Concentration and Loving-Kindness Meditations Differentially Impact the Attentional Blink and Stroop Effect
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Introduction
Very few studies of meditation have taken a comparative approach in order to identify the relative effects of two or more types of contemplative practice. A comparative approach would elucidate not only the different effects of diverse meditation techniques, but could also facilitate identification of underlying mechanisms. In this study, we compared the relative effects of concentration meditation (CM) and loving-kindness meditation (LKM) on two types of attentional tasks, an attention blink task and a Stroop task.

The attentional blink refers to the reduced identification accuracy for a target stimulus, such as a digit, when it appears 100-500ms after a previously identified target in a rapid serial visual presentation (RSVP) paradigm (Raymond, Shapiro, & Arnell, 1992). Both mindfulness meditation and loving-kindness meditation decrease the attentional blink (Slagter et al., 2009; May et al., 2011). We hypothesized, however, that CM would not similarly reduce the attentional blink. The attentional blink is reduced in situations where attentional investment in the RSVP stream of stimuli is decreased (Olivers & Nieuwenhuis, 2006). Concentration meditation, however, involves the focusing of awareness onto a specific object. The relationship between automatic and controlled processing in a Stroop task may vary as a function of the relative strength of an individual’s top-down attention. Mindfulness meditation has shown to decrease errors in the Stroop task compared to non-meditators (Moore & Malinowski, 2009). We hypothesized the CM would result in a smaller Stroop effect than LKM.

Method
Participants
Participants were drawn from two sections of a freshman course at Carroll University and randomly assigned to either a loving-kindness meditation condition (n = 16) or a concentration meditation condition (n = 15). The average age was 18.07 (SD = .28) for both CM and LKM participants.

Meditation Instruction
Participants in both conditions received instruction on their respective meditation for approximately 20 minutes. Both groups started with a progressively body scan. After the body scan, participants in the LKM group were asked to bring their awareness to their heart area, and imagine that as they inhaled, they inhaled into their heart, and as they exhaled, they exhaled from their heart. After several minutes, they were then asked to call to mind the image of someone who naturally evokes feelings of love and kindness. They were then instructed to silently direct three phrases to that mental image: “May you be well,” “May you be happy,” and “May you be free from suffering.” After several minutes, participants were then asked to change their mental image from someone who naturally evokes love and kindness to an image of themselves. They then directed the same three phrases to themselves. Finally, participants returned to imagining their breath emanating from their heart for a couple of minutes. After their body scan, concentration meditators were asked to identify a sensation associated with their breathing and attend to that. When their mind inevitably wandered, they were instructed to simply return to the breath.

Attentional Blink Task
Each trial contained 20 randomly selected distractors and targets (without replacement). Distractors consisted of the letters A-Z (excluding B, I, O, Q, S, Z) and targets were drawn from the set 2-9. Trials began with a central fixation cross appearing on the screen for 1 second. Distractors and targets appeared centrally in black 20 pt font on a grey background for 33 ms, with an inter-stimulus interval of 30 ms. The first target (T1) was presented in either the 6th, 7th, 8th, or 9th position. The second target (T2) occurred at Lags 1, 3, 5, or 8. T1 and T2 positions were fully crossed. After the final distractor, participants were asked which digit appeared first. Following their response, they were asked which digit appeared second. Participants saw a total of 160 trials, randomly presented across four blocks of 40 trials.

Stroop Task
Participants completed 144 trials, half of which were incongruent trials and half of which were neutral trials. In incongruent trials, one of four color words (YELLOW, BLUE, RED, GREEN) appeared centrally on the screen in one of the other three font colors, which were randomly selected. In neutral trials, participants saw strings of X’s with lengths matching the number of characters in the color words in one of the four font colors. Trials began with a centrally presented fixation cross appearing for 1500 ms. The color word or string remained on the screen until the participant selected a font color on a response pad.

Procedure
When participants came in for testing, they first practiced their assigned meditation for 10 minutes. The experimenter left the room during this time to allow the participants to focus on their meditation. Participants then completed the attentional blink task, Stroop task, and a third task (not reported here), which were counterbalanced between participants.

Results
For the attentional blink, a 4 (lag) x 2 (condition) mixed measures ANOVA of T2 T1% (correct identification of both targets) revealed significant effects for lag, F(3,23) = 54.32, p < .001, condition, F(1,25) = 9.44, p < .005, and the lag x condition interaction, F(3,23) = 3.88, p < .022. Figure 1 depicts the relationship between participants in the LKM and CM groups at each lag. Practitioners of LKM correctly identified a larger percent of T2/T1 at Lags 3 and 5 than those practicing CM. A one-way ANOVA of the maximum blink size (maximal AB) revealed a significant difference, F(1,26) = 20.95, p < .001. The average maximal AB for the LKM group was 11.54 (SD = 7.84), compared to 30.9 (SD = 13.73) for the CM group.

For the Stroop task, a 2 (condition) x 2 (trial type) mixed measures ANOVA showed main effects for type, F(1,27) = 71.58, p < .001, condition, F(1,27) = 12.24, p < .01, and a condition x type interaction, F(1,27) = 7.24, p = .01. Both groups exhibited a Stroop effect, though the effect was much more pronounced in those that had practiced loving-kindness meditation. LKM has a mean Stroop effect (incongruent – neutral trial reaction times) of 85.44 (SD = 35.04) compared to 33.85 (SD = 27.38) for concentration meditators. There was a significant positive correlation between the Stroop effect and meditation condition (r = 26, r = .48, p < .01) and a significant negative correlation between maximal AB and condition (r = 26, r = -.67, p < .001; see Figure 2). The partial correlation between maximal AB and the Stroop effect, controlling for condition, was r = -.02, p = .592, indicating that the zero-order correlations may be entirely explained by meditation condition.

Conclusions
Ten minutes of concentration meditation resulted in an increased attentional blink and a decreased Stroop effect, relative to ten minutes of loving-kindness meditation. These results are consistent with Olivers and Nieuwenhuis’ (2006) overinvestment hypothesis of the attentional blink and the role of focused top-down attention in attenuating the Stroop effect. These results are particularly notable in that just 10 minutes of meditation in meditation-naïve participants induced state effects which influenced the subsequently performed tasks. They also suggest that the attentional blink and Stroop task may be good measures for tracking the relative effects of CM and LKM. Future longitudinal work could track the relative changes in each task for each meditation condition. In addition, future work should include an active control group to provide a benchmark against which these effects could be compared. This would enable a more grounded analysis of the mechanisms underlying the observed effects.

References

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