

**Pilot Evaluation of Effects of Digitally Delivered Breathing and  
Relaxation Exercises on Students' Emotional States**

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### **Abstract**

University students are a subpopulation that is prone to negative emotional states and psychological disturbances. This study proposes that breathing and relaxation exercises can help students manage this stressful transitional period. The objective of this study was to investigate potential effects of these exercises on students' affective states via an online application. A total of 32 university students were given alternate nostril breathing, boxed breathing and progressive muscle relaxation exercises. Their affective states were examined before and after each of the exercises by conducting paired sample t-tests. Results indicated that all 3 exercises had a positive effect on students' affective states. That is positive affect increased and negative affect decreased. Our findings conclude that breathing and relaxation exercises delivered digitally can benefit university students regulate their affective states.

**Key words:** breathing exercise, progressive muscle relaxation, students, affective states

## Introduction

*“We are all born with a determined number of breaths. How many years it corresponds to depends on how fast we are breathing.”* Anonymous Yogic saying

### Problem Definition

College students are a subpopulation that is prone to negative emotion due to many factors such as high academical demand and test anxiety (Beiter et al., 2015). Many college students are dealing with mental health issues. In fact, at any given time 10% to 20% of student population is suffering from psychological problems such as anxiety, depression and substance abuse (Auerbach et al., 2016; Kumaraswamy, 2013). It can easily be inferred that there are many students suffering below the threshold of detection or remain undetected. The reasons for those problems are various. Students are prone to psychological problems because of leaving their home state, academic pressures of meeting grade requirements, post-graduation anxiety, being fully responsible for their daily living, exposure to new people and a new environment, issues with their identity, fear of failure (Beiter et al., 2015; Kumaraswamy, 2013). Students have trouble regulating their negative emotions and they experience excessive worry, feelings of inferiority and anxiety (Kumaraswamy, 2013). The intensity of psychological problems makes it essential for colleges to target them in college settings for student well-being (Beiter et al., 2015). And, as the causes of psychological problems that students are facing with and their manifestations are extremely diverse, developing intervention methods that are applicable for a broad range of problems is crucial. Breathing and relaxation exercises are promising as their long and short term positive effect on mental health has been shown in previous research (Chen et al., 2016; Jerath et al., 2015).

## **Rationale for the Study**

Digital health and mental health interventions have been gaining popularity (Godara et al., 2021). It is no surprise because they have been proven effective in many studies (Ma et al., 2018). Adaptation of interventions to online platforms have been shown significant in alleviating depressive and anxious symptoms, stress reduction, and enhancement of mental well-being (Godara et al., 2021). On top of their effectiveness they have other advantages compared to physically delivered interventions. For example, digital interventions provide greater accessibility, anonymity, convenience and cost-effectiveness compared to face-to-face interventions (Christensen et al., 2014). Condensing intensive and complex face-to-face programs into brief and low-cost digital interventions that require no in-person contact with the trainers is thus promising. The fact that majority of young people are active online makes it viable to reach to a large amount of young people that are in need of these interventions (Christensen et al., 2014).

As university students are prone to negative emotionality and as they are digitally active, Erasmus University has initiated a project to design a mobile well-being application. The goal is to create a digital tool for students teaching them strategies that can help them regulate their emotions. The application is composed of many interventions such as mindfulness, self-compassion, problem solving, cognitive restructuring practices. This study was conducted to pilot evaluate 3 breathing and relaxation exercises.

## **Theoretical Framework**

Breathing and relaxation exercises have been used for healing purposes in Eastern cultures for thousands of years. They have also come to the attention of Western scientific world in the last decades as promising tools to ameliorate physiological and psychological disturbances (Brown & Gerbarg, 2009). In those decades evidence has been gathered about which specific

problems can potentially be counteracted by these practices. Mechanisms of that effect have also been studied. Results have yielded consistent scientific evidence for the beneficial effects of these practices over many psychophysiological problems such as chronic lung diseases, high blood pressure, asthma, cardiac illness, elevated cholesterol, insomnia, fibromyalgia; and psychological problems such as panic disorder, stress and anxiety related disorders, mood disorders and emotion regulation (Brown & Gerbarg, 2009; Ley, 1999). Although the range of effect of breathing and relaxation exercises is surprisingly fascinating, it all makes sense when we consider their common mechanism. Etiologically, a prominent cause of many psychophysiological diseases is chronic stress (Hopper et al., 2019). Overactivation of autonomic nervous system characterizes the long term cause of many problems. Anxiety disorder, bipolar disorder and attention deficit hyperactivity disorder (ADHD) are all characterized by hyperarousal (Posner et al., 2005) and patients with panic disorder consistently hyperventilate (Ley, 1999).

On top of their proven effectiveness these practices have major advantages compared to the alternative, medication. They provide a holistic treatment approach targeted to autonomic nervous system (ANS) rather than individual transmitters in brain. They are evidence-based, low cost and do not have unwanted side effects such as addiction and adverse reactions like medication (Jerath et al, 2015). Upon training they can be self-administered, always at disposal of the individual whenever needed (Chen et al., 2016; Hopper et al., 2019; Nemati, 2013). This study will pilot the immediate effect of two breathing exercises (namely, alternate nostril breathing and boxed breathing) and progressive muscle relaxation exercise on students' emotional states. As the aforementioned exercises are among the exercises included in the application that is being designed to improve student well-being through many practices, the target population of this study is thus Erasmus University students.

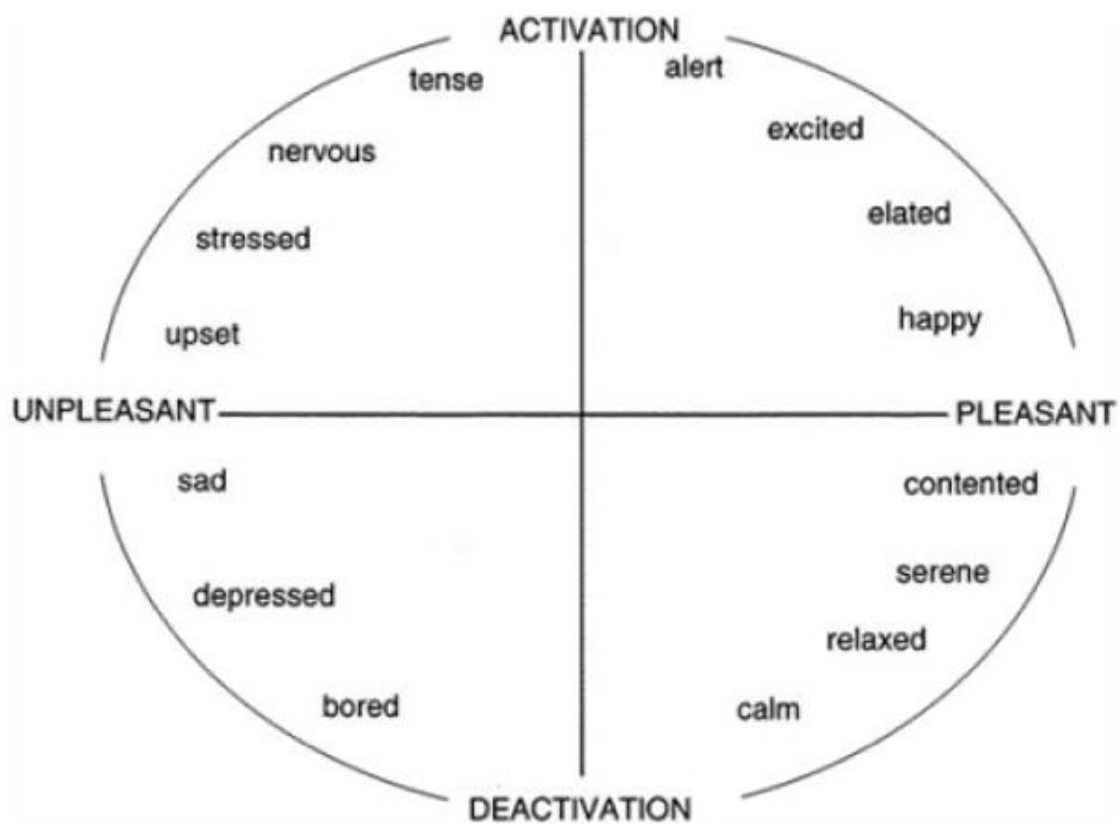
Recent studies have proven that breathing and relaxation exercises can effectively be used to ameliorate chronic and acute psychophysiological disturbances (Jerath et al, 2015). There have been many studies supporting this idea (Chen et al., 2016; Crockett et al., 2016; Mason et al., 2013). The most common underlying mechanism is their effect on ANS (Chen et al., 2016). ANS has two different states: sympathetic and parasympathetic. Sympathetic state is associated with “fight or flight” mode in response of stress. Parasympathetic state on the other hand is associated with “rest and digest” mode which puts humans into a regenerative state (Weissman & Mendes, 2021). With the aid of the exercises a shift from sympathetic to parasympathetic dominance is established. This happens through the bi-directional link between breath and ANS. ANS regulates breath, but in return the voluntary manipulation of breath regulates ANS activity. Anxious and stressful states are associated with increased breath rate and with decreased breath depth (Chen et al., 2016; Kreibig, 2010). When one breaths unconsciously, this happens through ANS affecting breath. Overbreathing, which is characterized by breathing rapidly, is an adaptive evolutionary response to fight or flight situations (Ley, 1999). That results in general activation of the body, increased heart rate, breath rate, skin conductance, and muscle tone. But it is established that conscious manipulation of breath for higher breathing rates results in instantaneous excitation of ANS. It is obvious that this bidirectional link can be used to regulate ANS activity through breathing (Jerath et al., 2015). Most of modern life situations do not benefit from too much sympathetic activity and require us to remain calm. Thus, anxiety results in maladaptive responses to modern life problems. This leads us to consider using this link to downregulate ANS activity for a healthier and a more functional life both on an individual and a societal level (Ley, 1999).

ANS was originally conceptualized as functioning independently of the rest of the nervous system. However, there are various interactions between the central and autonomic nervous system (Kreibig, 2010). Conscious mechanisms have the potential to override reflex

mechanisms (Burg & Michalak, 2010; Jerath et al., 2015). Breathing as the only vital function under both voluntary and involuntary control is a prominent way to override ANS activity (Brown & Gerbarg, 2009). Slow breath has been found to result in near-complete inhibition of sympathetic nervous system. That results in observable neural changes such as hyperpolarization and inhibition of amygdala and thalamic cells (Jerath et al., 2015). Voluntary changing of breath was found to explain 40% of the variance in emotions and has the potential to alter the emotional states (Philippot et al., 2002). This theoretical foundation has led to the adaptation of breathing exercises in clinical and community settings (Chen et al., 2016).

One of the main areas that breathing and relaxation exercises can effect is emotionality. Emotion is defined as a multicomponent response to previous events that results in changes in behavior, subjective feeling, and physiological arousal (Kreibig, 2010). Originally it was proposed that emotions are distinct from each other, but recently it was understood that they share lot of commonalities between them and individuals are not always easily able to differentiate between them (Philippot et al., 2002). Circumplex model is a widely used model to study emotions (see Figure 1). It puts emotions on a two dimensional continuum of valence and arousal which makes their interpretation easy and functional (Posner et al., 2005). That is the reason this model was chosen for analysis of this study. As aforementioned, there is a bidirectionality between emotional states and breathing (Jerath et al., 2015). Specifically, emotional states can lead to changes in breathing patterns. All negative emotions are linked with abnormalities in breathing. For example, anger results in fast and deep breathing, fear and sadness are associated with shallow and fast breathing. Generally negative emotional states such as anger, anxiety, fear, disgust and sadness are associated with faster breathing rate, along side with other abnormalities such as interruption of breathing flow (Kreibig, 2010; Philippot et al., 2002). Slow, deep breathing on the other hand is linked with relief and contentment. Breathing and relaxation exercises have a potential to ameliorate emotional states by increasing

positivity and decreasing the arousal level of emotional states. (Jerath et al., 2015; Philippot et al., 2002).



**Figure 1.** *Circumplex Model. Classification of emotions based on their valence and arousal level on a 2 dimensional plane.*

The main objective of this study is to pilot evaluate the proximal effects of these practices, delivered digitally, on students emotional states. Effectiveness is studied on an emotion regulation level. Emotion regulation is defined as “all of the conscious and nonconscious strategies we use to increase, maintain, or decrease one or more components of an emotional response” (Gross, 2001).

### **Hypotheses**

This study aims to test the immediate effects of alternate nostril breathing, boxed breathing and progressive muscle relaxation on Erasmus University students’ emotional states. Firstly,



we expect a general shift from higher levels of arousal to lower levels of arousal after students engage in the exercises as these practices are believed to assist a parasympathetic response which is the calm, resting state of the body. Secondly, we expect a general shift from unpleasant emotional states to pleasant emotional states as regular and deep breathing characterizes positive emotions such as happiness and relaxation. We also would like to know whether students enjoyed the practices and whether they found them helpful. This information will indicate if they would like to integrate these exercises to their daily life.

The study aims to support the findings of previous research but also has a very practical element to it. Learning how to regulate one's emotions through breath would result in more adaptive responses to stressors and can prevent development of serious mental health problems. The successful implementation of these practices to populations would result in much more healthier and functional societies (Jerath et al., 2015; Philippot et al., 2002).

## **Methods**

### **Participants**

32 students (Mean age= 22.34 years, SD=2.87) took part in this study. According to G\*Power (Faul et al., 2009) this experiment has a moderately high statistical power to detect an effect with a medium effect size.

Initially, the aim was to have only Erasmus University Rotterdam students as participants. But due to convenience reasons university students from other countries were also included in the study. Recruiting sufficient number of EUR students to obtain the necessary sample size was not possible to achieve within the given time for recruitment. Main inclusion criteria was participants being active bachelor or master students.

22 (~70%) of participants were from Erasmus University. 14 participants were males, 15 were females and 3 were non-binary. 11 participants were Turkish, 7 were Dutch and the rest

were from various different countries. This sample mainly included international students of Erasmus University. 12 participants were master students whereas 20 were bachelor (see Table 1 for detailed demographics).

**Table 1.** *Distribution of the sample by nationality, educational level, and gender.*

Nationality	n	Educational Level	n	Gender	n
American	1				
Cypriot	1				
Czech	2			Male	14
Dutch	7	Bachelor's	20		
French	1				
Greek	2				
Irish	1			Female	15
Italian	1				
Latvian	1				
Portuguese	1				
Spanish	1	Master's	12	Non-binary	3
Surinamese	1				
Turkish	11				
Ukrainian	1				

## Materials

### *Measuring instruments*

The emotional state questionnaire for this study was based on the Circumplex Model (Posner et al., 2015). 7 emotional states (i.e., happiness, stressfulness, relaxation) of the students was assessed before and after the interventions. The emotional states are measured on a 5 point Likert scale (list the extreme values: e.g., 1- Not at all – 5 Very much). The states are categorized in 4 dimensions of affect: positive activated (happiness, energeticness) and deactivated (relaxation) affect and negative activated (stressfulness, frustration) and deactivated (sadness, fatigue) affect. The question “How ‘X’ do you feel at the moment?” is answer by Not at all (1) A little (2) Moderately (3) Quite a bit (4) Extremely (5), X being the affective state that is being measured. For example the participant will be asked “How calm

you feel at the moment?” and she will answer it with a number on Likert scale. The investigation of all 4 domains of 2 dimensions will put her affective state in a place on a two dimensional plane.

The questionnaire was distributed via Qualtrics and was e-mailed to participants with a link attached to it. Demographic information of the students was collected prior to study. The demographic questionnaire was composed of questions about year of birth, gender, nationality, study subject, and study level.

Likeability and Helpfulness of the exercises was assessed via a 100 point slider scale (dislike a great deal – like a great deal) at the end of each exercise.

### ***Procedure***

Bachelor and master’s students were approached via e-mail lists or personally at Erasmus University. The participants gave their informed consent before participating in the study. All the questionnaires and exercises were presented via Qualtrics. Once participants gave their consent, they were then presented with a crash course on the theoretical basis of these exercises. They completed 3 exercises in 3 consecutive days. Exercises were instructed via prerecorded voice format. Each exercise took about 5 minutes. Detailed instructions can be found in appendix 3, 4, and 5 for each exercise.

**Day 1.** Upon recruitment students were given the demographic questionnaire. After that, a psychoeducational material in written format about the general purpose and mechanisms of breathing and relaxation exercises was given to them. This course was psychoeducative regarding the exercises to be done in the upcoming consecutive days.

**Day 2.** The participants filled in the affect questionnaire to measure their affective state prior to any exercises. Then, they were given audio guided instructions to exercise 1 (The order

of the exercises was randomized to avoid order effects). After the practice they again completed the affect questionnaire alongside with likeability and helpfulness measures. At the end of the practice, participants were thanked for their contribution and debriefed about the potential effects of the practice. Participants did not receive any remuneration.

**Day 3 and 4.** The same procedure with day 2 applied only with other exercises this time.

### ***Data Processing and Statistical Analyses***

The primary outcome measure was the changes in students' affective states before and after the interventions. That was assessed in four domains composed of two dimensions of valence and activation. Positive activated domain had the scores of "happy and energetic". Negative activated had the scores of "frustrated and stressed". Positive deactivated had the scores of "relaxed" solely. Negative deactivated had the scores of "sad and fatigued". The data for pairs of feelings was averaged for doing the analyses. Then, the data were evaluated by using paired sample t-tests to explore the differences in the affective states pre and post exercise. Four paired sampled t-tests were conducted for each of 3 exercises. The assumptions of independence of observations and random sampling were met for the t-test. Outlier analysis was done by checking whether there were any data below or over 3 SDs compared to mean scores. No outliers were detected. The assumption of normal distribution was checked by looking at the kurtosis and skewness scores. All the data had skewness scores between -.5 and .5; and kurtosis scores between -1 and 1. Hence, data was normally distributed. An alpha level of .05 was used to test the significance of effect.

Exercise likeability and helpfulness were evaluated by calculating the averaging the slider scores to observe user experience with the exercise.

## Results

Data from 32 participants were analyzed. 8 participants were discarded from the study because they failed to do the exercises after completing the psychoeducation.

### *Boxed Breathing:*

Four paired sample t-tests were conducted to compare the 4 composite scores, namely positive activated, positive deactivated, negative activated and negative deactivated, before and after participants engaged in the breathing exercise.

The results have shown that participants scored significantly higher in positive activated affect upon completion ( $M=3.672$ ,  $SD=.747$ ) of the boxed breathing exercise compared to before the exercise ( $M=2.953$ ,  $SD=.928$ ),  $t(31)= -5.756$ ,  $p<.001$ ,  $d= .706$ . Furthermore, Participants also scores higher in positive deactivated affect after engaging in the boxed breathing exercise ( $M=3.969$ ,  $SD=.933$ ), compared to before the exercise ( $M=2.969$ ,  $SD=.933$ ),  $t(31)= -5.259$ ,  $p<.001$ ,  $d= 1.078$ .

In terms of negative affect, results have shown that participants scores significantly decreased on negative activated ( $Mna=1.656$ ,  $SDna =.689$ ) and deactivated affect ( $Mnd= 2$ ,  $SDnd= .772$ ) after engaging in the exercises compared to the time immediately before the exercise, ( $Mna=2.422$ ,  $SDna=.872$ ),  $t(31)= 5.202$ ,  $p<.001$ ,  $d= .833$ ; ( $Mnd= 2.437$   $SDnd= .821$ ),  $t(31)= 2.791$ ,  $p=.009$ ,  $d= .887$ .

In terms of positive and negative emotions, these results are in line with our hypotheses. That is, positive emotions have increased, and negative emotions have decreased.

However, in terms of activation and deactivation results are not in line with our hypotheses. That is, positive activated and deactivated emotions have increased while negative activated and deactivated emotions have decreased.

The average likeability score for boxed breathing exercise was 73.19 (SD=20.69) whereas the average helpfulness score was 76.84 (SD=18.82).

Table 2. shows a summary of the results of this practice.

**Table 2.** Means and standard deviations of measures before and after the boxed-breathing exercise

Variable	Mean (Before-After)	SD(Before-After)	T score
Positive activated	2.953, 3.672	.928, .747	-5.756**
Positive deactivated	2.969, 3.969	.933, .933	-5.259**
Negative activated	2.422, 1.656	.872, .689	5.202**
Negative deactivated	2.437, 2.000	.821, .772	2.791*
Likeability	73.19	20.69	-
Helpfulness	76.84	18.82	-

Note: \* = <.05, \*\* = <.001, Likeability and Helpfulness scores were collected only after each exercise.

#### *Alternate Nostril Breathing:*

Four paired sample t-tests were conducted to compare the 4 composite scores, namely positive activated, positive deactivated, negative activated and negative deactivated, before and after participants engaged in the breathing exercise.

The results have shown that participants scored significantly higher in positive activated affect upon completion (M=3.484, SD=.666) of the alternate nostril breathing exercise compared to before the exercise (M=2.703, SD=.812),  $t(31) = -6.360$ ,  $p < .001$ ,  $d = .695$ . Furthermore, Participants also scores higher in positive deactivated affect after engaging in the alternate nostril breathing exercise (M=3.656, SD=.787), compared to before the exercise (M=2.375, SD=.975),  $t(31) = -5.571$ ,  $p < .001$ ,  $d = 1.301$ .

In terms of negative affect, results have shown that participants scores significantly decreased on negative activated (Mna=1.953, SDna =.807) and deactivated affect (Mnd= 2.141, SDnd= .721) after engaging in the exercises compared to the time immediately before the exercise, (Mna=2.891, SDna=.905),  $t(31) = 4.290$ ,  $p < .001$ ,  $d = 1.236$ ; (Mnd= 2.719 SDnd=.842),  $t(31) = 3.834$ ,  $p = .001$ ,  $d = .853$ .

In terms of positive and negative emotions, these results are in line with our hypotheses. That is, positive emotions have increased, and negative emotions have decreased.

However, in terms of activation and deactivation results are not in line with our hypotheses. That is, positive activated and deactivated emotions have increased while negative activated and deactivated emotions have decreased.

The average likeability score for alternate nostril breathing exercise was 70.94 (SD=18.26) whereas the average helpfulness score was 74.94 (SD=17.36).

Table 3. shows a summary of the results of this practice.

**Table 3.** Means and standard deviations of measures before and after the alternate nostril breathing exercise

Variable	Mean (Before-After)	SD(Before-After)	T score
Positive activated	2.703, 3.484	.812, .666	-6.360**
Positive deactivated	2.375, 3.656	.975, .787	-5.571**
Negative activated	2.891, 1.953	.905, .807	.4290**
Negative deactivated	2.719, 2.141	.842, .721	3.834*
Likeability	70.94	18.26	-
Helpfulness	74.94	17.36	-

Note: \* = <.05, \*\* = <.001, Likeability and Helpfulness scores were collected only after each exercise.

#### *Progressive Muscle Relaxation:*

Four paired sample t-tests were conducted to compare the 4 composite scores, namely positive activated, positive deactivated, negative activated and negative deactivated, before and after participants engaged in the relaxation exercise.

The results have shown that participants scored significantly higher in positive activated affect upon completion (M=3.781, SD=.792) of the alternate nostril breathing exercise compared to before the exercise (M=2.766, SD=.783),  $t(31) = -5.915$ ,  $p < .001$ ,  $d = .971$ . Furthermore, Participants also scores higher in positive deactivated affect after engaging in the

alternate nostril breathing exercise ( $M=4.187$ ,  $SD=.965$ ), compared to before the exercise ( $M=2.531$ ,  $SD=.842$ ),  $t(31)=-8.125$ ,  $p<.001$ ,  $d= 1.153$ .

In terms of negative affect, results have shown that participants scores significantly decreased on negative activated ( $Mna=1.703$ ,  $SDna =.620$ ) and deactivated affect ( $Mnd= 1.875$ ,  $SDnd= .647$ ) after engaging in the exercises compared to the time immediately before the exercise, ( $Mna=2.844$ ,  $SDna=.979$ ),  $t(31)= 6.899$ ,  $p<.001$ ,  $d= .935$ ; ( $Mnd= 2.765$   $SDnd=.898$ ),  $t(31)= 5.090$ ,  $p=.001$ ,  $d= .990$ .

In terms of positive and negative emotions, these results are in line with our hypotheses. That is, positive emotions have increased, and negative emotions have decreased.

However, in terms of activation and deactivation results are not in line with our hypotheses. That is, positive activated and deactivated emotions have increased while negative activated and deactivated emotions have decreased.

The average likeability score for progressive muscle relaxation exercise was 76.22 ( $SD=20.26$ ) whereas the average helpfulness score was 80.00 ( $SD=17.85$ ).

Table 4. shows a summary of the results of this practice.

**Table 4.** Means and standard deviations of measures before and after the progressive muscle relaxation exercise

Variable	Mean (Before-After)	SD(Before-After)	T score
Positive activated	2.766, 3.781	.783, .792	-5.915**
Positive deactivated	2.531, 4.187	.842, 965	-8.125**
Negative activated	2.844, 1.703	.979, .620	6.899**
Negative deactivated	2.765, 1.875	.898, .647	5.090*
Likeability	76.22	20.26	-
Helpfulness	80.00	17.85	-

Note: \* =  $<.05$ , \*\* =  $<.001$ , Likeability and Helpfulness scores were collected only after each exercise.



## Discussion

The goal of this study was to pilot evaluate effects of 2 breathing exercises and progressive muscle relaxation exercise on university students' affective states. The affective states were clustered into 4 domains according to Circumplex Model (Posner et al., 2005). To see the effects, we compared the scores of affective states before and after 3 exercises: alternate breathing, boxed breathing, and progressive muscle relaxation.

Our results indicated that all 3 exercises had significantly altered the affective states of students in all 4 domains. All 3 exercises increased the emotions in positive activated and deactivated states while decreasing emotions in negative activated and deactivated states. A significant change in affect is in accordance with previous research (Philippot et al, 2002). The directionality of change was as expected on the axis of positive and negative valence. The participants self-reported to be experiencing positive emotions (happy, energetic and relaxed) to a higher extent while experiencing negative emotions (frustrated, stressed, sad, fatigued) to a lesser extent after doing the exercises. However, in terms of activation level the results did not lead to a consistent interpretation as the positive activated scores increased while negative activated scores decreased. Similar trends were observed in the positive deactivated and negative deactivated scores. The former increased whereas the latter decreased. To simplify, all the positive valenced emotions of happiness, energeticness, and relaxation increased. There was no difference of direction of effect according to activation level of these emotions. All the negative valenced emotions of sadness, fatigue, frustration, and stressfulness decreased again without any difference of direction of effect according to activation level of the emotions. That might have to do with exercises bringing some relaxation but also tiring participants to some extent while they are being administered as they require concentration and mindfulness. We believe that the regular practice of these exercises will increase their positive effects while decreasing the energy that they consume. Because as any exercise that requires concentration

and skill, these exercises also have a learning curve that leads to ease in administration and increase in efficiency.

All 3 exercises have shown to influence affect in the same way on all 4 domains of emotions differing in quantity. Specifically, positive activated levels (happy and energetic) were increased after the exercises, alongside with positive deactivated levels (relaxed). Negative activated (frustrated and stressed) and negative deactivated (sad and fatigued) states were decreased. This increase in positive emotions, especially in relaxation, is in line with previous findings on the effects of these exercises (Chen et al., 2016; Jerath et al, 2015). Progressive muscle relaxation in particular had a bigger effect size on all quadrants. That particular practice has lead to a greater effect than other 2 exercises. That might have to with that exercise being more holistic, engaging muscle relaxation alongside with breathing regulation and mind concentration (Xiao et al., 2020).

Students getting happier, more energetic, more relaxed and less sad, less fatigued, less frustrated, and less stressed after the exercises is great to note. Because all these changes in emotional clusters are positive changes for well-being. On top of those positive changes it should be noted that this was achieved without any unwanted side-effects that drugs might cause, minimum costs, and no personal, face to face supervision (Jerath et al, 2015). Prerecorded digital guidance was enough to promote these changes. This gives a great power to these practices to be implemented to many people easily.

Future research should focus on the potential scope of intervention via these practices. That is, what type of problems can be addressed by them and how. This study investigated the changes in emotional states right after the exercise is completed. Future research could focus on longer terms of effect alongside with individual differences of effect of these practices. As there are many different breathing and relaxation exercises it might be useful to find the most effective one for each individual in each situation.

Our study adds on previous research with several characteristics. It is targeted to a specific subgroup: university students and aimed at acquiring effectiveness information to build an health intervention app. That gives our study a theoretical foundation but also a practical element. The effectiveness of those exercises via online delivery is also a relatively new area of inquiry. That way our study adds on to previous research by focusing on particular subgroup and a particular way of application. This is essential because it is about time to move beyond theoretical investigation of effectiveness of these exercises. Their practical implementation in community settings in a scientifically proven way will ameliorate quality of life on an individual and also on a community level. For that, more research with specific subgroups and ways of administration should be done. The usage of physical measures on top of self-report measures could also bring more insight for the practical implementation of these exercises in various contexts.

### **Conclusion**

Our study concludes that online application of breathing and relaxation exercises to university students is a promising tool to ameliorate their affective states, reduce their anxiety and increase their relaxation. The results support the intention of assisting the well-being of students. After years of theoretical work on breathing and relaxation exercises it is about time to create tools out of them to serve the community. We believe that our work has shed more light upon that.

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## Appendix 1

Emotion Questionnaire:

How happy do you feel at the moment? (1-Not at all, 2-A little, 3-Moderately, 4- Quite a bit, 5- Extremely)

How energetic do you feel at the moment?

How relaxed do you feel at the moment?

How frustrated do you feel at the moment?

How stressed do you feel at the moment?

How sad do you feel at the moment?

How fatigued do you feel at the moment?

## Appendix 2

Crash Course

Breathing and Relaxation, why does it matter?

Our autonomic nervous system is evolved to have two distinct modes: sympathetic and parasympathetic. Sympathetic mode is the "fight or flight" mode that the body gets into when faced with a stressor. This mode is characterized by increased physical arousal, vigilance, heart rate and blood flow to skeletal muscles. In this state, the blood flow to your gastrointestinal system (which is a fancy way of saying your internal organs :) is decreased. The emotions of anger, fear, anxiety which are classified as negative emotions are related to this state. Parasympathetic mode on the other hand is the "rest and digest" mode. In this mode digestive enzymes increase, heart rate decreases, muscles and the mind relaxes. This is why this mode is associated with feelings of calm, serenity and contentment which are positive emotions.

While both states are vital for our survival and well-being (I mean, evolution can't be wrong, right? Wait for it!) there is a key point. Those systems are evolved for the needs of the ancestral humans and our genes evolve at a much slower pace than our social lives.



Most of the stressors our ancestors were facing with were acute stressors. Meaning that the stressor was physically present in the moment and having the "fight or flight" mode active actually helped them in the situation. Let me visualize this to you with a story. Imagine one of our ancestral grandfathers who got tired of all the hunting quest decides to sit down a little and lay his back on that huge rock with a lot of dried leaves on it. As he lays his back the rock "ROOAAARSS!" and he looks up to see that the rock with the leaves on it was actually a giant brown bear. His sympathetic mode kicks in getting him ready to "fight or flight" the situation. Now what are his options? First the optimistic ones. He can successfully fight and win. He can successfully run away from the bear. This results in no more need of sympathetic mode. The danger has been avoided. Now let's look at the bitter outcomes. He fights and becomes lunch for the bear. Or, he tries to escape in vain and becomes both a work out and lunch for the bear. This again results in no more sympathetic activation in our ancestor. Well, because he is no more.

Most of the stressors in our modern lives are not that instantaneous (and furry) though. We have longer term stress sources such as approaching deadlines and future anxiety. Even the stressors that are instantaneous (such as a first date with your crush) do not benefit much from "fight or flight" mode (you know it sweaty hands!). We need to stay calm, rational and conscientious to deal with the modern stressors. Besides, the chronic stress that results from the longer term, abstract stressors causes us our well-being on many levels. Chronic over-activation of sympathetic nervous system is the cause of many illnesses, psychological symptoms, digestive problems, sleep troubles and sexual dysfunction (are you more interested now?).

So there is a discrepancy between the needs of our modern environment and our biological mechanisms. How can we fix that?

It was traditionally believed that our autonomic nervous system was merely regulated via environmental stimuli. If the environment would induce a stress response we would be "slaves to it". Turns out we are not! Breath and bodily awareness have been established as ways to regulate one's mood, emotion regulation and physical arousal. There is a bidirectional link. When your mind perceives a stressor it destabilizes your breathing pattern. You breathe shallow and fast. But the conscious regulation of breath also has the power to overrule the mind. If you breathe calm, slow and deep in the face of a stressor your breath whispers to your mind: "Hey buddy, relax. There is no need for tension. Look at me I am happy!" And your minds follows its guidance.

Breathing and relaxation exercises have been used for thousands of years in Eastern traditions. Lately, they have come to the attention of Western scientific world. And they are being investigated in an empirical way to adjust them to our modern lives. They are promising! In the 3 days to come you will be presented with 2 breathing exercises and a progressive muscle relaxation exercise. As a clinical psychologist to become and a yoga teacher who has been trained in India, I do not promise you enlightenment. I present to you relaxation via techniques that you can use any time once you have learned them.

May you breathe well and only become tense when necessary.

### Appendix 3

#### Alternate Nostril Breathing

Alternate nostril breathing is an ancient yogic breathing technique. As the name suggests it is done by breathing through nostrils one by one, taking turns. It helps to focus and relax the mind. Ruminators benefit very much from this technique! It also balances and stabilizes the breath over two nostrils. Sometimes one nostril is blocked to a certain extent that interferes with breathing quality. This exercise is good for recognizing and fixing that imbalance.

Before you start, find a quiet place that you feel relaxed. Take a comfortable seated position and tuck your chin in slightly. When you are ready, start the audio

“Connect the index and middle fingers of your right hand. Put them in the middle of your eyebrows. Gently, put your right thumb to the side of your right nostril. Put your ring finger, connected with your pinky finger to the side of your left nostril. You can check the images. Exhale fully through your nose. Close your eyes. Block your left nostril with your fingers touching it. And inhale through your right nostril for 4, 3, 2, 1. Block your right nostril, open your left nostril and exhale through your left nostril. For 4, 3, 2, 1. Inhale through your left nostril for 4, 3, 2, 1. Block your left nostril, open your right nostril and exhale through your right nostril for 4, 3, 2, 1. Inhale through your right nostril for 4, 3, 2, 1. Exhale through your left for 4, 3, 2, 1. Inhale through your left for 4, 3, 2, 1. Exhale right 4, 3, 2, 1. Inhale right 4, 3, 2, 1. Exhale left 4, 3, 2, 1. Inhale left 4, 3, 2, 1. Exhale right 4, 3, 2, 1. Inhale right 4, 3, 2, 1. Exhale left 4, 3, 2, 1. Inhale left 4, 3, 2, 1..... Exhale right 4, 3, 2, 1. Inhale right 4, 3, 2, 1. Exhale left 4, 3, 2, 1. Gently, let you of your right hand and go back to your natural rhythm of breath. Slowly open your eyes. Well done.”

#### Emotional state assessment questionnaire + Helpfulness and likability scale

Thank you for doing the exercise. I hope it was helpful and that you feel relaxed and focused.

However, if this is not the case and if you had difficulty doing the exercise, it might be because the exercise was not performed correctly (sometimes it's tricky to catch the rhythm) or this exercise in particular does not work for you. Luckily there are many other breathing exercises that might be more fitting for what you need. Also remember, "Practice makes perfect". Over time and practice such breathing exercise will give much more serenity while taking much less effort.

If you have any remarks ( be it positive or negative) about the exercise please write them down below.

### Appendix 4

#### Boxed Breathing

The exercise you will perform is called Boxed Breathing. This technique can help you heighten your concentration while also being a powerful stress reliever. It's used by everyone from athletes to U.S. Navy SEALs, police officers, and nurses.

The name of this breathing technique refers to the fact that a box has four sides, and is represented here by the breathing rhythm: you will breath in for 4 counts, hold the inhale for 4 counts, breathe out for 4 counts and finally hold the exhale for 4 counts. This is a deep breathing technique helps you to slow down your breathing. It works by distracting your mind as you count to four, calming down your nervous system.

If you like you can combine your counting by imagining drawing a square with your breath. Inhale draws a vertical line up, hold draws a horizontal line to right (or left), exhale draws a vertical line down, hold draws a horizontal line to left (or right). Tadaa! You have a full square. Don't hesitate to color it as you like.

Before you start, find a quiet place that you feel relaxed. Take a comfortable seated position and tuck your chin in slightly. When you are ready, start the audio and close your eyes.

“Take a deep inhale through your nose. Exhale sigh it out through your mouth. Empty all the air in your lungs. We'll continue breathing in and out always through our nose. Exhale for 4, 3, 2, 1. Hold the inhale in for 4, 3, 2, 1. Exhale for 4, 3, 2, 1. Hold the exhale for 4, 3, 2, 1. Inhale for 4, 3, 2, 1. Hold 4, 3, 2, 1. Exhale 4, 3, 2, 1. Hold 4, 3, 2, 1. Inhale 4, 3, 2, 1. Hold 4, 3, 2, 1..... Exhale 4, 3, 2, 1. Slowly finish your practice and go back to your natural way of breathing. And slowly open your eyes, perhaps by blinking a few times. Well done.

Thank you for doing the exercise. I hope it was helpful and that you feel relaxed and focused.

However, if this is not the case and if you had difficulty doing the exercise, it might be because the exercise was not performed correctly (sometimes it's tricky to catch the rhythm) or this exercise in particular does not work for you. Luckily there are many other breathing exercises that might be more fitting for what you need. Also remember, "Practice makes perfect". Over time and practice such breathing exercise will give much more serenity while taking much less effort.

If you have any remarks ( be it positive or negative) about the exercise please write them down below.

## **Appendix 5**

### **Progressive Muscle Relaxation**

Progressive Muscle Relaxation (PMR) teaches you how to relax your muscles through a two-step process. First, you systematically tense particular muscle groups in your body, such as your neck and shoulders. Next, you release the tension and notice how your muscles feel when you relax them. This exercise will help you to lower your overall tension and stress levels, and help you relax when you are feeling anxious. It can also help reduce physical problems such as stomachaches and headaches, as well as improve your sleep.

Before you start, find a quiet place that you feel relaxed. Lie down on the ground (you can use a yoga mat or blanket) or on a bed. Spread your legs to the sides and let your feet drop to right and left. Put your hands on the floor next to your groin area, palms facing up. When you are ready, start the audio and close your eyes

“Take a deep breath through your nose and sigh it out through your mouth. Keep inhaling and exhaling through your nose with an easy, organic and slow rhythm. With the next inhale, point your toes forward and tense your feet muscles. Stay here for 5, 4, 3, 2, 1. Exhale, release your feet completely. Let them drop to the sides and get heavier down to earth. For 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. With the next inhalation, flex your feet towards your face, tense your calf muscles. Hold for 5, 4, 3, 2, 1. And let go. Relax your calves for 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Inhale, tense your quads, your glutes and your hips for 5, 4, 3, 2, 1. Exhale, relax all your upper legs and hips for 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Inhale, tense your core for 5, 4, 3, 2, 1. Exhale, relax your core for 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Inhale, tense your chest and your back for 5, 4, 3, 2, 1. Exhale, relax your back and chest for 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Inhale, tense your shoulders and your upper arms for 5, 4, 3, 2, 1. Exhale, relax for 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Inhale, make a fist and tense your fingers, your hands and your lower arms for 5, 4, 3, 2, 1. Relax your hands, open them and let them go down for 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Inhale, tense your facial muscles squeezing your eyes shut. All your facial muscles are tensed for 5, 4, 3, 2, 1. Exhale, relax your face. Let it get heavier down to earth for 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. Now with every exhalation, relax every and any body part deeper down to earth. Yield into gravity. Relax your eyelids. Relax your tongue. Your cheeks. Forehead. Your sculp. Your neck. Alongside with your muscles, relax your mind. As mind is just like any other muscle. It’s great that we have it. It’s a great tool for us. But as any other muscle it needs to rest. Otherwise it can’t function well and it causes us pain. Let everything be. Put them to sleep. We are gonna stay here for a few more minutes. Just deepen your relaxation with every exhale. .... Keep inhaling and exhaling. Without any rush, let that breath start the movement in your body from your finger and your toes. Slowly let that movement spread across your body. You can give yourself a nice stretch as if you are waking up in the morning. Slowly, turn to either side of yours and come to a seated position. When you are ready, blink your eyes open. Well done.”

Thank you for doing the exercise. I hope it was helpful and that you feel relaxed and focused.

You might be feeling a little dizzy. Try not to move too fast and too forceful for a while. Enjoy the organic and healthy high :)

If you had difficulty doing the exercise, it might be because the exercise was not performed correctly (sometimes it's tricky to catch the rhythm) or this exercise in particular does not work for you. Luckily there are many other relaxation exercises that might be more fitting for what you need. Also remember, "Practice makes perfect". Over time and practice such relaxation exercise will give much more serenity while taking much less effort.

If you have any remarks ( be it positive or negative) about the exercise please write them down below.