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Anxiety, Diazepam and Retrieval from Semantic Memory

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Abstract. Diazepam, an anxiolytic, was administered to 16 undergraduate volunteers in a double-blind design. Eight subjects were selected to be high in State and Trait anxiety and were slow in recall on a semantic memory task compared to non-anxious subjects. Instead of alleviating this detrimental effect of anxiety on memory, diazepam slowed recall in both the anxious and non-anxious.

Key words: Diazepam – Anxiety – Semantic memory

Easterbrook (1959) suggested that the decline in efficiency of human performance in high anxiety and arousal is due to the use of only the most dominant cues in a task. Eysenck (1975) applied this idea to recall from semantic memory by suggesting that heightened arousal facilitates retrieval of words normally dominant in the lexicon. Dominance in the lexicon was assessed by Battig and Montague (1969) who recorded the frequency of usage of words in particular categories. Eysenck assumed that frequency of usage reflected dominance in the memory. He found loud noise, commonly supposed to be an arouser, did slow the recall of non-dominant items. But a high level of self reported activation facilitated recall of high dominance items. Eysenck concluded that arousal did affect the recall of items differing in dominance. Easterbrook suggested the cue utilization hypothesis in the context of anxiety, and recently Meuller et al. (1978) have proposed that highly anxious persons reduce the range of cues they utilize in the organisation of verbal material. They see the anxious person as highly aroused. Eysenck (1979) has, however, proposed that the reason the anxious do poorly in tests is that they are "worried", i.e. a process of irrelevant thoughts competes with the task's demands. Unlike arousal this competition is supposed to slow all responses, irrespective of their dominance.

Minor tranquillizers, such as diazepam, have long been successfully used as anxiolytics (Valzelli 1973). In experimental tasks they have had a general slowing effect on all responses (Adams 1974; Hart et al. 1976; Malpas 1972). But there have been reports of an improvement in the performance of the anxious using minor tranquillizers (Parrott and Hindmarsh 1978; Nakano et al. 1978), suggesting a specific anxiolytic action rather than a global slowing of responses.

The present study examined recall and recognition on a task similar to Eysenck's. It was hypothesized that the effects of anxiety on the task would distinguish between the interpretation of anxiety as arousal (Easterbrook 1959) and worry (Eysenck 1979). If diazepam is an anxiolytic then it should antagonise the effects of anxiety only, without affecting performance of the non-anxious.

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Materials and Methods

Subjects. Sixteen undergraduate students volunteered to take part in a double-blind procedure involving the administration in tablet form of 5 mg of diazepam and an identical-looking placebo tablet on two separate visits to the laboratory. Half of the subjects were high and half were low in anxiety. Subjects were selected from a larger population on the basis of the Spielberger state-trait anxiety scales. Students' raw scores on the State and on the Trait questionnaires (Spielberger et al. 1970) were standardized in accord with the norms. Eight subjects were then selected from the extreme high scores on both state and trait anxiety and a further eight from the extreme low scores on both scales. Half of each anxiety subgroup were females and half were males. The mean standardized trait and state scores of the highly anxious were 58.5 and 66.8 and those of the non-anxious were 41.6 and 45.8 respectively. Subjects' ages ranged from 18–38 years. No subjects were taking any other medication at the time of the experiment.

Drug Administration. The drug was administered orally, as was the placebo, 1 h before testing took place. Diazepam is rapidly absorbed, reaching peak plasma concentrations in 1 h. Subjects visited the laboratory twice. Half of the high anxious and half of the non-anxious received the active tablet on their first visit and the placebo on their second visit and vice versa for the remaining subjects. About 14 days elapsed between visits. During the interval between tablet administration and testing subjects went away to study whilst absorption took place. All subjects gave informed consent to the experiment, and were ignorant only of the order of administration of drug and placebo.

Procedure and Testing. Procedures followed those used by Eysenck (1975). The latency and accuracy of recalling and recognising common and uncommon instances of selected category names were measured under drug and placebo conditions in the high and low anxiety subjects. Subjects received different test material on each visit and this was counterbalanced across conditions.

In the task subjects received a total of 24 recall and 48 recognition trials. In recall a particular category name (e.g. "fruit") was followed by a particular letter-cue (e.g. "p") on

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Table 1. Mean response latencies (ms) for recall of words in each condition (Hi D = high dominance, Lo D = low dominance) and their standard deviations (SD)

	High anxiety				Low anxiety			
	Placebo		Diazepam		Placebo		Diazepam	
	Hi D	Lo D	Hi D	Lo D	Hi D	Lo D	Hi D	Lo D
$\bar{X}$	1,637.1	2,230.1	2,157.9	3,083.2	1,483.9	2,082.6	1,591.2	2,328.9
SD	19.5	31.98	47.3	45.7	25.5	22.1	8.9	33.9

Table 2. Mean response latencies (ms) for the recognition of words in each condition (Hi D = high dominance, Lo D = low dominance) and their standard deviations (SD)

	High anxiety				Low anxiety			
	Placebo		Diazepam		Placebo		Diazepam	
	Hi D	Lo D	Hi D	Lo D	Hi D	Lo D	Hi D	Lo D
$\bar{X}$	1,150.2	1,373.3	1,279.6	1,497.3	1,123.8	1,225.7	1,153.2	1,336.8
SD	12	15.3	13.8	18.1	12.9	14.2	15.6	16.9

the video terminal of a computer (VDU). They were asked to respond as rapidly as possible with an instance of the category name beginning with the letter. Subjects were given 24 recognition trials where the category name was followed by an instance of the category (e.g. fruit – pear) to which they were instructed to respond "yes". During recognition a further 24 distractor items were inserted, composed of instances not drawn from these categories, to which subjects were instructed to say "no". Half of the instances, from which the cues were drawn, were high and half low dominance in the Battig and Montague norms (1969).

In testing, each category name was displayed on the VDU for about 1 s then 3 s later either the first letter of an instance of the category or, in recognition, a complete word, was displayed for a further 1 s. Subjects had up to 15 s to reply, vocally, before the next category name came up. A tone warned the subject that another trial followed 1 s later. The subjects' vocal response was recorded by the computer. Testing took approximately 40 min.

Results

Latency and accuracy data were analyzed by ANOVAs for the factors of drug treatment, anxiety levels and word dominance for recall and recognition scores. There was a statistically significant effect of drug treatment in both recall $[F(1,14) = 10.4, P < 0.01]$, and in recognition $[F(1,14) = 7.1, P < 0.01]$. As Tables 1 and 2 show, diazepam slowed down both recall and recognition under conditions of both high and low dominance. As might be anticipated from the construction of the test, dominant instances were much more rapidly recalled and recognized than were non-dominant instances $[F(1, 14) = 20.8, P < 0.001$ and $F(1,14) = 32.1, P > 0.001$, respectively].

Results summarized in Tables 1 and 2 also show that there was a strong tendency for the highly anxious subjects to be slower than the non-anxious in both recall and recognition. The slowness on the part of the anxious was significant in recall $[F(1, 14) = 4.68, P < 0.05]$, but not in recognition.

Although it was hypothesized that the anxiolytic agent would antagonize the adverse effect of anxiety on recall latency, there was in fact a tendency for the drug to slow recall more in anxious than non-anxious subjects, the interaction being of borderline significance $[F(1,14) = 4.22, P > 0.05]$. The drug slowed recall of the dominant items significantly in the anxious $[F(1,14) = 5.2; P < 0.05]$, but not in the non-anxious. A similar pattern was also seen in recognition data. There is no evidence here for an anxiolytic action of diazepam upon the anxious subjects, despite the adverse effect of anxiety on their memory task.

Of primary interest in the study is whether anxiety has a different action upon instances of high and low dominance. If anxiety had effects similar to noise-induced arousal as reported by Eysenck (1975), then an interaction between anxiety and dominance would be expected. However, there was absolutely no evidence that this was the case here, in recall $[F(1, 14) = 0.35; P > 0.05]$ or in recognition $[F(1, 14) = 1.5; P > 0.05]$.

An analysis of error scores revealed that low dominance items were omitted more often than high dominance $[F(1, 14) = 6.15; P < 0.05]$. No trade off between speed and errors was found. Not only was latency of recall and recognition inferior in anxious subjects with diazepam, but so also was accuracy although average errors of commission (7%) and ommission (0.5%) were too infrequent to test statistically.

Discussion

Results of the present study show that the effect of anxiety has to be clearly distinguished from noise-induced arousal and activation, as reported by Eysenck (1975). Anxiety was indeed detrimental to memory, especially in the more difficult task of recall. Although exactly the same pattern was apparent in recognition performance, the absence of a significant differ-

ence in the score conforms to the pattern Eysenck found, i.e. similar results in recognition to recall, but of much smaller magnitude. However, no evidence of an interaction between dominance and anxiety is apparent in our data: the effect of anxiety was detrimental on both low and high dominance items. Thus the results do not support a cue-utilization model of anxiety. There is no evidence that anxiety biases subjects to sampling the more accessible parts of their memory first, as Eysenck (1975) proposed was the case in noise induced arousal. The data favour Eysenck's (1979) suggestion that worry, defined as irrelevant thoughts competing with task demands, is the major component of anxiety and has the effect of reducing working memory capacity.

Similarly, the effect of diazepam was to impair both recognition and recall, the magnitude of the effect being larger in recall than in recognition. The larger adverse effect of diazepam on high than on low anxiety subjects indicates a tendency to potentiate the adverse effect of anxiety. This result appears contradictory to the wide-spread belief in the anxiolytic action of diazepam. The failure to find such action in the present experiment distinguishes the effect of diazepam on memory from the studies referred to earlier in which interactions were found to occur between drug effects and anxiety.

Results of the present experiment suggest that both diazepam and anxiety hinder the accessibility of memory, but by different processes. Anxiety reduces the capacity of working memory by introducing irrelevant thought processes which slow down memory search. Diazepam interferes with the search by reducing the rate of all responses, as earlier studies have suggested. In this regard diazepam may have an effect on memory that is separate from its anxiolytic action, and in keeping with its pluralistic pharmacological action.

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