CHAPTER IV
DESIGN AND METHODOLOGY

The purpose of the present investigation was to study the impact of negative air ion exposure on attentional process. It was decided to administer varying levels of negative air ions for varying durations. Hypotheses regarding the effect of negative air ions on attentional processes have been formulated in Chapter III. Four tasks, i.e. Selective attention, Sustained attention, Alternating attention and Divided attention were selected for administration. Keeping in mind the above described independent variables and their levels, following design was used.

DESIGN

A 3x4 factorial design was employed as given in the following table:

<table>
<thead>
<tr>
<th>Dosages (ions/cm³)</th>
<th>No exposure</th>
<th>1000-1200 ions/cm³</th>
<th>2500-3000 ions/cm³</th>
<th>4500-5000 ions/cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 days</td>
<td></td>
<td></td>
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</tbody>
</table>

n=15, N=180 (Independent group design)

Phase I: It was a pre-post phase. Each subject was tested on a task of sustained, selective, divided and alternating attention before and after the pre decided dose of negative air ions for given number of days in the design.

Phase II: In phase II, residual effect was studied. It was a repeated measure design. The post tests of each subject after the exposure was over were taken at an interval of 15, 30 and 60 days.
SAMPLE

350 students were taken from a public school of Rohtak. From those 350 students, a sample of total 180 students (n=15) studying in class 9th and 10th was selected on the basis of span of attention measured through Tachistoscope. The age range of the students was 14 to 16 years. These subjects were mixed gender groups (preferably equal number). Groups were equated in terms of equal mean of average attention span.

TOOLS

1) Tachistoscope

A falling door type mechanical Tachistoscope was used for measuring the span of attention. It is manufactured by MEDICAID SYSTEM and requires 220v 50 Hz main socket. It is made up of a wooden board with a small window at the centre. The cards were presented to the subject for a fraction of a second through this window. It helps in testing subject’s visual speed of attending and recognizing the stimuli. It is used for exposing visual stimuli as pictures, letters or words for an extremely brief period, used chiefly to assess visual perception, memory and learning.

2) Air Ion Counter:

Air ion counter was imported from Alpha Lab, U.S.A. It is used for counting air ions present in the environment measuring both types of polarities. It pulls air through a parallel plate assembly. Outer two plates are held at polarization potential (+’ or ‘-’). It works on a nine volt battery. It has three switches i.e. one for polarization (‘+’ or ‘-’), second for measurement/ stand by and third for polarization density i.e. knob should be at 19.99. It has a screen displaying ion counts in decimal points. If all the decimal points are visible, it indicates low battery. Polarity can be changed at any time when right switch is on measure, this starts the fan and the ion concentration shown on the display will be valid after 20 seconds. Number on the display is multiplied by 1000 to get the number of ions per cubic cm. These ions are of polarity selected by using polarity switch. Ion measurement should be made in still air. If the ions count is not proper ‘Re-Zero’ the measure switch and then again on the ‘Measure’. For the most accurate reading ion counter is to be held at arm’s length.
Figure 3: AIR ION COUNTER
Figure 4: Negative Ion Generator with Eight holes

Figure 5: Negative Ion Generator with Twelve holes
3) Negative Ion Generator

It is manufactured by Electronic Sales Corporation (ESCORP). It is generally used for purifying air by balancing ions in the air, giving fresh air. It works on 230 Volts AC line. Different models are available as per the area requirements. For the present experiment two ion generators (eight holes and twelve holes) were used.

Tasks:

In order to study the effects of negative air ions on attention, the tasks measuring the acquisition and retention were selected. For the present purpose following tasks standardised by Priyanka and Batra, 2014 from a series of work on Shankhpushpi were selected.

Selective Attention: Visual search task was used for measuring selective attention. In this task, each slide has 5 blocks containing different alphabets, one block at the centre and rest surrounding it. The participants are required to detect the presence of a letter which is same as the alphabet present at the centre block. Participants were asked to report present whenever they detect the presence of that same alphabet. This task was continued for 5 minutes.

Sustained Attention: Paced visual serial addition task was used for measuring sustained attention. For this task, participants were required to add adjacent pairs of digits from a string of single digit that was presented visually via PowerPoint such that each digit is added to the one immediately preceding it. Participants were required to add the digits on one slide into the next and speak the sum aloud, say slide 1(3) + slide 2 (4) =7, slide 2 (4) + slide 3 (5) = 9 and so on. Same procedure was to be followed for all the slides. The responses were recorded. This task was continued for 10 minutes.

Alternating Attention: Consonant-colour recognition task was used for measuring alternating attention. Each slide was divided into four parts. Subject was informed that one alphabet will appear at a time in any block of the slide. The primary task required the participant to report whether the alphabet present is a vowel or a consonant and secondary task required the subject to report about the colour of the alphabet in which it is written. Responses were recorded. This task was continued for 5 minutes.
**Divided Attention:** *Sequence recall and distractor task* was used. The primary task required the subject to see a 4 digit sequence such as 3,7,2,8. Participants were informed that after every four slides there will be a blank slide. Participants were required to add and report the sum of four digits aloud on the blank slide. The responses were recorded.

The secondary task was the signal detection task. Target letter was presented randomly at any slide. Subject has to report present whenever they detect the presence of any target letter. The task was continued for 5 minutes. Total number of correct responses on both the tasks was counted.

Each slide in each task was presented for a time of 1 sec 20 msec.

**PILOT WORK**

A separate laboratory was set up to conduct the experiment within the school setting. Permission for conduction of experiment was taken from the school authorities and the informed consent was taken from students. Before carrying out the actual experiment a pilot work was done in order to know the time in which the desired levels of doses could be attained. For this purpose, the intensity of the ions in the room, where the experiment was to be carried out, were noted down at different locations and at different time intervals with the help of ion counter. Firstly, the pilot work was conducted without the students present in the room. This gave an estimation of the timings for ion generators needed to be put ‘Off’ and ‘ON’ to maintain the required dose. Now finally it was conducted in the presence of 30 students just like it was to be done for the final data collection in each group. In order to count the air ions the ion counter was held at an arm’s length, in upright position with proper grounding. Improper grounding will repel negative ions causing the count to be too low. The grounding was done with the help of wet cotton and switches were set on the ‘ON’ sign and polarity button on the ‘negative’. Button was turned ‘ON’ (left switch can be either + or -). With right switch on standby, knob turned to “19.99”. The reading displayed on the screen was multiplied by thousand as to get the exact number of ions/cm³. This pre level of intensity measurement made the experimenter to understand the natural number of ions present in a particular room in both the conditions i.e. with and without the presence of students in the room. Earlier three ion generators (one of 5 holes, other of 8 holes and third one of 12 holes) were placed in the room at different positions and readings were noted down but this didn’t work out properly. Then the readings were noted down with two ion
generators of 8 and 12 holes respectively. Number of students which were present in the room was 30. During the presence of the students in the classroom setting initially the negative ions were 220 ions/cm$^3$. After this, two ion generators (one was of 12 holes/needle and other was of 8 holes/needle) were made to run in the room. Ion generators were set in the room properly at two different points and again the continuous readings were taken after every five minutes with the help of ion counter. Five readings were taken each time. Multiple readings were taken because variations in readings were observed. The readings were also taken from the different areas of the room and an exemplary table of readings are shown below, which are indicative of the rate at which the number of ions increased in the room.

Table 1: Showing the number of ions at various intervals

<table>
<thead>
<tr>
<th>Time (in minutes)</th>
<th>Readings of air ions</th>
<th>Mean</th>
<th>Ion/cm$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(-)</td>
<td>(+)</td>
<td>(-)</td>
</tr>
<tr>
<td>After 5 mins</td>
<td>0.56+0.59+0.52+0.54+0.60</td>
<td>4.56+4.21+4.34+4.45+4.02</td>
<td>0.56</td>
</tr>
<tr>
<td>After 10 mins</td>
<td>0.98+0.96+0.92+0.96+0.86</td>
<td>3.09+3.38+3.35+3.45+3.11</td>
<td>0.93</td>
</tr>
<tr>
<td>After 20 mins</td>
<td>1.96+1.92+1.56+1.76+1.92</td>
<td>2.34+2.71+2.58+2.34+2.50</td>
<td>1.82</td>
</tr>
<tr>
<td>After 30 mins</td>
<td>2.45+2.52+2.98+2.56+2.51</td>
<td>1.96+1.25+1.54+1.67+1.45</td>
<td>2.60</td>
</tr>
<tr>
<td>After 40 mins</td>
<td>3.86+3.74+3.62+3.85+3.92</td>
<td>0.95+0.87+0.89+0.76+0.87</td>
<td>3.79</td>
</tr>
<tr>
<td>After 50 mins</td>
<td>4.98+4.79+4.82+4.62+4.96</td>
<td>0.43+0.34+0.31+0.32+0.12</td>
<td>4.83</td>
</tr>
</tbody>
</table>

After 5 mins the level of negative air ions reached 560 ions/cm$^3$, after another 5 minutes it reached to 930 ions/cm$^3$. Similarly after 30 minutes the level reached to 2600 ions/cm$^3$. After 50 minutes the level was 4830 ions/cm$^3$. In this way, the readings were taken till the 4500-5000 ions/cm$^3$ level could be attained. This level could be attained after 50 minutes. So the time was decided in which the different intensities of ions were reached. The next step of the pilot work was to check when to switch off the ion generators and for how long in order to control the different ranges of ion doses. For example if the dose i.e. 1000-1200 ions/cm$^3$ is to be maintained at similar level throughout the experiment then the generator is to be put OFF for how long. Trials of various time intervals indicated that a 2 minutes break, when the level rises
up to the upper limit (1000-1200 ions/cm³) was enough after 10 minutes. For second and third dose these generators were put off for two minutes after every 15 minutes.

**PROCEDURE**

First of all, subjects of class IX and X were selected on the basis of span of attention. Tachistoscope was used for measuring the span of attention. Subject was asked to count and report the number of dots on every card being presented to them. Scoring was done and span of attention was measured. Only the subjects falling between the range 6-8 were taken as subjects having an average attention span were selected for the further experiment. Then the selected subjects were randomly allotted to exposure or no exposure group of different dose levels. Each group consisted of 15 subjects. For exposure, three ions level i.e. 1000-1200 ions/cm³, 2500-3000 ions/cm³ and 4500-5000 ions/cm³ were used. As it is a pre-post test study, before providing them the negative air ion exposure, subjects were made to perform all the tasks. After this, the final experiment intervention was started.

**Instructions:**

A good rapport was established with the subjects one by one and following instructions were given to them for the different task.

1) **Selective Attention:**

   Following instructions were given to the subject for performing the task:
   "Each slide has 5 blocks containing different alphabets, one at the centre and four surrounding it. You have to detect the presence of a letter which is exactly the same to the alphabet present at the centre block. Whenever you identify a letter same to the centre letter you will say present and on rest of the slides you will remain silent. Speak your response loudly. If you have any queries you can ask”.

2) **Sustained Attention:**

   For Sustained attention, following instructions were given to the subject:
   "In this task, some digits will appear one after the other. You have to add adjacent pairs of digits from a string of single digit such that each digit is added to the one immediately preceding it. For example if the digit on previous slide is 3 and on next slide is 4, then at the presentation of digit 4 you have to speak 7 and if the digit being presented n the next
slide is 5, you have to add ‘4’ and ‘5’ and have to speak ‘9’. You have to report the sums aloud as the digits will be presented. This task will continue for 10 minutes. If you want to ask anything you can ask without any hesitation”.

3) **Alternating Attention:**

Following instructions were given to the subject for Alternating attention:

“Each slide is divided into four parts. One alphabet will appear at a time in any block of the slide. Whenever the alphabet will appear at the upper half of the slide you will have to tell me whether the alphabet present is a vowel or a consonant and whenever the alphabet will appear at the lower half of the slide you will have to tell me about the colour of the alphabet in which it is written”.

4) **Divided Attention:**

For Divided attention, following instructions were given to the subject:

“This task measures that how well a person can manage two things simultaneously. In this task, a 4 digit sequence such as 3,7,2,8 will be presented to you. After every four slides there will be a blank slide. You are supposed to add and report the sum of four digits aloud on the blank slide. Besides this you have to do one more thing. In between a target letter will appear randomly at any slide. You have to say present whenever you detect the presence of any target letter but simultaneously your addition of digits will go on. The task will continue for 5 minutes. If you want to clear any doubts you can ask”.

After giving the instructions for each task, the tasks were actually carried out and the responses of the subjects were noted down. Now they were either exposed to or not exposed to negative air ions as per their belongingness to their respective groups. After the exposure post test were taken. On each post test the placement and sequence of the target items to be recognised was changed.

For exposure group subject were made to sit in a room daily for one hour with special permission of the school authority. Two negative ion generators i.e. 8 hole generator and 12 hole generator were set in the room at two different points. Subjects were made to sit with in the 2 meter range of the ion generators so that they can properly inhale the ions. Fans were kept off. Therefore, the data was collected during October to March when the temperature in the room varied between 22-27°C. Before starting the exposure dose, for the first dose i.e. 1000-1200 ions/cm³ the
working in the presence of the teacher as instructed. Ions were counted with the help of ion
counter from a distance of two meters from the subject’s face after every 10 minutes. Whenever
the ion level started rising above the 1200 ions/cm$^3$ or somewhat near it, the ion generator was
switched OFF for two minutes which was also decided on the basis of pilot work done before the
actual experiment. ‘Switching ionizers were made to run for about 15 minutes in the classroom
so that ion count reaches above the desired level. Now the subjects were seated comfortably and
switch of the ionisers were kept on ‘Off’ position. When the level reached below, then again the
ion generators were switched ON. This way the dose was maintained for one hour. Similar
procedure was repeated for 30 days. Testing of subjects on different tasks was done after the
exposure of 10, 20 and 30 days. Same procedure was followed for the second dose (i.e. 2500-
3000 ions/cm$^3$) and third dose (i.e. 4500-5000 ions/cm$^3$). For the second dose ion generators
were put ON for 35 minutes and the desired level was reached. On the pilot work it was clear
that there is a need to put OFF the generators for 2 minutes after every 10 minutes so as to
maintain the level of ions at 2500-3000/cm$^3$. Similarly for the third dose i.e. 4500-5000 ions/cm$^3$,
the ion generators were made to run for 50 minutes. There was again a need to put OFF the
generators for 2 minutes after every 10 minutes in order to maintain the dose range.

The control group was also treated in the same way. The subjects were made to sit in the room,
without knowing about whether the generators are ON or not. They carried out their routine
work. The same classroom environment was maintained as they were busy with their class
activity. To create the same environment and to generate the same feelings the experimenter kept
on monitoring the levels of ions. Now the post test of these subjects was taken in the same way.
For conduction of post test, two confederates were trained and for post test, similar tasks of the
same difficulty level as that of pre test were used. These tasks were taken immediately after the
exposure of negative ions. Then after a time interval of 15, 30 and 60 days of the exposure
group.

In order to see the residual effect, the tasks of post tests were conducted after 15 days, 30 days
and 60 days. Responses of the subjects on different tasks were noted down. Tables of pre-post
scores on various tasks were prepared and put to statistical analysis as discussed in the next
chapter.