktiken, zu einer Steigerung der Achtsamkeit führt, und ob diese Aktivität charakterisiert ist durch Förderung von Aufmerksamkeitsfunktion, welche die Basis für Achtsamkeitstechniken bilden, sowie geprägt von gleicher neurologischer Aktivität. Zu diesem Zweck wird die subjektive Erfahrung von Achtsamkeit als mentaler Zustand retrospektiv anhand eines Fragebogens erhoben und die Effizienz der Aufmerksamkeitsfunktionen quantifiziert durch Messungen von Reaktionszeiten. Ebenfalls wird die Gehirnaktivität anhand EEG aufgezeichnet, dazugehörige Ergebnisse sind jedoch nicht Teil der vorliegenden Arbeit. Um zu prüfen, ob etwaige Effekte spezifisch auf seine Eigenschaften zurückzuführen sind, wird das Mandala mit zwei weiteren kreativen Aufgaben verglichen. Vorherige Untersuchungen haben gezeigt, dass kurze Achtsamkeitsinduktionen zuverlässig zu einer Steigerung in Achtsamkeit führen und, dass sogar kurze Einführungen in die Achtsamkeitsmeditation kognitive Fähigkeiten positiv beeinflussen. Die Ergebnisse der vorliegenden Studie zeigen keine Veränderung im Ausmaß der empfundenen Achtsamkeit oder der Aufmerksamkeitsfähigkeiten. Zusammenfassend, liefern die gegenwärtigen Befunde weder einen Beweis für die Fähigkeit des Ausmalens von Mandalas Achtsamkeit zu induzieren, noch einen Einfluss auf Subkomponenten der Aufmerksamkeit zu besitzen.

Schlüsselwörter: Achtsamkeit; Mandala; Ausmalen; State Mindfulness; Attention Network Test

B Supplementary Figures

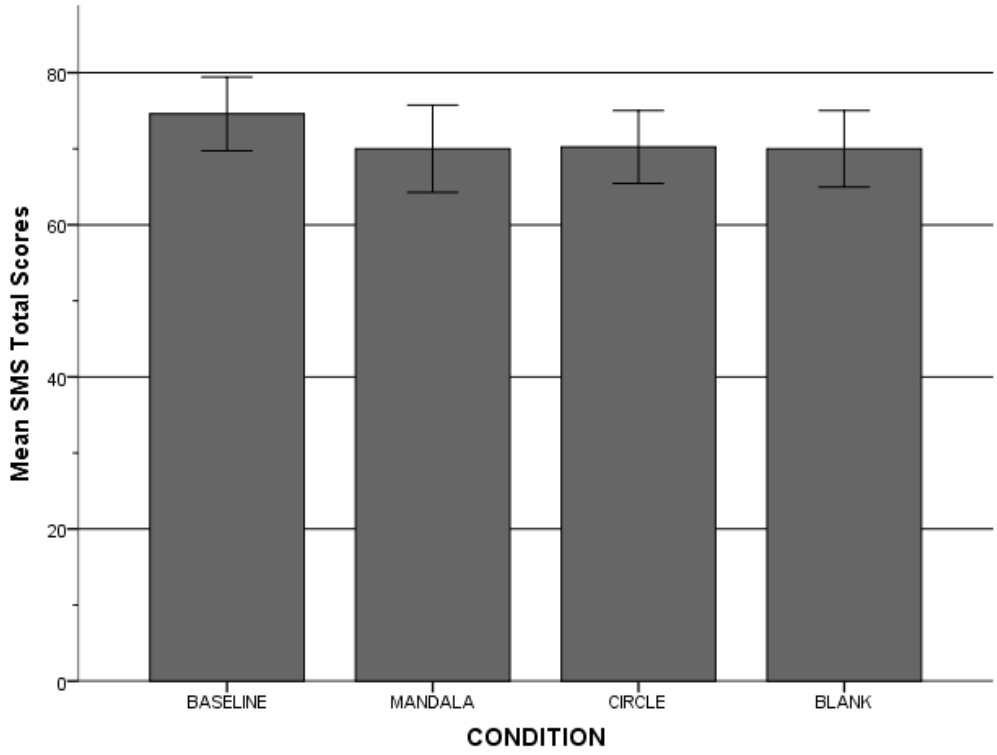

Figure 1. Mean SMS total scores for all task conditions, including 95% confidence intervals (*CI*).

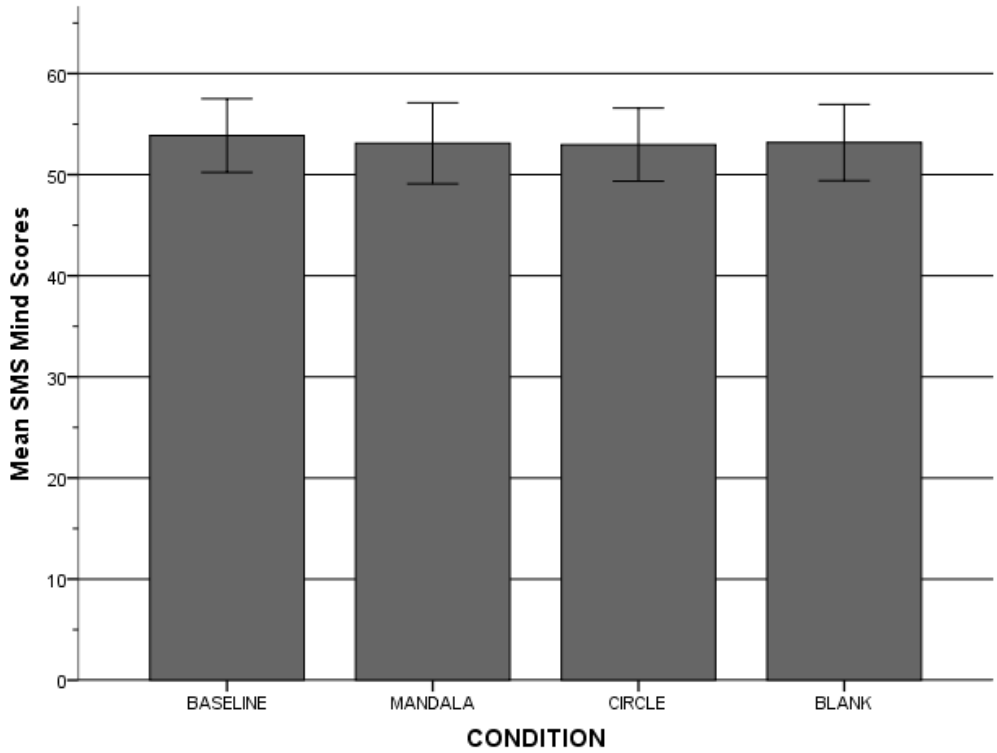

Figure 2. Mean SMS scores for the mind subscale for all conditions, including 95% confidence intervals (*CI*).

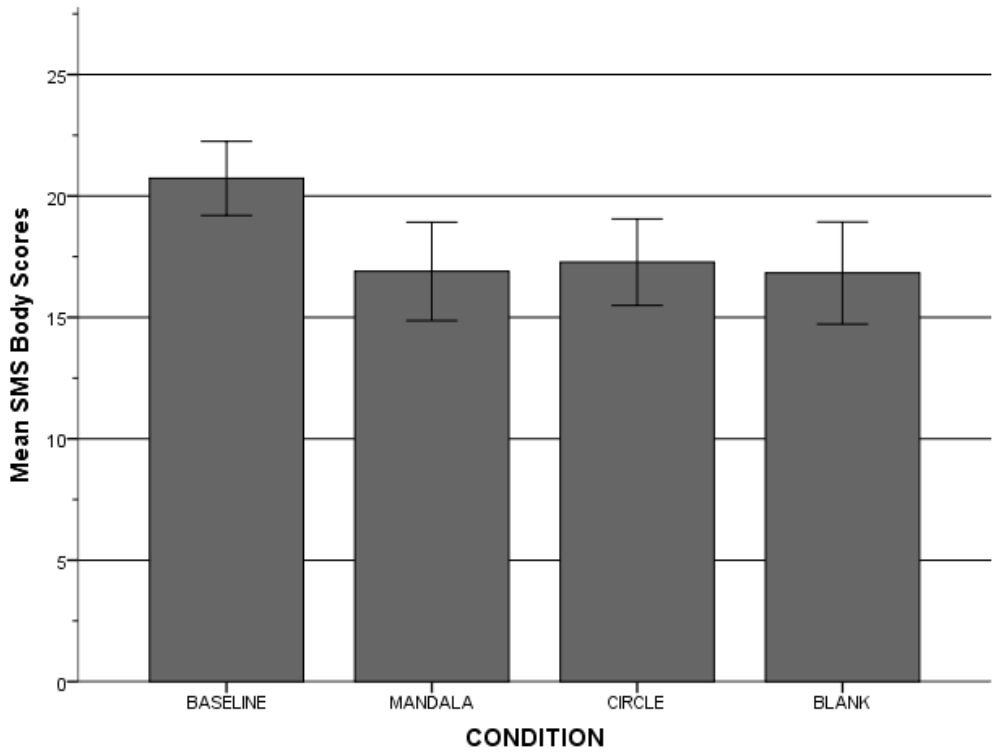

Figure 3. Mean SMS scores for the body subscale for all conditions, including 95% confidence intervals (*CI*).

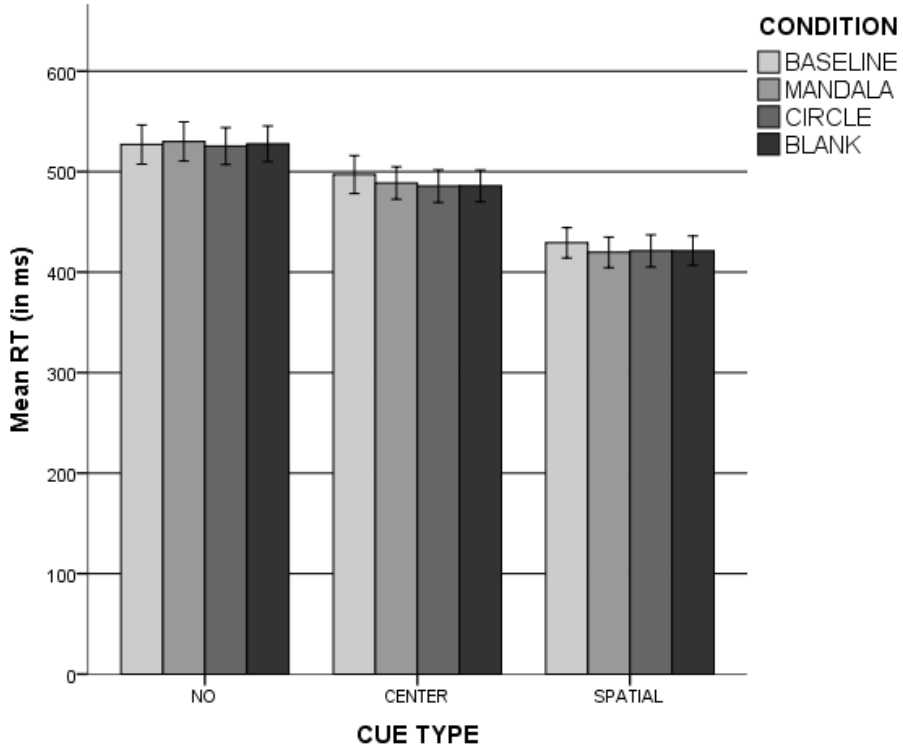

Figure 4. Overall mean reaction times (RT) under all cue conditions and for all task, including 95% confidence intervals (*CI*). conditions.

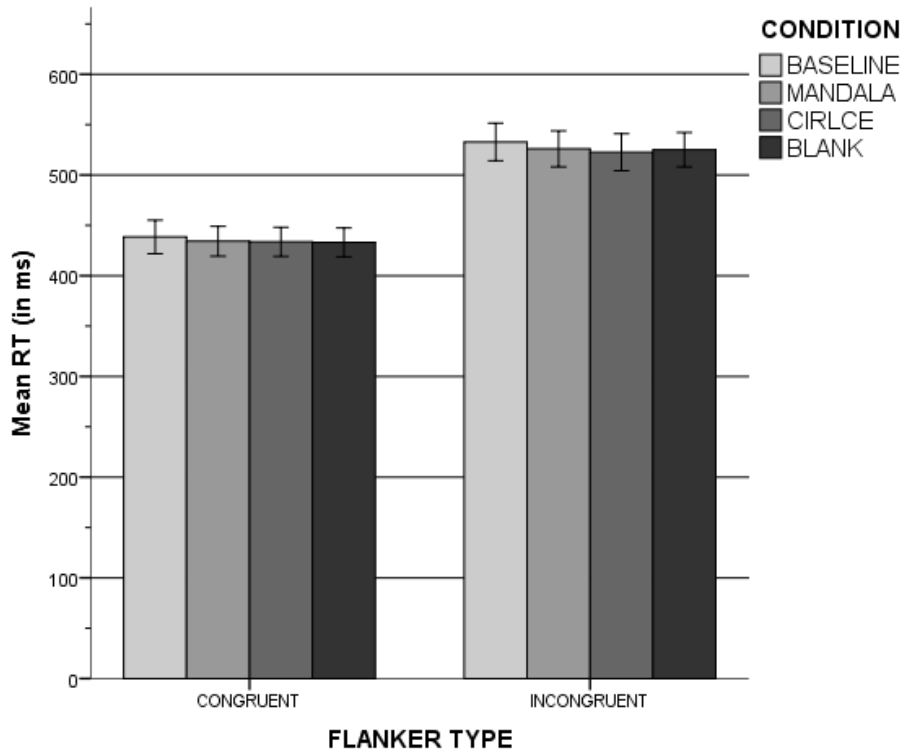

Figure 5. Overall reaction times (RT) under all flanker conditions and for all task conditions, including 95% confidence intervals (*CI*).

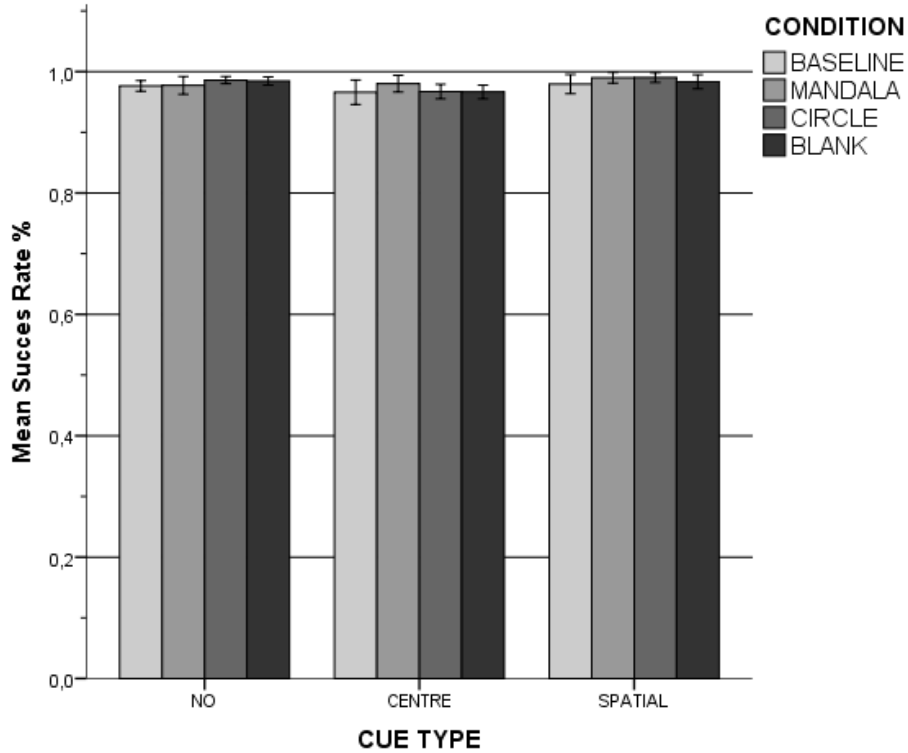

Figure 6. Overall accuracy under all cue conditions and for all task conditions, including 95% confidence intervals (*CI*).

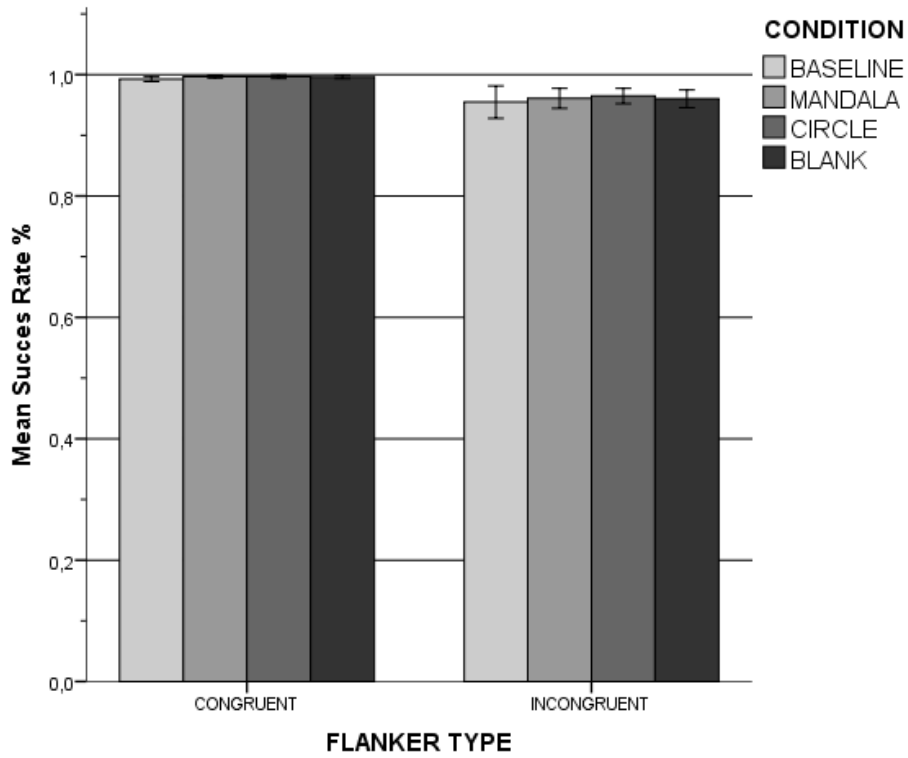

Figure 7. Overall accuracy under all flanker conditions and for all task conditions, including 95% confidence intervals (*CI*).

C Study Material

State Mindfulness Scale

Instructions:

Ihnen werden nun nacheinander Aussagen angezeigt, wobei wir Sie bitten würden auf einer Skala von 1 bis 5 (1 = trifft nicht zu; 5 = trifft zu) anzugeben inwiefern diese auf Sie zutreffen.

Bitte geben Sie ihre Antwort mit den Zahlentasten 1-5.

Beispiel:
Ich fand einige meiner Erfahrungen interessant.
Trifft nicht zu 1 - 2 - 3 - 4 - 5 Trifft zu

*Wir bitten Sie in diesem Durchgang, die Aussagen IM BEZUG AUF IHREN BISHERIGEN TAG zu betrachten!

Falls es noch Unklarheiten gibt, wenden Sie sich bitte an den Versuchsleiter.
Den Fragebogen beginnen mit der LEERTASTE

**Note*: Only for the first assessment in regard to the participant´s day so far. Later always in respect to the preceding task

All Items with German translation below:

1. I was aware of different emotions that arose in me.

   Ich war mir verschiedener verschiedenen Emotionen bewusst die in mir aufkamen.

2. I tried to pay attention to pleasant and unpleasant sensations.

   Ich habe versucht auf angenehme und unangenehme Empfindungen zu achten.

3. I found some of my experiences interesting.

   Ich fand einige meiner Erfahrungen interessant.

4. I noticed many small details of my experience.

   Mir sind viele kleine Details meiner Erfahrung aufgefallen.

5. I felt aware of what was happening inside of me.

   Ich war mir bewusst was in mir vorging.

6. I noticed pleasant and unpleasant emotions.

   Mir sind angenehme und unangenehme Emotionen aufgefallen.

7. I actively explored my experience in the moment.

   Ich hab aktiv meine Erfahrung im Moment erkundet.

8. I clearly physically felt what was going on in my body.

   Ich hatte ein klares (physisches) Gefühl dafür was in meinem Körper vorging.

9. I changed my body posture and paid attention to the physical process of moving.

   Ich habe meine Körperhaltung geändert und dabei auf den physischen Prozess der Bewegung geachtet.

10. I felt that I was experiencing the present moment fully.

    Ich hatte das Gefühl den Moment voll und ganz zu erfahren.

11. I noticed pleasant and unpleasant thoughts.

    Mir angenehme und unangenehme Gedanken aufgefallen.

12. I noticed emotions come and go.

    Mir ist aufgefallen wie Emotionen kamen und gingen.

13. I noticed various sensations caused by my surroundings (e.g., heat, coolness, the wind on my face)

Mir sind verschiedene Empfindungen aufgefallen welche durch meine Umgebung ausgelöst wurden (z.B. Hitze, Kälte, der Wind auf meinem Gesicht)

14. I noticed physical sensations come and go.

Mir ist aufgefallen wie physische Empfindungen kamen und gingen.

15. I had moments when I felt alert and aware.

Ich hatte Momente in denen ich mich klar und bewusst fühlte.

16. I felt closely connected to the present moment.

Ich fühlte mich eng verbunden mit dem Moment.

17. I noticed thoughts come and go.

Mir ist aufgefallen wie Gedanken kamen und gingen.

18. I felt in contact with my body.

Ich fühlte mich in Kontakt mit meinem Körper.

19. I was aware on what was going on in my mind.

Ich war mir bewusst was in meinem Verstand vorging.

20. I was interested to see the patterns of my thinking

21. I noticed some pleasant and unpleasant physical sensations

Positive and Negative Affect Scale

Instructions:

Ihnen werden in diesem Fragebogen nacheinander eine Reihe von Wörtern gezeigt, diese beschreiben unterschiedliche Gefühle und Emotionen.

Lesen Sie bitte jedes Wort und geben Sie mit den Zahlentasten 1-5 an, wie
sehr Sie dieses Gefühl DERZEITIG fühlen.

Weiter mit der LEERTASTE

All Items:

1. aktiv; 2. bekümmert; 3. interessiert; 4. freudig erregt; 5. verärgert; 6. stark; 7. schuldig; 8. erschrocken; 9. feindselig; 10. angeregt; 11. stolz; 12. gereizt; 13; begeistert; 14. beschämt; 15. wach; 16. nervös; 17. entschlossen; 18. aufmerksam; 19. durcheinander; 20. ängstlich

Attention Network Test – short version

Instructions:

In diesem Test untersuchen wir Prozesse der Aufmerksamkeit. Ihnen wird auf dem Bildschirm ein Pfeil präsentiert der entweder nach links oder rechts zeigt, z.B. --> oder <--. In den einzelnen Versuchen wird dieser Pfeil auf beiden Seiten von weiteren Pfeilen flankiert (siehe Beispiel).

--> --> <-- --> -->
oder
--> --> --> --> -->

Ihre Aufgabe ist es die richtige Richtung anzugeben, in die der Pfeil in der MITTE zeigt. Bitte drücken sie die LINKE Maustaste falls dieser nach Links zeigt und die RECHTE Maustaste falls dieser nach Rechts zeigt.

Bitte gehen Sie sicher, dass sie so schnell wie möglich und möglichst korrekt Antworten. Ihre Reaktionszeit sowie ihre Erfolgsquote werden registriert.

Weiter mit der LEERTASTE

Im Zentrum des Bildschirms werden Sie ein Kreuz sehen (+).
Die Pfeile werden entweder über oder unter diesem Kreuz erscheinen.
Wir empfehlen daher, dass Sie über die Dauer des Tests das Kreuz an fixieren.

In einigen Versuchen werden Ihnen zusätzlich anhand von Sternzeichen (*) Hinweise dazu gegeben wann oder wo die Pfeile erscheinen werden.
Falls der Hinweis im Zentrum erscheint, signalisiert dies, dass die Pfeile sofort danach erscheinen werden.

Falls der Hinweis lediglich über ODER unter dem Fixationskreuz auftaucht signalisiert dies, zudem wo die Pfeile erscheinen werden (unten oder oben).
Bitte versuchen Sie bis zum Auftauchen der Hinweise ständig das Kreuz zu fixieren.

Beispiel:

*
+ oder + oder *
*

Weiter mit der LEERTASTE
Das Experiment enthält insgesamt 3 Blöcke.
Beim ersten Block handelt es sich um eine Trainingsphase. Diese benötigt ungefähr 2 Minuten.
Die anderen beiden Blöcke benötigen jeweils ungefähr 5 Minuten.
Nach jedem Block wird es Ihnen möglich sein eine Pause zu machen.
Zum Weitermachen drücken Sie bitte die Leertaste.
Der nächste Block beginnt dann unverzüglich.
Falls Sie noch weitere Fragen haben, wenden Sie sich bitte an den Versuchsleiter.
Zum Beginnen der Trainingsphase bitte LEERTASTE drücken

Procedure

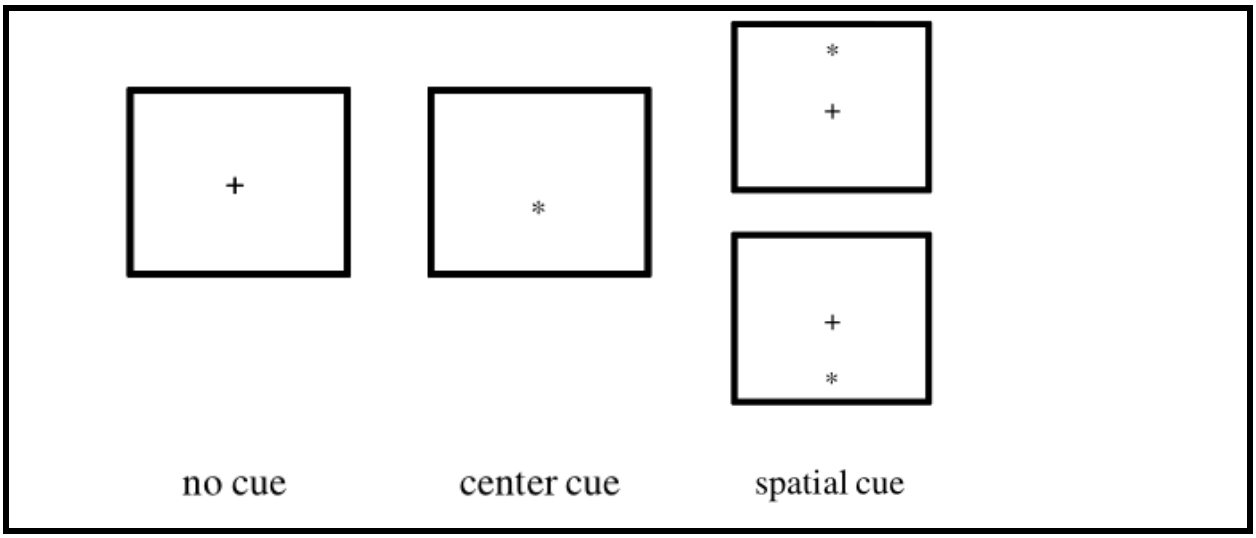

Figure 8. All three cue conditions.

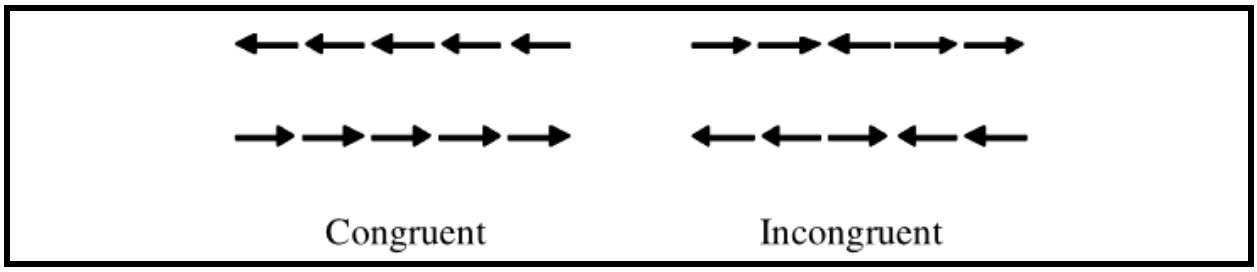

Figure 9. Different flanker conditions.

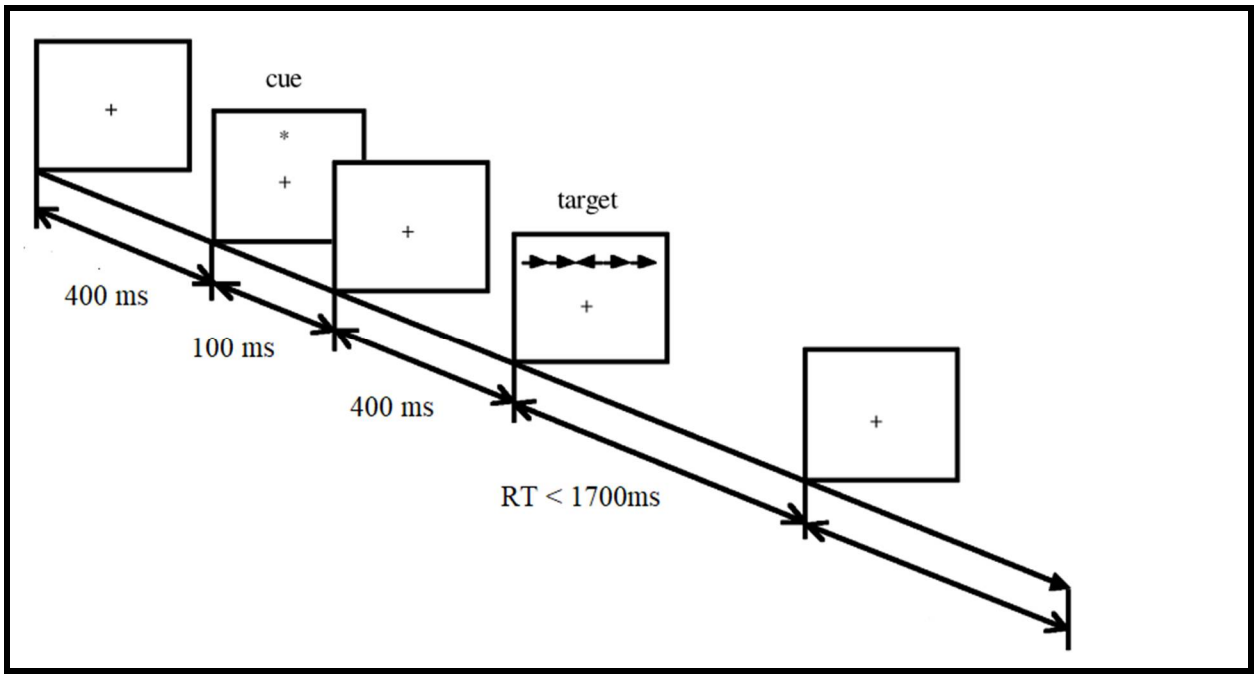

Figure 10. An example of the procedure

Task Conditions

Instructions:

Der Reaktionstest ist damit beendet!

1. Entnehmen Sie nun die Unterlage für die Aufgabe aus dem Umschlag mit der Nummer 1. Bitte nutzen Sie die bereitgelegten Buntstifte und malen/zeichnen Sie innerhalb der Kreises. Sie dürfen NICHT außerhalb des Kreises malen/zeichnen.
2. Entnehmen Sie nun die Unterlage für die Aufgabe aus dem Umschlag mit der Nummer 2. Bitte nutzen Sie die bereitgelegten Buntstifte und malen/zeichnen Sie innerhalb des Kreises. Sie dürfen NICHT außerhalb des Kreises malen/zeichnen.

3. Entnehmen Sie nun die Unterlage für die Aufgabe aus dem Umschlag mit der Nummer 3. Bitte nutzen Sie die bereitgelegten Buntstifte und malen/zeichnen Sie. Als kleine Inspiration finden Sie die bereits vorgezeichneten Linien. Sie dürfen dabei die ganze Fläche der Seite nutzen.

Sie haben für diese Aufgabe 10 Minuten Zeit.
Sie müssen die von Ihnen begonnene Arbeit nicht in diesem Zeitraum beenden.
Ihre Arbeit wird nicht bewertet werden und Sie erhalten diese zurück.
Wichtig ist, dass Sie die komplette Zeit die für die Aktivität vorgesehen ist nutzen!
Wenn Sie bereit sind zu beginnen, drücke Sie bitte die LEERTASTE

Examples of Works from Task Conditions

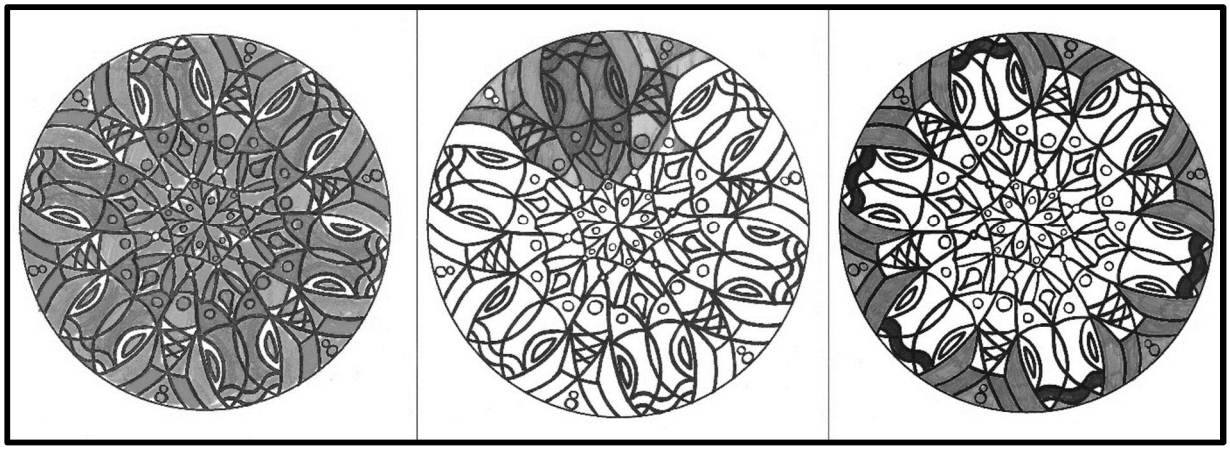

Figure 11. Three different works from the colouring mandala condition.

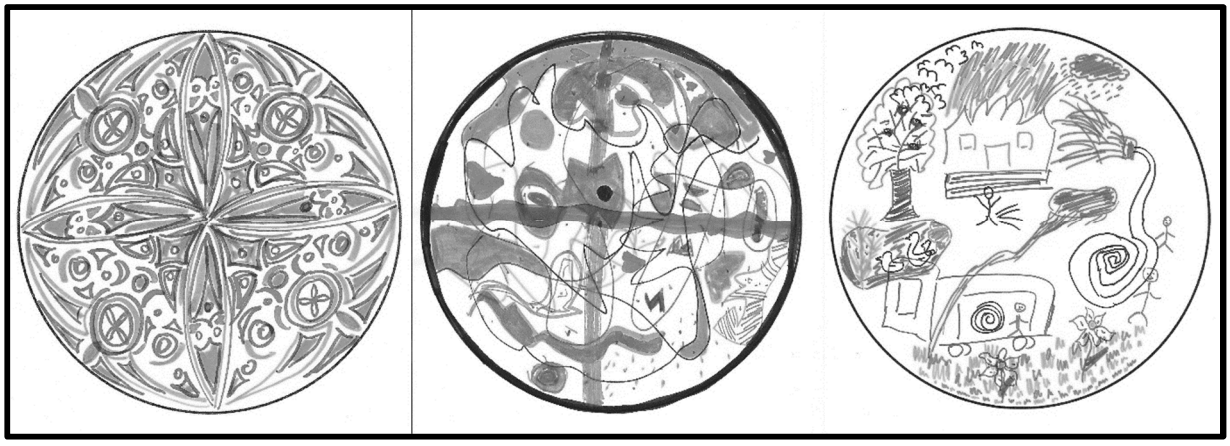

Figure 12. Three different works from the circle condition.

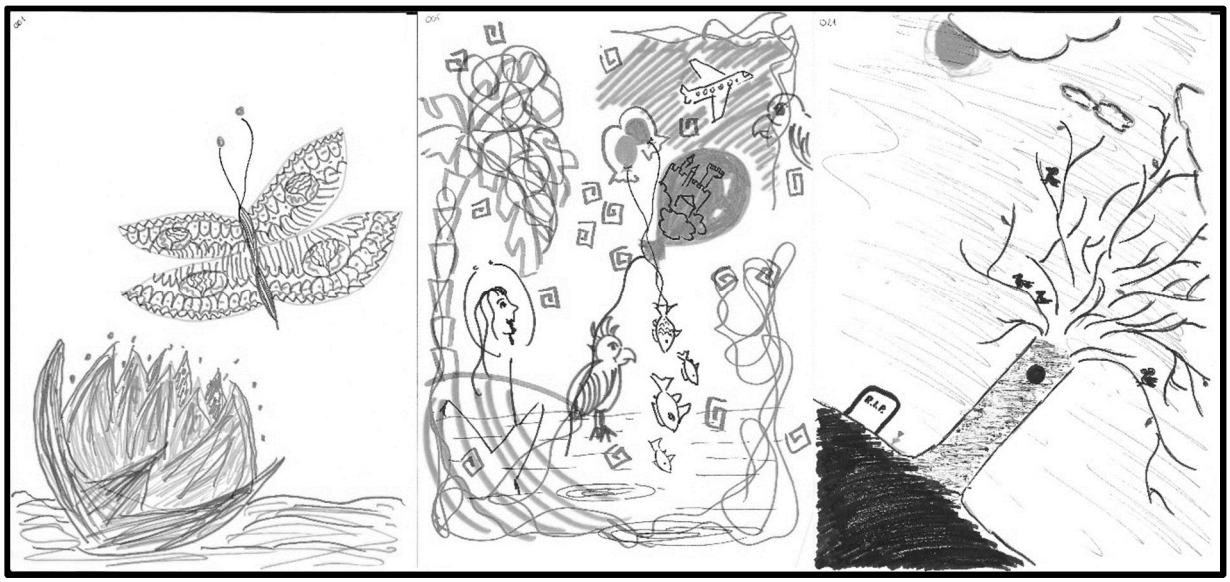

Figure 13. Three different works from the blank sheet condition.