Does aromatherapy actually work?

Erica Cousins

Background:

The autonomic nervous system is made up of two parts. The sympathetic system responds to stress with the “flight or fight” response to prepare the body for facing a stressor by increasing heart rate, blood pressure, and sweating. The parasympathetic system helps promote rest and relaxes the body by decreasing heart rate, blood pressure, and sweating while allowing digestion to increase. The relative activity of each system determines arousal. If a person is sitting in a comfortable chair reading a book, the parasympathetic will be favored; but, if a person is being chase by a bear, the sympathetic will be favored. To measure the relative activity, heart rate and sweating can be measured. Heart rate is measured by taking a person’s pulse. Sweating is measured using skin conductance (how easily electricity moves across the skin) which increases as moisture level increases. Skin conductance is also known as galvanic skin response (GSR).

Aromatherapy is based on the idea that scent can impact the balance of the autonomic nervous system. For instance, a person may light lavender candles in their home if they want to relax because they believe it increases parasympathetic activity. A study by Sayorwan, Siripornpanich, Piriapunyaporin, Hongratanaworakit, Kotchabhakdi, and Ruangrungsi (2012) demonstrated that lavender oil inhalation significantly decreased heart rate, blood pressure, and skin temperature. Saeki and Shiohara (2001) found similar results. When participants were exposed to lavender oil for 10 minutes, participants had a decrease in galvanic skin response and blood pressure.

Besides impact on the autonomic nervous system, some people use aromatherapy because
they believe scents impact their cognitive function (such as memory or attention). Moss, Cook, Wesnes, and Duckett (2003) found that participants exposed to lavender scent did worse on working memory and reaction time tasks than those exposed to no scent. On the other hand, rosemary scent (thought to be stimulating rather than relaxing) enhanced performance on the same cognitive tasks.

These two effects of scents in aroma therapy (changes in autonomic function and changes in cognition) are related. During a period of stress, being highly attentive and having a good memory is advantageous (e.g. If a bear is chasing a person, the person would be more likely to survive if they noticed or remembered a place to hide). Quas, Carrick, and Boyce (2006) found that children had better memory after a stressful event (fire alarm) which increased sympathetic arousal.

The Current Study: Methods and Results

This study considers the effects of aromas (lavender, peppermint, and no scent) on sympathetic nervous system arousal (measured with heart rate and GSR) and cognitive tasks that measure attention and working memory. When a participant is exposed to lavender, it is expected for his/her heart rate and GSR to decrease, while peppermint is expected to increase heart rate and GSR. For cognitive function, lavender is expected to decrease accuracy and increase reaction time, whereas peppermint is expected to increase accuracy and decrease reaction time.

For this study 15 participants (eight males and seven females) completed two cognitive tasks for each of three different scents (lavender, peppermint, and no scent). During the tasks, the participant wore a surgical mask with a cotton roll attached inside. The cotton roll contained one drop of one of three different oils (lavender, peppermint, or canola- which does not have a scent). The order of scents was randomized. All data was analyzed using ANOVA.
The first cognitive task was a “go/no-go task.” The go/no-go task is a measure of attention and inhibitory control. The task requires that a subject quickly differentiate between two similar stimuli (which requires attention) and then inhibit a response to one of the stimuli (inhibitory control). During this task, participants were asked to look at a red dot (fixation point) until either a solid green circle or a patterned green circle appeared. The participant was asked to click the circle if it was solid green but refrain from clicking if it was patterned. The accuracy and average reaction time (time from when the circle was presented to when it was clicked) was recorded.

The data showed that there was no effect of scent on accuracy for the go/no-go task ($F(2, 26) = 0.882, p = .426$). As shown in Figure 1 below, accuracy for lavender, peppermint, and no scent were the same.

The effect of scent on reaction time for the go/no-go task approached significance which means the reaction time did change depending on the scent but not enough to say conclusively that the scent changed the reaction time ($F(2, 26) = 2.960, p = .061$). As shown in Figure 2 below, reaction time for lavender, peppermint, and no scent were slightly different but not enough to be conclusive.
Males and females did not have different accuracies ($F(1, 3) = 2.124, \ p = 0.169$) or reaction times ($F(1, 13) = 0.132, \ p = .723$).

The second cognitive task was a “multimodal n-back task.” The multimodal n-back task measures working (or short term) memory because the participants must hold the images and sounds in their mind long enough to compare them with those presented later. In this task, participants saw a series of pictures at the same time that they heard a series of digits. The participant was asked to press <F> if the picture that was displayed was the same as the one displayed 2 back (e.g. If the pictures displayed were a cloud, a dog, and a cloud, the participant would press <F> for the second cloud because cloud was presented 2 back). The participant was asked to press <space> if the digit he/she heard was the same as the one heard 2 previously (if the participant heard “five”, “seven”, “five”, (s)he was expected to press <space> for the second “five”). The accuracy for each task (visual and auditory) was recorded.

The data showed there was no effect of scent on accuracy for the multimodal n-back task ($F(2, 26) = 0.237, \ p = 0.791$). Participants achieved the same accuracy regardless of the scent.

Figure 2. The effect of smell on reaction time during the go/no-go task. Error bars represent standard error.
they were exposed to. There was no effect of task (auditory or visual) on accuracy meaning that participants did equally well on the auditory and visual sections of the n-back task ($F(1, 13) = 0.224, p = 0.644$). Males and females also did equally well on the multimodal n-back task ($F(1, 13) = 0.490, p = 0.496$). Figure 3 shows that participants did about the same on each section of the task (visual or auditory) regardless of which scent they were exposed to ($F(2, 26) = 0.007, p = .225$).

![Figure 3](image)

*Figure 3. The effect of smell on accuracy of multimodal n-back task. Error bars represent standard error.*

During the experiment, electrodes were placed on the right forearm above the anterior (palm-side) of the wrist and the inside of each leg above the ankle to measure heart rate. The average heart rate during each task was measured. The scent did not have an effect the average heart rate ($F(2, 26) = 1.762, p = .192$). The task (go/no-go or multimodal n-back) also did not have an effect the heart rate ($F(1, 13) = 0.277, p = .607$). Males did not have higher or lower average heart rates than women ($F(1, 13) = 0.060, p = .810$). Figure 4 (shown below) shows that the scent did not affect which task produced a greater heart rate ($F(2, 26) = 0.100, p = .905$).
GSR transducers were placed around the index and middle finger of participants’ left hand during the experiment to measure conductance of the skin. The minimum GSR, peak to peak (variation in GSR), and area under the curve (total GSR) were measured. Like the average heart rate, variation in GSR was not affected by the scent ($F(2, 26) = 0.447, p = .645$) or task ($F(1, 13) = 0.911, p = .357$). Men and women showed the same variation in GSR ($F(1, 13) = 0.186, p = .674$). Figure 5 (shown below) shows that the scent did not affect which task produced more variation in GSR ($F(2, 26) = 0.017, p = .983$). Minimum and total GSR showed the same results.

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**Figure 4.** The effect of smell and task on average heart rate. Error bars represent standard error.

**Figure 5.** The effect of smell and task on GSR variation. Error bars represent standard error.
Discussion:

The results of this study did not support the prediction that scent would impact autonomic or cognitive function. While there have been studies supporting the relaxing impact of lavender, Howard and Hughes (2010) would dispute these claims saying that many of the studies on lavender have not used proper placebos or blinding (preventing subjects from knowing what the researchers expect to happen). They found that expectancy, not the actual aroma, is what causes autonomic changes. In this study, participants were blind the aroma (they did not know what scent they were being exposed to or the expected effects of the scent). Researchers manipulated expectancy by telling participants that the scents would have a particular effect (e.g. One participant may be told lavender has a relaxing effect whereas another may be told it has a stimulating effect). They found that aroma did not have an effect on GSR, but the prime (information about what the scent would do) did. They also found an interaction between prime and aroma meaning that the effect of aroma on GSR depended on the prime they were given. Moss, Howarth, Wilkinson, and Wesnes (2006) found that the effect of chamomile (thought to be relaxing) on memory and attention also depended on the expectation of the participant. If the participant believed that the aroma was stimulating, (s)he performed better. If the participant believe that the aroma was relaxing, (s)he did worse. These studies show that aroma may not actually impact autonomic function and cognitive task performance, but rather expectations associated with the aroma do.

Some improvements could be made to the study. First, the participant was exposed to the scent for a brief period of time (likely only about 5 minutes). In the Saeki and Shiohara (2001) study, the participants were exposed to the scent for 10 minutes. The shorter exposure may have not given the scent enough time to act on arousal and cognition. To improve this study in the
future, participants may be exposed to the aroma for longer before running the cognitive tests. In
addition, there was not much time between the different scents, which may have prevented the
autonomic system to return to its normal balance between scents. A longer period between scents
may prevent the previous scent from interfering with the effects of the next scent. The GSR
transducer is very sensitive to movement which may have caused problems with that data
because the participants were completing a number of tasks and were not always careful to
ensure they did not move the left hand.
References


