EXPERIMENTS ON THE RELATIONSHIP BETWEEN ANXIETY AND PSYCHOLOGICAL STRESS IN SERIAL ROTE LEARNING

KEIICHI GOTO AND YOSHIO SUGIYAMA

Sapporo Medical College

Recently, many studies on anxiety and psychological stress have been performed by Taylor, Spence and Lazarus, etc. (Taylor, 1958). Since Taylor developed a scale of anxiety named MAS (Manifest Anxiety-Scale) in 1953, the role of anxiety indicated by MAS in learning situation has been relatively clarified. Taylor and Spence (1954) have interpreted the role of anxiety by Hull's D formulation, and considered anxiety as a drive which influences human performances through its multiplicative relation to habit strength. They reported some evidences which indicate a certain positive correlation between the level of anxiety and the rate of eyelid conditioning. On the other hand, Deese and Lazarus (1953), and some other investigators found the negative role of anxiety in verbal learning.

The present study was designed to analyze these facts among the experimental results concerning the role of anxiety measured by MAS. Our theoretical basis for the experimental approach was placed on the following hypotheses. Firstly, it is assumed that the gross difference of MAS scores was assumed to reflect the difference of the chronic emotional states, so that the highly anxious group should show higher level of emotionality than less anxious group. Secondly, if the anxiety interacts with the some factors of the situation, highly anxious people would react more emotionally to the threatening situation and they would find it more difficult to perform superiorly than less anxious group. According to the second hypothesis, the level of difference between both groups should depend on the environmental conditions, such as presence or absence of some kinds of psychological stress in the experimental situation.

In many studies reported so far (Taylor, 1956), the function of stress was merely to increase the difference of drive level between both groups and thereby increase the difference of performance level between them. However, stress may have different effects upon the performance level of highly anxious group and less anxious group. In fact, Lucas (1952) indicated that the highly anxious group was more deteriorated in the performance of serial rote learning than the less anxious group when stress (failure report) and the intra-serial duplication were given.

Concerning stress factors in the environment, furthermore, we should take into account the factor of motivation, because there are personality differences which vary the degree of individual motivation among subjects. The following experiments were performed to see the interaction of the effects of anxiety, psychological stress and motivational instruction in the serial rote learning situations.

EXPERIMENT I

Experimental method

Design: A three-factor design was employed, involving two levels of psychological stress (failure-report and non-report), two levels of anxiety (high and low) and two levels of motivational instructions (high and low). Five subjects were placed into each of eight cells
Subjects: 297 female students in the third year grade of a high school in Sapporo City were tested in their classrooms by the modified form of Taylor's manifest anxiety scale. Twenty students scoring above 68 and twenty below 34 on the MAS were selected as the high anxiety group (HA) and the low anxiety group (LA), respectively. Score ranges of HA and LA corresponded to the upper and lower 7% of the MAS-score distribution of the whole tested students. At the beginning of the MAS testing, students were told that the test (questionnaire) was concerned with their health conditions. Subjects did not know that their selection for the learning experiments was based on their scores of the MAS test.

Materials: The practice list (List-A) contained 8 syllables association value which were derived at random from Glaze's (1928) list of English nonsense syllables, and the experimental lists (List-B) were 12 syllables selected randomly from the syllables of 0-6 percent association values of Umemoto's (1951) list of Japanese nonsense syllables. Each of these syllables was written in black ink on white card, 12 x 8 inches in size, so that subjects could read them easily from the distance of 10 yards.

Procedures: The next day after the MAS testing, the materials of nonsense-syllables were given to Ss selected by the testing. Using the anticipation method, the two series of syllable cards were presented to the whole group in one of their classrooms by experimenter's hands with 2 sec. exposure per card, 2 sec. intervals between cards, and 6 sec. intertrials-intervals. Accordingly one trial for a series of nonsense syllables needed 48 sec. Subjects were given 5 trials for the practical list after the preliminary instruction.

In the preliminary instruction, Ss were given the explanation about the method of response. Ss were asked to write down the next syllable during the presentation of preceding syllable. Following the practice session a rest period of about 5 minutes was inserted, and each of the high and low anxiety groups was divided into two subgroups which were nearly matched in their results of the practice session. They were called the high and low motivated groups, and were given high and low motivational instructions respectively. High motivated group (HM) was given the instruction that the test was a kind of learning ability test for high school students, and that Ss should pay their best effort to the test. Low motivated (LM) group was given the instruction that the test was attempted to know some characteristics of the association values between syllables, and that the importance of the test was not in the discovery of subject's performance level or effort but rather in the discovery of some uncovered characteristics of the list.

After the verbally given motivating instructions, all Ss received 15 trials of the experimental list. These trials were divided into three sections, five trials for each*. Between Sections 1 and 2, Ss in each group were randomly assigned to either of the two conditions of stress; one condition contained experimenter's verbal estimations of failure in spite of any result of subjects performance, and another consisted of neutral conversation about school life, both of which were given individually after finishing the 5th and 10th trials by one of four assistant experimenters. The failure estimation was almost similar to that of Lazarus et al., and as follows: “Miss——, you seem to be having trouble with the test. You did not reach the standard level of senior high school students. Is anything wrong? I can't understand what the matter is. You have been much worse than the other students who have worked on this test. In fact, your score is one of the lowest scores we've had.” The similar suggestions were repeated at the end of Section 2.

At the completion of experiment, Ss in failure stress group were released from their tension by telling them friendly that the test was not so serious, failure estimations were false, and it was one of the techniques to make people stressful in mental life.

* There was no inter-section rest except a short period for verbal suggestions.
Fig. 1. During the practice session, in which all Ss were given the same task and instruction, the differences between HA and LA groups were insignificant ($F=1.19$, $df=4/4$). This fact provided a basis for matching the eight subgroups in learning-ability of serial rote learning to isolate the effects of stress, and motivational instructions. In this sense, we could assume the original equality among subgroups, so far as subject's learning ability measured by incorrect responses was concerned.

Analysis of variance by nonparametric method (Wilson, 1956) was applied to the numbers of incorrect responses which were employed as the measure of learning process, for Section 1, 2, and 3. In order to determine the effects of anxiety and motivation in the early stage of learning, Section 1 was used. Section 2 was used to see the effects of anxiety, motivation and
stress and the interactions among them in
the middle stage of learning, and the Sec-
tion 3 was used to analyze the effect of
these conditions in the later stage. Table
1 A–C shows the comparisons of numbers
of incorrect response among groups. The
significant difference was found only in
motivational instruction in section 1 ($P < .01$). The highly motivated group
learned more rapidly than lowly motivated
group in this section, whereas the effect
of anxiety was not found significant.
In Section 2, as we see in Table 1 B,
the stressed group showed its inferiority
in performance to nonstressed group ($P < .01$), and there were also interaction
effects between stress and motivation.
The effect of anxiety was still insignificant
but its interaction with motivation was
significant. Both of these interaction ef-
fects disappeared at the last stage of learn-
ing. Stress-effect was found highly signifi-
cant ($P < .01$), and also interacted with
anxiety. Regarding anxiety-functioning,
it appeared that highly anxious Ss were
affected by failure-stress. The two groups
of high and low anxiety, who did not differ
significantly from each other in the earlier
stages of experiment, showed some differ-
cences in the later stage, that is, anxiety was
apt to interact with stress to make incorrect
responses.

**Experiment II**

**Subjects:** The high anxiety group consisting
of 8 Ss scored above 58 on the MAS and the
low anxiety group of 8 Ss scored below 26
were used; they corresponded to upper and
lower 13.7% of the anxiety distribution respec-
tively. Each group was divided into stress and
non-stress subgroups of 4 Ss each. All Ss were
selected from 58 female students in the first
year grade of the same high school.

**Procedures:** Experimental materials used
were the same as List-B of Experiment I. The
procedures were the same, except the following:
Twenty-five trials were prepared for learning,
and after 15th trial was completed the condi-
tion of stress-report was reversed, that is, Ss
who had received failure-estimation-reports on
the 5th and 10th trials were not given any fail-
ure estimation but success-estimations on their
learning on the 15th and 20th trials, and Ss who
previously had received no failure estimation
became to get failure-estimations.

**Results**

In this experiment, to analyze the effect
of failure-stress among anxious Ss, reversal-
technique was employed. Learning curve
for each group was shown in Fig. 2. As
Table 2
Analysis of variance of number of incorrect responses of Experiment II (by Wilson's non-parametric method)

A: Section 2

<table>
<thead>
<tr>
<th>Factors</th>
<th>$df$</th>
<th>$\chi^2$ value</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>1</td>
<td>1.88</td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>1</td>
<td>5.26*</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>A × S</td>
<td>1</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>3</td>
<td>7.16</td>
<td></td>
</tr>
</tbody>
</table>

B: Section 3

<table>
<thead>
<tr>
<th>Factors</th>
<th>$df$</th>
<th>$\chi^2$ value</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>1</td>
<td>2.20</td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>1</td>
<td>4.09*</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>A × S</td>
<td>1</td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>3</td>
<td>6.58</td>
<td></td>
</tr>
</tbody>
</table>

C: Section 4

<table>
<thead>
<tr>
<th>Factors</th>
<th>$df$</th>
<th>$\chi^2$ value</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>1</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>1</td>
<td>14.67*</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>A × S</td>
<td>1</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>3</td>
<td>15.43</td>
<td></td>
</tr>
</tbody>
</table>

D: Section 5

<table>
<thead>
<tr>
<th>Factors</th>
<th>$df$</th>
<th>$\chi^2$ value</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>1</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>1</td>
<td>42.91**</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>A × S</td>
<td>1</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>3</td>
<td>43.13</td>
<td></td>
</tr>
</tbody>
</table>

E: The whole sections

<table>
<thead>
<tr>
<th>Factors</th>
<th>$df$</th>
<th>$\chi^2$ value</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>1</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Stress (S)</td>
<td>1</td>
<td>44.74**</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Part (P)</td>
<td>1</td>
<td>211.79**</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>A × S</td>
<td>1</td>
<td>0.549</td>
<td></td>
</tr>
<tr>
<td>A × P</td>
<td>1</td>
<td>1.35</td>
<td></td>
</tr>
<tr>
<td>S × P</td>
<td>1</td>
<td>19.06**</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>A × S × P</td>
<td>1</td>
<td>2.04</td>
<td></td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>7</td>
<td>279.53</td>
<td></td>
</tr>
</tbody>
</table>

shown in Table 2 A–E, the effect of stress was found highly significant in every section of whole trials, but the difference between high and low anxiety groups was not significant.

One of the characteristics of the results is that after the stress was removed in the stress-reversal condition, the deteriorative effect of stress upon learning was gradually extinguished, and the learning came to improve. To find the effect of reversal and non-reversal, a comparison was done between two parts, trials before 15th and after 16th. According to the results of this analysis shown in Table 2 E, in addition to the effect of stress and the difference between the first part (Sections 1–3) and second part (Section 4 and 5), the interaction between stress and part was strongly significant ($P < .01$).

**DISCUSSION**

The results obtained in these two experiments were consistent with those by Lazarus, Sarason et al., but inconsistent with the drive hypothesis on MAS stated by Taylor and Spence. Findings on the anxiety factor measured by MAS in learning process were not given any satisfactory explanation by the Taylor and Spence's theory which were deduced from Hull's formulation to account for the clear relations between anxiety and the facilitation in classical conditioning or the detrimentation in complex learning. In our earlier study (1957), it was found that the effect of anxiety was related to the difficulty of task, and the easier the task was, the better was the performance of HA group.

However, the results of the present study show that in the interactive situation between anxiety and psychological stress, anxiety was related to learning process under the imposition of stress condition. Anxiety factor might be interfered by other variables which were influential in learning situation, and therefore it could be assumed that anxiety-functioning would be easier to be affected by some dominant cues in
the situation and the mode of anxiety state might be a floating reflection of Ss' emotional states.

In Experiment I, the high motivating instruction facilitated learning and the low motivating instruction deteriorated it. It might be considered that the high motivating instruction strengthened the associative factor of motivation-functioning, whereas the low motivating instruction left it unchanged. An interpretation of motivation was considered by Farber (1955). According to his assumption, the motivation involves the associative and non-associative functions; the former function is concerned with the reinforcement of goal oriented response in learning, and the latter is related to the reinforcement of general response tendencies including error responses. Following these postulations, the main effect of motivation found in Section I of Experiment I was considered as the associative function which affected the goal oriented response. The instruction given to the high motivated group emphasized that the test was related to one's intelligence, therefore the improvement of response in HM group could be considered to have more linear or directive relation with the goal oriented response than LM group. However this tendency would be weakened after the imposition of stress. The stress used in both experiments had stronger effect than any other variable in learning situation, and it might be interfered by subject's emotional state to inhibit the drive level.

These discussions would lead to the following conclusions:

1. MAS seems to measure an aspect of the emotionality which the individual person possesses, rather than the drive level as Taylor claims.

2. The measured aspect of emotionality represents the degree of sensitivity to the dominant cues in the situation, and this sensitivity would be varied with the structural modification of the situation.

3. The general effect of stress on learning is stronger than any other variable.

4. Another effect of stress seems to be a disruptive one which enhances the incorrect response for highly anxious Ss.

REFERENCES


(Received December 9, 1960)