Demonstration of coffee effect on psychomotor performance: A Teaching-Learning experience

Agarwal A.K*, Shehnaz SI, Razia K, Arifulla, M
Department of Pharmacology, Gulf Medical University, Ajman, UAE

*Presenting Author

ABSTRACT

Objective: Animal experiments have been reduced to mere demonstrations and/or withdrawn from the undergraduate curriculum. A new clinical pharmacology experiment has been introduced which is simple, safe and has the ability to quantify the drug effect in an objective manner. The objective was to demonstrate the stimulant effect of coffee on psychomotor performance using Paper and pencil tests.

Material and Methods: Digit Letter Substitution Test and Six Letter Cancellation Test were administered during the pharmacology practical hour in different batches of MBBS and Pharmacy program after obtaining the written informed consent. The experiment involved practice, Pre-coffee session, Coffee intake (2g/200ml), post-coffee session followed by student’s feedback using a questionnaire.

Results: There was no significant difference between the scores during practice session and pre-coffee session. However, there was a 15-20% increase in the post-coffee scores which was statistically significant (p<0.05; Student t-test) as compared to pre-coffee scores. The students gave a good feedback about the experiment as reflected by a mean score of 4.6±0.3 on a scale of 5.

Conclusion: The stimulant effect of coffee was observed by majority of the students as reflected by their increased score in the psychomotor tests. They found the experiment interesting and appreciated the approach to understand the drug effect.

Keywords: Coffee experiment, Psychomotor tests, paper and pencil tests
INTRODUCTION
Animal experiments have been designed and standardized to demonstrate the effects of certain drugs on body organs in undergraduate health professions education. However, the logistics of animal availability, expenses incurred and increased consciousness and awareness towards the animal welfare\(^1\)-\(^3\), these experiments have been reduced to mere demonstrations and/or withdrawn from the undergraduate curriculum (MCI). This also supports the principle of ‘Three Rs’ (i.e. Replacement, Refinement and Reduction)\(^4\).

Computer assisted learning experiments (simulations) were introduced as an alternative to satisfy the ethical concerns and animal rights activists\(^5\)-\(^6\) and changed the real experiments into a virtual learning. The responses are far from actual, as the biological variations due to several external factors are eliminated and the experimental conditions can be defined exhibiting similar responses on each occasion. Moreover, simulation experiments deprive the students to get hands on experience with the living tissues and their future application in research.

In the current scenario, we need to look for alternative exercises which will expose the students to experimental methodology with scientific explanation. Experiments like dosage calculations, rational drug selection, evaluation of drug information, and therapeutic drug monitoring, have been employed as alternatives for pharmacology practicals\(^7\),\(^8\). A clinical pharmacology experiment demonstrating the analgesic effect of NSAIDs is real and often appreciated by the students due to their direct involvement.

In an effort looking for experiments at undergraduate level, Department of Pharmacology, Gulf Medical University, Ajman (UAE) introduced a new experiment in the teaching curriculum which is simple, safe and has the ability to quantify the drug effect in an objective manner. The aim of the experiment is to demonstrate the stimulant effect of coffee on psychomotor performance in students using Paper and pencil tests\(^9\). These tests have been employed to reflect the mental components such as recognition, perception, integration, processing and reaction in various designated tasks. This experiment has very few requirements and can be easily performed during the practical hours.

MATERIALS AND METHODS
The faculty involved familiarized themselves with the tests so as to plan the experiment for smooth implementation during the practical time. The experiment required preparation of worksheets and arrange for coffee at specified time. All students (above the age of 18 years) were introduced to both the tests and instructions necessary instructions were issued before administering the tests. Moreover, strict monitoring of timings was followed during the performance of these tests by the students. One group pretest-posttest experimental design was followed to demonstrate the effect of coffee.
Exercise Undertaken: Demonstration of stimulant effect of coffee using paper and pencil tests.

Materials required:
1. Three sets of Parallel worksheets for Six Letter Cancellation Test (SLCT)
2. Three sets of parallel worksheets for Digit Letter substitution Test (DLST)
3. Stop watch
4. Office bell
4. Standard hot coffee (2g Nescafe coffee powder/200ml of hot water)

The details of the experiment as conducted are as follows:

Steps for performing psychomotor tests:

A. Six Letter Cancellation Test:
   1. Identify the six alphabets in the given key.
   2. Strike off these “target alphabets” in the working section at your maximum speed.
   3. Time allowed is 90 seconds.
   4. Actual score = Total attempted - incorrect attempts

B. Digit Letter substitution Test:
   1. Identify the letter for each digit in the given key.
   2. Substitute the digits in the working section with the corresponding letter at your maximum speed.
   3. Time allowed is 90 seconds.
   4. Actual score = Total substitutions - incorrect substitutions.
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SIX LETTER CANCELLATION TEST (SLCT)

NAME:_________ Course:_________ DATE:_______ SESSION:_______

Target Alphabets: R L F T O Z
Cancel the above six alphabets with a slash in the given text at your maximum speed.
Time allowed: 90 sec
--------------------------------------------------------------------------------------------

Q W E R T A Y U I O P A S D F G H L J K M Z X C V B N T M Y S Q C
P O I D U Y T R E V W Q Z X C V B N M L K J H G F D S F A B P G O
A D S F G J H K L Z C X V B W M N Q J E W R T U Y I O P M H N F Z
Q P W O E I R U T Y A L S K D J F H G Z M X N C B V D H U P A R W
S Q A Z W S X O E D C R F V T G B Y H Q N U J M I K L O P K L T S T
M N B V C X Z L K J H G F D S A P O I U Y T R E W Q A E I O U R A

Total attempted:  
Incorrect:  
Net Score:
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DIGIT LETTER SUBSTITUTION TEST (DLST)

NAME: 

KEY:

BATCH: 

DATE: 

SESSION: 

TIME: 90 Sec

Substitute the number in each box with the corresponding alphabet

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<tr>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>8</th>
<th>9</th>
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<tr>
<td>S</td>
<td>W</td>
<td>B</td>
<td>N</td>
<td>P</td>
<td>L</td>
<td>A</td>
<td>F</td>
<td>C</td>
</tr>
</tbody>
</table>

Total attempted: 
Incorrect: 
Net Score:
PROCEDURE

1. Practice session:
These tests were administered during the pharmacology practical hour in different batches of MBBS and Pharmacy program. The students were explained about the importance and relevance of these paper and pencil tests which objectively assess the psychomotor functions of an individual. It was made clear that these tests are not meant for assessing the memory or intelligence of a subject. Since, they are speed tests; the performance is influenced by the mental alertness, concentration and coordination abilities. These tests integrate different mental functions such as perception, recognition, integration and reaction to the assigned task. Steps involved in performing the tests were explained to the students, and one practice test session was organized to familiarize them with both the tests.

2. Informed consent:
All doubts regarding the test performance were clarified and a written consent was obtained from those who volunteered to take coffee and participate in subsequent sessions. Each batch consisted of 25 to 30 students. The study has been approved by the ethics committee.

3. Pre-coffee session:
The worksheets for SLCT were distributed and kept upside down. The students were asked to write their names on the back of the sheet. This was followed by the first bell indicating the beginning of the ‘working time’ which ended with a second bell after 90 seconds. The students were asked to start and stop immediately as the bell rang. The sheets were randomly exchanged among the students for peer evaluation and returned back. The net score was calculated as: Total attempted – Wrong attempts. The second test, DLST, was administered in a similar manner with a gap of 5 minutes. This completed the Pre-coffee session.

4. Post-Coffee session:
This was followed by the coffee break in which 200ml of standard coffee was served to the students within 5-10 minutes. They were free to interact with each other for next 20 minutes. The two tests were re-administered as before using Parallel work sheets (i.e. a different key was used in each session). This completed the post Coffee session.

5. Interpreting scores obtained:
The students were asked to record the scores of the two tests, under different conditions (practice, pre-coffee and post coffee) in their practical note-book and draw conclusions based on pharmacological explanation.

6. Students’ Feedback:
Towards the end, students’ feedback on the new experiment introduced was obtained using a 10 point questionnaire on five point scale (Strongly agree to strongly disagree). The response for each question was analyzed for further refinement of the practical.

RESULTS

In every batch, 4-6 students refused to participate for different reasons. The scores of all participating students in the 8 batches were combined to calculate the mean value for the three sessions (Practice, pre- and post-coffee session) (Table 1). There was no significant difference between the scores during practice session and pre-coffee session.
However, there was a 15-20% increase in the post-coffee scores which was statistically significant (p< 0.05; Student t-test) as compared to pre-coffee scores. The students gave a good feedback about the experiment as reflected by a mean score of 4.6±0.3 on a scale of 5.

Table 1: Mean scores of psychomotor tests during practice, Pre-coffee and post-coffee sessions

<table>
<thead>
<tr>
<th>Psychomotor Tests</th>
<th>Mean Test Scores (n= 200)</th>
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</thead>
<tbody>
<tr>
<td>Paper &amp; pencil Test</td>
<td>Practice session</td>
</tr>
<tr>
<td>SLCT</td>
<td>36±7</td>
</tr>
<tr>
<td>DLST</td>
<td>54±10</td>
</tr>
</tbody>
</table>

*P < 0.05

**DISCUSSION**

The test performance is affected by the motivation, understanding, interest, mood, environment, quality of worksheet, personality type, etc. and thus scores may vary for different groups and sub-groups. Moreover, the clear understanding of the principle and concepts of paper and pencil tests among the faculty is important to plan the experiment in an organized manner. There was a significant increase in the score of both the tests (SLCT, DLST) after coffee intake suggesting a stimulant effect of coffee enhancing psychomotor performance. However, one of the sources of variation in results was difference in quantity consumed by different students. Moreover, some students (12%) confessed that they lost interest by the third session due to repetitive nature of the test and did not perform at their best thus having little change in their scores. Interestingly, a small number of students (5%) had a lower score due to anxiety after coffee intake. This is a known side effect of coffee in certain individuals. Students (6%) who did not show an increase in score revealed that they frequently consumed coffee during the day and thus probably did not reflect the change.

The analysis revealed that the majority of the student found the experiment interesting and informative with active involvement. It helped to understand the approach for conducting and interpreting the results of an experiment. Moreover, they experienced how the mild stimulant effect of coffee can enhance their performance in psychomotor tests. This could probably motivate them to learn more about drugs and their effects. The experiment has been largely appreciated by the students in all batches. However, few students felt that the tests were too simple for their level and should have a certain degree of complexity to keep up their interest.

**CONCLUSION**

The experiment is simple and can be considered for incorporating in clinical pharmacology practical at the under-graduate level to demonstrate the drug effect in an interesting manner. It is recommended to first organize the session within the department involving the faculty to get the hands-on with the requirements, procedural details and the sequence of events for smooth implementation. The stimulant effect of coffee was observed by majority of the students as reflected by their increased performance in the psychomotor tests. However, the scores are influenced by the
experimental conditions and other confounding factors. The students found the experiment interesting and appreciated the approach to understand the drug effect.

REFERENCES