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THE EFFECTS OF INDUCED ANXIETY ON THREE STAGES OF COGNITIVE PROCESSING IN COMPUTERIZED VOCABULARY LEARNING

Peter D. MacIntyre
University of Ottawa

R. C. Gardner
University of Western Ontario

Language anxiety is a prevalent phenomenon in second language learning. This experiment examines the arousal of anxiety caused by the introduction of a video camera at various points in a vocabulary learning task. Seventy-two students of 1st-year university French were randomly assigned to one of four groups: (a) one group who had anxiety aroused during their initial exposure to the stimuli, (b) a second group who had anxiety aroused when they began to learn the meanings of the words, (c) a third group who had anxiety aroused when they were asked to produce the French word (when prompted with the English), and (d) a control group who did not experience anxiety arousal. Significant increases in state anxiety were reported in all three groups when the video camera was introduced, and concomitant deficits in vocabulary acquisition were observed. It is concluded that the stage at which anxiety arises has implications for any remedial action taken to reduce the effects of language anxiety.

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Address correspondence to Peter MacIntyre, School of Psychology, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5.

Over the years there have been some contradictory conclusions reached about the role of anxiety in the learning of a second language (see Scovel, 1978). One explanation offered for this inconsistent pattern of results is the confusion caused by blending different perspectives on the nature of anxiety. In the literature on the role of anxiety in second language learning, three general approaches have been identified: trait, state, and situation-specific perspectives (MacIntyre & Gardner, 1989, 1991c). *Trait* anxiety refers to the stable predisposition to become anxious in a cross-section of situations (Spielberger, 1983). *State* anxiety is the transient, moment-to-moment experience of anxiety as an emotional reaction to the current situation (Cattell & Scheier, 1963). According to Spielberger (1983), trait anxiety refers to the probability of experiencing state anxiety. *Situation-specific* anxiety can be considered to be the probability of becoming anxious in a particular type of situation, such as during tests (labeled as "test anxiety"), when solving mathematics problems ("math anxiety"), or when speaking a second language ("language anxiety").

It is now evident that in order to obtain a consistent pattern of results, it is necessary to distinguish a specific type of anxiety, *language* anxiety, from other forms (MacIntyre & Gardner, 1991c). Horwitz, Horwitz, and Cope (1986) define language anxiety as "a distinct complex of self-perceptions, beliefs, feelings, and behaviors related to classroom language learning arising from the uniqueness of the language learning process" (p. 128). Consistent with Spielberger's (1983) framework, language anxiety can be seen as the probability of experiencing anxiety arousal in a second language context, such as in a language classroom or when communicating in the second language.

Empirical research has demonstrated that language anxiety is associated with deficits in listening comprehension, reduced word production, impaired vocabulary learning, lower grades in language courses, and lower scores on standardized tests (Horwitz & Young, 1991; MacIntyre & Gardner, 1991c). This anxiety is presumed to develop out of several negative experiences in second language contexts. After a number of anxiety-arousing experiences, the student may come to reliably associate the second language with apprehension or anxiety (MacIntyre & Gardner, 1989).

The effects of language anxiety can be explained with reference to the cognitive consequences of anxiety arousal (Eysenck, 1979; Schwarzer, 1986). When an individual becomes anxious in any setting, negative self-related cognition begins. Thoughts of failure (e.g., "I will never be able to finish this"), self-deprecation ("I am just no good at this"), and avoidance ("I wish this was over") begin to emerge. Once present, these thoughts consume cognitive resources that might otherwise be applied to the task at hand. This can create additional difficulties in cognitive processing because there are fewer resources available, possibly leading to failure, more negative cognitions that consume more resources, and so on. Language anxiety can pose a significant problem for the language learner because language learning is a fairly intense cognitive activity.

Tobias (1979, 1986) presents a model of the cognitive effects of anxiety on learning from instruction. In this model, learning is divided into three stages: input, processing, and output. The *input* stage consists of the individual's first exposure to a stimulus. If anxiety is aroused during the input stage, internal reactions may

distract the individual's attention, fewer stimuli may be encoded, and repeated exposure to the task may be necessary to overcome the effects of the anxiety. At the *processing* stage, incoming messages are understood and learning occurs as new words are given meaning. If anxiety is aroused at this stage, both second language comprehension and learning may suffer if the meaning of novel items is not recognized, either based on the learner's experience or in relation to similar native language items. Finally, during the *output* stage, second language material is produced in the form of either spoken or written messages. Anxiety arousal at this stage may lead to ineffective retrieval of vocabulary, inappropriate use of grammar rules, or an inability to respond at all.

Although these three stages of learning overlap, it is instructive to distinguish among them. The distinctions are especially useful in locating the source of performance problems that may be traced back to one of the earlier stages of learning. For example, a student may fail a test in a language course because anxiety interfered with the learning of vocabulary items and the student thus lacks sufficient knowledge to pass the test. However, a fully competent student may also fail the same test because anxiety arousal during testing interfered with the retrieval of vocabulary items that had been mastered. Placed in a more relaxed performance context, the performance of these two students would probably be very different.

Eysenck (1979) cautions researchers to consider the potential effects of anxiety on both the efficiency and effectiveness of cognitive processing, that is, to examine both the time required to complete a task and the quality of performance on the task. It is possible that anxiety will reduce the speed of cognitive operations but not their ultimate quality. For example, two students may obtain the same final grade in a language course but the more anxious student had to spend much more time studying to achieve the same level of performance. Previous research in the language area has suggested that anxious students study more yet achieve lower grades, reflecting the potential effects of anxiety on the input, processing, and output stages of language learning (Horwitz et al., 1986; Price, 1991).

The input and output portions of the Tobias (1986) model were tested by MacIntyre and Gardner (1991b). They measured performance at the input stage using a task that required memory for numbers read quickly from a tape recorder. The output stage was measured by the Thing Category vocabulary production test, wherein subjects generate as many appropriate vocabulary items as possible in a limited time. These measures were completed in both English (native language) and French (second language). Significant negative correlations were found between French language anxiety and performance on the French versions of the tasks at both the input and output stages. French language anxiety did not correlate significantly with performance on the English versions of the same tasks.[1] This suggests that language anxiety affects both second language production and the initial encoding of second language information.

As with many investigations of language anxiety, the effects of preexisting anxiety were examined in that study. However, the Tobias model specifies that anxiety aroused at a particular point in the learning process, that is, state anxiety, can influence learning at that stage and subsequent stages. Thus, it is meaningful to

consider the effects of anxiety arousal at various points in learning. Some research has been conducted in the area of second language that is relevant to this approach.

Steinberg and Horwitz (1986) induced anxiety in one group of subjects by treating them in an unfriendly manner and videotaping their performance in the second language. A second group of subjects was made to feel relaxed by having the experimenter treat them warmly and not videotape their production. The experimental task required the description of ambiguous scenes in the second language. Subjects in the anxiety group were found to be significantly less interpretive in their comments than the more relaxed subjects. Anxiety arousal appeared to reduce their willingness to risk providing an interpretation and possibly using less familiar linguistic structures (see also Kleinmann, 1977). Somewhat conflicting results were obtained in a study by Gardner, Day, and MacIntyre (1992). That study also made use of a video camera to arouse anxiety in one group of students. No difference in learning was found, however, between the group that was videotaped and the group that was not. Moreover, no significant differences in self-reported anxiety between the two groups were reported.

It is possible that the subjects in the Gardner et al. (1992) study were motivated by the video camera and were therefore able to compensate for the effects of anxiety arousal. Within the three-stage model, Tobias (1986) notes that increased effort can compensate for the negative effects of anxiety at any of the stages.[2] In general, however, the speed of second language interactions may be too fast to allow for such a recovery. Tobias also suggests that if an opportunity to compensate is not provided, anxiety arousal will influence all subsequent learning stages.

Two other discrepancies between the Steinberg and Horwitz (1986) and Gardner et al. (1992) studies should be noted. First, the anxiety levels may differ because of the differential treatment of subjects by the experimenter between the studies. Treating subjects coolly as opposed to warmly may arouse anxiety, decrease motivation, or both. A more likely possibility is that the demand to communicate orally led to the increased anxiety in the Steinberg and Horwitz study. MacIntyre and Gardner (1989, 1991a) stress that it is the communicative demands of the second language that arouse the most anxiety. The computerized learning task did not require communicative performance and therefore may not have aroused much anxiety.

The purpose of the present study is to test the effects of anxiety arousal on the three stages of learning described by Tobias (1986). The study was designed in the tradition of experimental psychology to test the effects of manipulating one variable (anxiety) on another variable (vocabulary acquisition). A laboratory-based study was chosen to gain control over extraneous factors present in language classrooms and permit the testing of specific hypotheses generated from Tobias's model. In this case, the hypothesis being tested is that anxiety arousal interferes with vocabulary learning and production. Our design will allow us to investigate the immediate effects of anxiety arousal at each of the three stages of learning (Tobias, 1986), to examine the effects of anxiety arousal during learning stages on subsequent use of the vocabulary items, and to track these effects over time.

A computerized learning task, similar to that used by Gardner et al. (1992), was employed wherein students were required to learn a series of correct English–

French noun pairs. A computerized learning program permits examination of the exact amount of time students require to learn the vocabulary items, a potentially important dimension in the Tobias model. In order to arouse anxiety, a video camera was used to record groups of subjects at different points during learning. Video cameras have been used successfully in previous studies to arouse anxiety (Cook, 1985; Cotton, Baron, & Borkovec, 1980; Plant & Ryan, 1985). In order to strengthen the effects of the anxiety manipulation, a communicative demand was introduced for all subjects prior to the vocabulary learning trials. Subjects were told, prior to exposure to the vocabulary items, that they would be required to use the new vocabulary later in the study.

METHOD

Subjects

Seventy-two subjects were recruited by telephone from class lists of 1st-year university French courses at a large university. Each participant was paid seven dollars ($7).

At the outset of the study, subjects were randomly assigned to one of four experimental groups. The video camera was introduced at different times to all but one group of subjects (control group). The other three groups were exposed to the camera prior to the input, processing, or output stage of learning, respectively. The introduction of the camera at a given stage was intended to arouse anxiety at that stage. The camera remained in position for the duration of the study and was not turned off until the final task had been completed.

Materials

The materials required for this study included a paired associates learning task, measures of state anxiety, and three other performance measures.

Learning Program. The initial portion of the study required subjects to learn 19 pairs of English–French nouns. This was accomplished by means of a computer program divided into three stages: Input, Processing, and Output. At the Input stage, subjects saw the set of French nouns that they were about to learn. At the Processing stage, these French nouns were paired with their English translations (*paired associates*) and shown to the subjects. At the Output stage, subjects were required to type the French noun when prompted with the English half of each pair. This stage allowed subjects to study the pairs in order to improve learning. The learning program will be described more fully in the Procedure section.

State Anxiety Measures. A single-item, visual analog measure of state anxiety, the *anxometer* (MacIntyre & Gardner, 1991b), was employed at several points during

the study as a measure of state anxiety. The anxometer was presented in two forms, a computerized version and a paper-and-pencil version.

The computerized anxometer was presented as a thermometer-style figure on the computer screen. Subjects could cause the anxiety level shown on the screen to rise or fall by pressing the up or down arrow key, respectively. This version of the anxometer has a range of scores from 0 to 16 and was presented five times during the course of the study.

The other version of the anxometer was presented on a sheet of paper with six thermometer-shaped figures, one corresponding to each of six experimental tasks that followed the paired associates learning task. Subjects saw each anxometer under a heading that indicated the task to which it referred. Following MacIntyre and Gardner (1991b), this version of the anxometer was presented using a 10-point scale.

Intervening Performance Tasks. The following three tasks were included in order to introduce a delay between the vocabulary learning program and later use of the new vocabulary; therefore, they will be referred to as *intervening tasks.*

Digit Span. The test administered in the current study was similar to that used by MacIntyre and Gardner (1991b) in which strings of single-digit numbers were read from a tape recorder. One set was presented in English and two sets were given in French. Subjects were required to write the numbers in the same order. The strings varied from six to nine digits in length, with two strings of digits at each level (i.e., there were two different strings of six digits, two strings of seven digits, etc.). The number of digits placed in their correct position in English and in French were counted separately. Prior to data analysis, the two scores on the French digit span were added together and divided by two to form a score comparable to that of the English digit span. This task requires the retention of items for only a brief period of time and does not involve the production of French. The numbers are not given meaning in the experiment and therefore almost no processing is required. Therefore, this task may be considered predominately dependent on the input stage.

Thing Category test. This test involves the naming of elements appropriate to a given category (MacIntyre & Gardner, 1991b). Three categories required French items (e.g., "things that belong in a suitcase"), and three categories required English responses (e.g., "things that belong in a refrigerator"). Subjects were given 1 min to write their responses for each category. The score for this test is based on the number of responses that correctly belong to the categories in each language. This task involves the spontaneous production of appropriate items and is therefore indicative of the output stage.

Self-Description. Subjects were asked to describe themselves for 1 min in both English and French. In order to facilitate similar descriptions in both languages, subjects completed the description first in English and then in French. For the French version, subjects were encouraged to repeat as many elements as possible of the English description. For all subjects, the self-descriptions were recorded on a cassette tape recorder. An independent judge, unaware of the hypotheses of the current study, determined the *length* of the self-descriptions by counting the number of statements produced by the subject in each language. The judge also rated the

self-descriptions along four dimensions using scales proposed by Young and Gardner (1990). These included ratings of *fluency* (the degree to which the subject spoke without interruption), *accent* (the degree to which the subject sounded like a native speaker of the language), *sentence complexity* (the degree to which the subject spoke in complete and complex sentences), and *depth* (the degree to which personal information was provided as opposed to superficial characteristics). This task involves spontaneous verbal production and therefore reflects the output stage.

Vocabulary Recall Task. In order to test for the recall of the vocabulary items learned on the computer, subjects were asked to respond orally to 19 French questions. A sample item follows:

Question: *Quand je veux me brosser les cheveux, qu'est-ce que j'utilise?*
"When I want to brush my hair, what do I use?"

Answer: *Un peigne.*
"A comb."

Each question could be appropriately answered with one of the French vocabulary items from the learning program, and subjects were instructed to use those items to generate the best possible responses.

Procedure

Before beginning the learning trials, all subjects were told that they would be asked "to use these words later on in the study." This was intended to introduce a demand to communicate that would be expected to arouse some anxiety in all subjects. Following this instruction, the Baseline computerized anxometer was completed and the learning trials began.

Learning Program. The learning trials were conducted using an IBM-compatible microcomputer. The program was written and compiled in QUICKBASIC using timing routines adapted from Graves and Bradley (1988), who have suggested that they approximate millisecond timing. The program presented 19 pairs of English–French nouns that have been used in previous studies (Gardner & MacIntyre, 1991; MacIntyre & Gardner, 1989). It has been shown that these pairs are largely unfamiliar to most subjects (Desrochers, 1980).

The learning program had three stages, intended to correspond to each of Tobias's (1986) three stages of learning. The anxometer was used to measure anxiety–arousal at each stage.

Input stage. The purpose of the Input stage was to provide subjects with their initial exposure to the French stimuli. After reading the instructions for the Input stage, subjects rated their current level of anxiety using the computerized anxometer (Input anxometer). They were then presented with 19 French nouns, one at a time, on the computer screen. Subjects viewed the French nouns for 1.5 s each. The order of the items was randomized making the sequence of each trial unique both within

and across subjects. Each of the items was presented two times, and all items appeared once before any were repeated.

Following this, subjects completed a recognition task. Thirty-eight items comprised the test, 19 of which had been presented and 19 of which had not. The prompt "Did you see this one?" appeared below each item. The subject responded by typing a "1" or "2" corresponding to "yes" or "no," respectively. The number of items that were presented and correctly recognized (Input score, maximum = 19) and the response latency were recorded by the computer.

Processing stage. The Processing stage involves learning the meaning of the French nouns. After reading the instructions for the Processing stage, subjects rated their current level of anxiety using the computerized anxometer (Processing anxometer). Following this, the 19 English–French equivalent pairs were presented at a fixed rate of one pair every 2.5 s, and the order of the pairs was unique (random) both within and across subjects. Two presentations of each pair were made, and none was repeated until all had been shown once.

This stage was followed by a recognition task. In addition to the 19 correct pairs, 19 other pairs were formed at random with the restriction that each of the items could be used as a distracter only once. Subjects were asked "Is this pair correct?" and responded by typing a "1" or "2" corresponding to "yes" or "no," respectively. The number of pairs presented that were correctly recognized (Processing score, maximum = 19) and their latencies were recorded by the computer.

Output stage. The Output stage involves the production of the second language. After reading the instructions for the Output stage, subjects rated their current level of anxiety using the computerized anxometer (Output anxometer). They were then given four trials. Within each trial, each of the 19 English nouns were presented at the top of the computer screen followed by the prompt "Translation?" A limit of 10 s was imposed, after which the program requested the translation. The computer scored each response, giving 1 point for a response that matched the stimulus and no points for a failure to match the stimulus. Subjects could choose not to attempt a response by pressing the return key, which also received a score of 0. No time limit was imposed on typing the responses. This stage is referred to as "Output" because the total number of correct responses generated over the four trials (Output score) is the primary variable of interest.

Following the subject's response, the correct pair was presented for study for up to 10 s. To move on to the next item, subjects pressed the return key. If the 10-s time limit was exceeded, the message "Too much time" appeared on the screen and the program proceeded to the next English stimulus. A total of four trials were presented.

Intervening Tasks. Before testing subjects' recall of the paired associates, the Digit Span, Thing Category, and Self-Description tasks were administered in that order. Following the self-descriptions, subjects were asked to complete the paper-and-pencil version of the anxometers corresponding to each of those tasks. The English and French versions of the tasks were rated separately yielding a total of six anxometer scores for the intervening tasks.

Vocabulary Recall Task. Following the intervening tasks, subjects were asked to respond to 19 questions using the vocabulary acquired from the learning program. The questions were presented by computer, and subjects were given a 20-s time limit in which to respond before the next question was presented. Subjects could choose to move on to the next question at any time by pressing the return key. The subjects' oral responses were recorded on a cassette tape. The responses were scored as follows: 2 points for a correct response given in an appropriate sentence, 1 point for an incorrect response (including failure to respond in sentence form), and no points if the subject failed to respond within 20 s. After the final question, a computerized anxometer was administered (Recall anxometer). The score for the responses to the questions can be considered an output variable.

Following this task subjects were thanked for their participation, paid the subject fee, asked to sign a receipt, and were given a feedback sheet describing the study. Subjects were encouraged to ask questions following the study and were provided with the names and phone numbers of the investigators. Finally, the scores on the computer tasks were displayed on the computer screen and were discussed with the subject.

RESULTS

The primary purpose of this study was to examine the effects of induced anxiety on the vocabulary learning trials and on the intervening tasks. The following analyses were performed in order to examine the effect of the camera on anxiety levels during the learning task and its subsequent effect on learning task performance and the ability to answer the vocabulary recall questions, as well as the effects of the camera on anxiety during the intervening tasks and subsequent performance on those tasks. Each of these analyses combines between-groups factors with repeated measures; therefore, data analysis was conducted with split plot analysis of variance (ANOVA) procedures. Split plot ANOVA is most appropriate when interest is directed toward the repeated measures factor and its interaction with a between-groups factor (Kirk, 1982).

Effects of the Camera on Anxiety Ratings During the Learning and Recall Tasks

A 4 × 5 split plot ANOVA was performed on the computerized anxometer scores taken during the learning program and the vocabulary recall task. The between-groups factor was experimental group (control, input, processing, and output groups), and the within-subjects factor was the phase when the anxometer rating was made (baseline, input, processing, output, and vocabulary recall anxometers).

Results show a significant effect for phase ($F(4, 272) = 37.91$, $p < .01$) and a significant Phase × Experimental Group interaction ($F(12, 272) = 2.84$, $p < .01$). The main effect for phase appears to result from significant increases in anxiety during the Vocabulary Recall task for all four groups. Planned comparisons (t tests) revealed that the final anxometer score, obtained following the responses to the

vocabulary recall questions, was significantly higher than the baseline anxometer score in each of the four groups ($t > 5.2$, $p < .01$ for all tests). These results indicate that responding to the questions was more anxiety provoking than the learning trials for all four groups. These results are consistent with previous studies (Horwitz et al., 1986; MacIntyre & Gardner, 1989, 1991a) that suggest that oral communication in the second language is especially anxiety provoking.

The Phase × Experimental Group interaction appears to be the result of significant increases in anxiety immediately following the introduction of the video camera in the three experimental groups (see Figure 1).

Newman-Keuls post hoc tests of means revealed no significant differences in the baseline anxometers of the four groups, indicating that each group had similar levels of anxiety at the outset of the experiment. Three planned comparisons (t tests) were performed to examine the elevation in anxiety immediately following the introduction of the camera as compared to the baseline trial. In all three experimental groups, t tests revealed that the anxiety level increased significantly when the camera was introduced ($t > 2.3$, $p < .05$ for all tests). For the control group, post hoc tests (Newman-Keuls) revealed no significant differences among the four mean anxometer scores taken during the learning program, excluding the Vocabulary Recall task ($q < 3.32$, $p > .05$ for all tests). The control group experienced a relatively constant level of anxiety throughout the paired associates learning program.

Taken together, these analyses indicate that the video camera had a significant effect on anxiety ratings during the learning trials. The camera was successful in arousing anxiety and is therefore expected to show an effect on the scores obtained during the learning trials.

Effects of the Camera on Learning and Recall

For the learning portion of the study, two types of dependent variables were recorded: performance scores and time measures. In order to examine the effects of the video camera on the performance scores, the Input score, Processing score, Output score, and the Vocabulary Recall score were entered into a one-way multivariate analysis of variance (MANOVA) to test for differences among the groups. The main effect for experimental group was significant at the multivariate level, (Pillais = .307, $F(12, 201) = 1.92$, $p < .05$). Univariate F tests reveal a significant effect for group on the processing score ($F(3, 68) = 3.40$, $p < .05$) and output score variables ($F(3, 68) = 2.74$, $p < .05$).

Figure 2 presents the data for all four of these measures. It was expected that the three groups who were not exposed to the camera at the Input stage (the control, processing, and output groups) would show similar means for the Input score and that these means would be higher than the mean for the group that was exposed to the camera (input group). The top left panel of Figure 2 indicates that this was, in fact, the obtained pattern of means; however, the corresponding univariate F ratio was not significant, $F(12, 146) = 1.89$, n.s.).

Similar predictions were made for the Processing stage score, shown in the top right panel of Figure 2. It was expected that the two groups who were exposed to

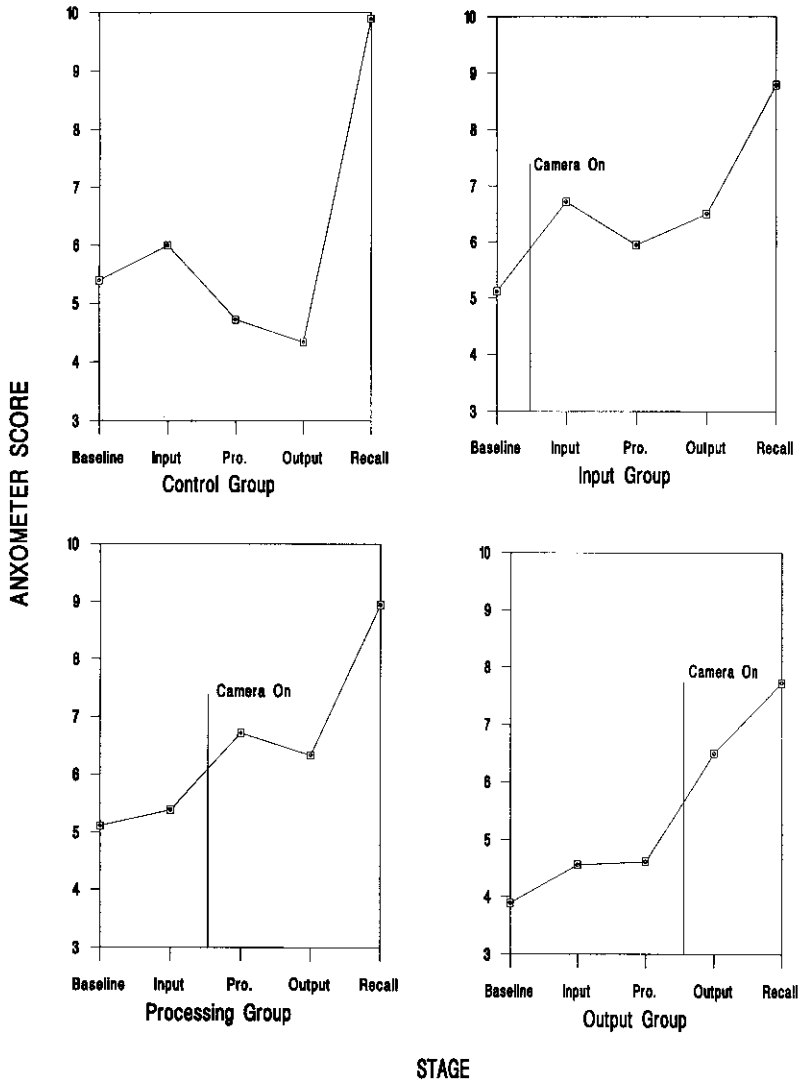

Figure 1. Anxometer scores obtained within each group during the learning and recall tasks. Pro = processing.

the camera at the Processing stage (the input and processing groups) would not perform as well as the two groups who were not exposed to the camera (control and output groups). The pattern for the Processing stage conforms to expectation, with the exception of the output group, whose score was expected to be more similar to that of the control group. However, the only significant contrast (Newman-Keuls) showed that the control group had significantly higher scores for this stage than the

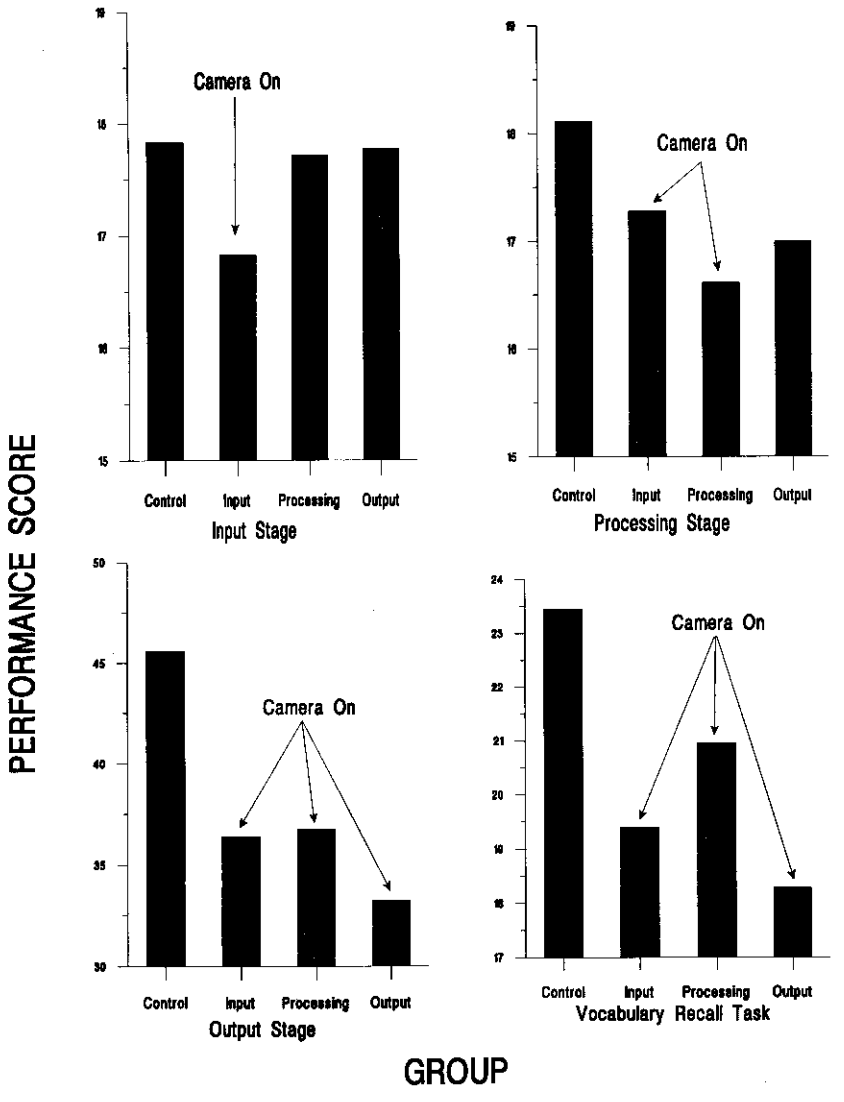

Figure 2. Performance scores for the three stages of the learning program and the recall task by group.

processing group ($q(4, 68) = 4.348$, $p < .05$). These results show that the deficit in recognition of the pairs is largest for the group that most recently had anxiety aroused.

For the Output stage score shown in the bottom left panel of Figure 2, it was expected that the means of all three groups exposed to the camera (input, processing, and output groups) would be less than the mean of the control group. The

observed pattern of means conforms to expectation.[3] Newman-Keuls tests revealed that the mean for the control group is significantly higher than the mean for the output group ($q(4, 68) = 3.86$, $p < .05$). The scores for the input and processing groups lie in the middle, and they are not significantly different from either of the other two groups. This may reflect the dissipation of anxiety for subjects in the input and processing groups because the camera had been on longer for them than for the output group. As with the two previous stages, the lowest score on this task is observed for the group most recently exposed to anxiety.

The scores for the Vocabulary Recall task were expected to be highest for the control group and somewhat lower for the other three groups because of the accumulated effects of anxiety. The expected pattern was observed. The control group showed the best performance on this task. A t test comparing the mean of the control group with the combined means of the other three groups was marginally significant ($t(70) = 1.96, p < .06$).

Considered in conjunction with the analysis of the anxometers, these results indicate that the presence of state anxiety reduced the effectiveness of cognitive processing at various stages of learning.

The other type of variable measured during the learning portion of the study was response time. In order to examine the effects of Group on the time taken to complete the Input, Processing, and Output stages of the learning program, a one-way MANOVA was performed. No significant effects for group were observed at the multivariate or univariate levels. This indicates that the four groups took similar amounts of time to complete the learning trials.

Effects of the Camera and Language of Presentation on the Anxiety Ratings During the Intervening Tasks

The anxiety reactions to each of the intervening tasks were analyzed using a 2 × 3 × 4 split plot MANOVA, with language (2) and task (3) as the within-subjects factors and experimental group (4) as the between-subjects factor. Significant main effects were observed for language ($F(1, 68) = 88.90$, $p < .01$), task ($F(2, 136) = 58.82$, $p < .01$), and the interaction of Language × Task ($F(2, 136) = 4.41$, $p < .05$).

It is clear that the English tasks are less anxiety provoking than the French ones and that tasks increase in anxiety from the Thing Category test to the Digit Span to the Self-Description (see Table 1). The interaction can be explained by noting that the difference between the ratings for the English and French versions of the Digit Span (1.9) is larger than for the English and French versions of the Thing Category test (1.6) and the smallest difference is observed for the English and French versions of the Self-Description task (1.1).

In the preceding analysis, none of the effects involving group was significant. The use of the video camera did not appear to influence these ratings; therefore, an effect for Group is not expected to emerge in the analyses involving performance on these tasks.

Table 1. Differences in anxometer ratings and scores for the intervening tasks by langauge

	Langauge of Task		
	English	French	*t* Value
Digit Span test			
Anxometer rating	3.0	4.9	8.98*
Score	42.5	34.7	8.03*
Thing Category test			
Anxometer rating	4.2	5.8	7.57*
Score	38.3	24.3	16.16*
Self-Description			
Anxometer rating	6.1	7.2	5.20*
Length	9.9	7.5	7.81*
Accent	6.4	4.3	15.12*
Fluency	6.3	4.4	13.30*
Sentence complexity	3.7	3.5	0.80
Depth	4.1	3.5	3.26*

*$p < .01$.

Effects of the Camera and Language of Presentation on the Intervening Tasks

A 2 × 4 split plot MANOVA was performed on the data obtained from the Digit Span test, Thing Category test, and Self-Description in both English and French. The within-subjects factor was language and the between-subjects factor was experimental group. It was expected that performance on all three tasks would be better in English than in French; therefore, an effect for language was anticipated in the following analysis. However, because similar levels of state anxiety were obtained in all four groups during these tasks, the scores on these tasks are not expected to differ among the four experimental groups.

A significant multivariate effect was observed for language (Pillais = .882, $F(7, 64) = 64.1$, $p < .01$). The effect of group and the Language × Group interaction were not significant. As can be observed in Table 1, scores on the English versions of all three tasks were significantly greater than the French versions and the ratings of speech quality were significantly higher for the English versions, with the exception of sentence complexity.

The results of these analyses have implications that are the mirror image of those emerging from the learning program data. In this case, the camera did not appear to arouse different levels of state anxiety in the groups and, therefore, no effects of group were obtained on the performance variables. Thus, when the camera induced state anxiety, performance declined for the group most recently exposed to anxiety arousal, and when the camera did not induce anxiety, no significant differences in performance were observed.

DISCUSSION

Several studies have demonstrated a correlation between language anxiety and performance in a second language (Horwitz & Young, 1991; MacIntyre & Gardner, 1991c). One explanation for these findings is that students who report experiencing language anxiety in the past are prone to experiencing state anxiety when exposed to a second language context. The arousal of state anxiety then interferes with ongoing cognitive activity, as suggested by the Tobias (1986) model. This interference reduces the ability to take in information, to learn new material, and to demonstrate that learning in terms of second language production.

The major purpose of this study was to investigate the effects of induced anxiety on performance at each of the three stages of learning. The results indicate that, in each experimental group, the highest anxiety rating was obtained immediately following introduction of the camera, and performance at each of the stages was found to be significantly reduced for the group of subjects who most recently had anxiety aroused.

On the other hand, the absence of an effect for the camera on the anxiety ratings during the intervening tasks (Digit Span, Thing Category test, and Self-Description) suggests that the subjects eventually were able to cope with the state anxiety aroused by the camera. The groups did not show differences in their levels of anxiety and they did not differ in performance either.

These results support the findings of both Steinberg and Horwitz (1986) and Gardner et al. (1992). In the former study, state anxiety was aroused in one group, and their performance suffered on a free speech task. In the latter study, state anxiety was not aroused and no performance deficits were observed on a vocabulary learning task. In the current study, state anxiety was aroused at different points in the paired associates learning program, but it had dissipated during the intervening tasks, leading to performance deficits on the paired associates but not on the intervening tasks.

Further implications about the effects of anxiety arousal may be drawn from this study. It is clear that the group that had not been exposed to anxiety–arousal, the control group, performed best at all stages of learning. It should be noted, however, that the students in this group experienced significantly more anxiety when responding orally to the questions in the Vocabulary Recall task than they had experienced earlier in the study. It is clear that the communicative task is much more anxiety provoking than is the learning task. The groups exposed to the video camera showed similar elevations in state anxiety during the Vocabulary Recall task, as well.

The results also support the suggestion that anxiety reduction alone will not fully compensate for the cognitive deficits created by anxiety arousal. In the literatures on both test anxiety and communication apprehension, debates have occurred over the efficacy of anxiety-reduction strategies versus skills training. The conclusion in both domains appears to be that anxiety reduction alone is not sufficient to ensure that the performance of anxious individuals will improve (McCroskey & Richmond, 1991; Sarason, 1986). This is consistent with both the theory of Tobias (1986) and the results of the present study.

In conclusion, it appears that anxiety arousal at earlier stages of processing will create cognitive deficits that can be overcome only when the individual has the opportunity to recover the missing material, that is, to return to the Input and/or Processing stages. Anxiety reduction alone might make a student feel better and improve the chances of future success, but it would not guarantee the recovery of material not previously learned. For this reason attempts to reduce language anxiety must be based on the assumption that anxious students will possess a relatively smaller knowledge base than relaxed students because of the cognitive effects of anxiety arousal at all three stages of language learning. Therefore, anxiety reduction strategies should be accompanied by efforts to re-input information that may be missing or improperly processed.

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NOTES

1. It should also be noted that forms of native-language anxiety, such as communication apprehension in English, were not related to performance in the second language.

2. If anxiety arousal leads to increased effort on a task that was relatively simple, it is possible for anxiety to facilitate performance. This effect has not been observed in the literature very often (MacIntyre & Gardner, 1991c; but see Kleinmann, 1977).

3. The Output stage allowed subjects to continue learning the vocabulary pairs. However, scores on the first trial of the Output stage represent the production of material learned at the Processing stage alone. A one-way ANOVA on these scores showed a significant effect for group ($F(3, 68) = 3.19$, $p < .05$). The means showed essentially the same pattern as for the Output score measure (8.22, 5.61, 6.06, and 5.22 for the control, input, processing, and output groups, respectively). Newman-Keuls tests showed that the mean of the control group was significantly higher than the other three groups, which did not differ among themselves.

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