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EFFECTS OF TIME STRESS AND STIMULUS-RESPONSE SET SIZE ON THE EFFICIENCY OF DETECTION OF INVOLVEMENT WITH SUPPRESSED INFORMATION THROUGH THE USE OF THE FORCED NUMBER-GUESSING TECHNIQUE*

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Effects of time stress and limitation of stimulus and response set size on the detection of suppressed involvement with information through the forced number-guessing technique, were investigated. Variations in load do not affect the overall detection efficiency, but the mechanisms through which 'guilty' *S*s expose themselves are a function of the specific loading conditions applied. The results indicate that information suppression might be considered as an information processing paradigm.

1. Introduction

Lieblich and Ninio (1972) have reported that it is possible to detect the involvement of persons with suppressed numerical information through the use of a forced guessing technique. The basic experimental paradigm simulated a police interrogation of 2 subgroups of subjects (*S*s) one of which was given advance knowledge about a crime, such as the age of the victim, the hour at which the murder was committed, etc. ('guilty'), and another subgroup of *S*s who were given no such information ('non-guilty'). 'Guilty' *S*s were instructed to suppress any involvement with the critical information in their possession. During the simulated blind interrogation all the *S*s were asked to guess the critical numbers.

The results indicated that it was possible to detect the involved *S*s

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through the use, as a decision dimension, of the amount of correlation between the suppressed set and two-number-sets generated by *S*s during the interrogation.

The aim of the present set of studies was twofold: (a) to replicate constructively the earlier findings, (b) to investigate the effects of increasing time stress and the effects of the size of the stimulus-response ensemble on the detection efficiency.

These variables are known in general to be related to load in information processing tasks. Most relevant to the present paradigm are the studies of Baddeley (1962, 1966) who investigated the effects of time stress and number of alternatives on the degree of randomness of number and letter sequences generated by *S*s. Baddeley found that the redundancy of the sequences increased linearly with the rate of pacing (between 4 sec and 0.5 sec per item). In a free timing experiment the sequences produced were considerably more random than in a paced situation. Increasing the number of alternatives to be randomized decreased the rate of number generation, up to 16 alternatives. As Baddeley (1966) pointed out, it was difficult in his experiment to measure the effect of the number of alternatives on the randomness of the sequences.

It seemed to be of interest to clarify whether the variables operating in paradigms which are typically employed in information processing experiments, such as numbers generation, apply to a situation in which *S* has to *suppress* involvement with information.

The two experiments reported in this study in conjunction with the previous one (Lieblich and Ninio 1972), produce the framework in which the information processing characteristics of the task are explored.

2. General method

Except for the specific experimental variations, the procedure was identical to the one previously employed by Lieblich and Ninio.

3. Experiment 1: Effects of stimulus and response set size on detection efficiency

In the previous study (Lieblich and Ninio 1972), the feeling was expressed that the different natural ranges of the crime items contributed to: (1) the high Q correlations observed

both in the 'guilty' and 'non-guilty' groups between the crime profile and *S* generated profiles, and (2) to the differential amount of correlation between the crime profile and *S* generated profiles, which was the basis for correct classification of the two groups.

Experiment 1 was designed both to eliminate the differences in natural ranges of the crime items and to constrict considerably the size of the response vocabulary.

3.1. Subjects

Forty-one Hebrew University students served as *S*s. Twenty-two served as 'guilty' and 19 served as 'non-guilty' *S*s.

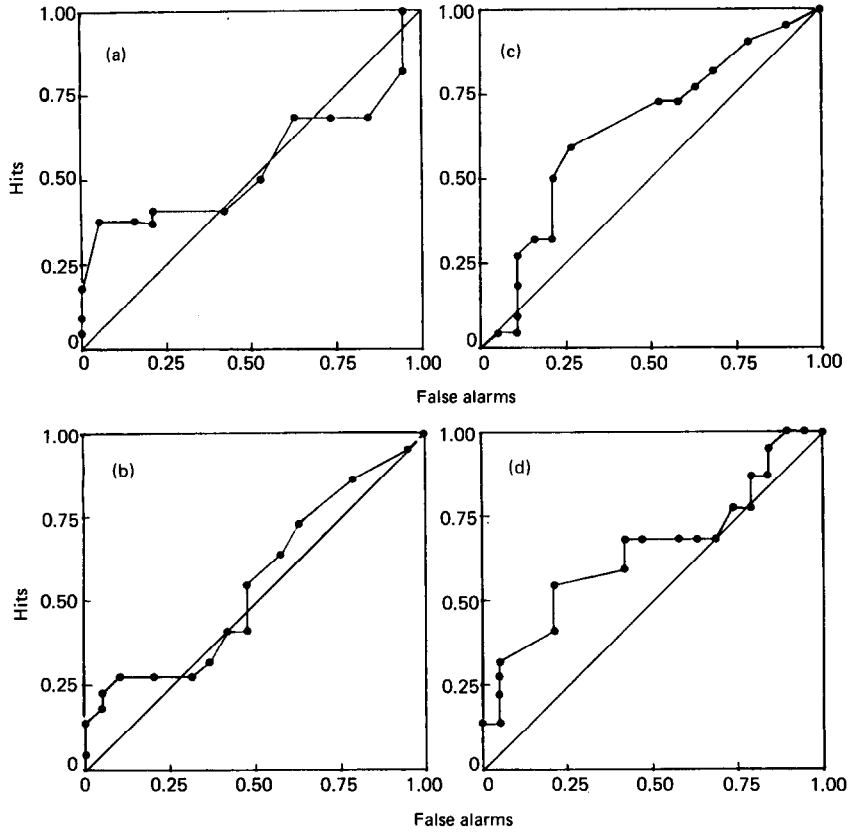

Fig. 1 Receiver operating characteristic curves for (A) Q correlation between the 'crime' profile and the profile generated in the first questioning (B) Q correlation between the profiles generated in the first and second questionings (C) between the 'crime' profile and the profile generated in the second questioning (D) the sums of these Q correlations.

3.2. Procedure

There were 2 departures from the procedure of Lieblich and Ninio (1972): (1) all items were restricted in their range to numbers in the range 1–30; (2) two new items, day of week and amount of money found in the victim's possession, were used in substitution of the items relating to the number of shots fired and the time at which the crime was committed. The six crime details used were: victim's wages per day: 22; number of house in which the crime was committed: 27; age of victim: 18; number of years in the country: 2; the amount of money in victim's possession: 23; day of month on which the crime was committed: 7. The numerical values of the items were randomly chosen. As in the previous experiment, the wages item was not used in the computation of the correlations.

4. Results

Three within-*S* correlation coefficients were computed between: (a) the actual crime profile and the data generated at the first questioning; (b) the actual crime profile and the second generated numbers; (c) the first and the second generated profiles.

Fig. 1 presents the ROC curves in which each of the above mentioned correlation coefficients and their arithmetic sum serves as the decision dimension.

As in the previous experiment, minus correlations were transformed into 1 plus their absolute value. While computing the ROC curves, the 'guilty' *S*s were supposed to exhibit higher values on the correlation dimension. Fig. 2 presents the ROC curve for the sum of the reaction times to the items in the first questioning. The 'guilty' *S*s were detected by having a *lower* sum of reaction times that the 'non guilty' *S*s.

The absolute distances of the *S*s' responses from the crime profile, as well as the variances of the different profiles generated, did not produce ROC curves with areas above 0.55, (0.50 being the non-discrimination value). This finding replicates the results obtained in the previous study.

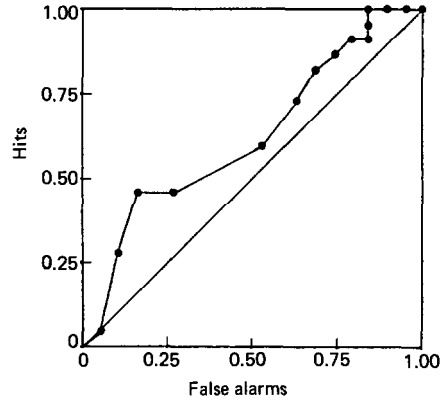

Fig. 2. ROC curve for the sum of the response time in the first questioning.

5. Discussion

Restricting the range of the stimulus and response set seems to reduce the number of high positive correlations both in the 'guilty' and 'non-guilty' *S*s (see table 1). This phenomenon is more pronounced in the 'guilty' group and thus cannot provide an efficient basis for discrimination between the two groups. On the other hand, the number of negative correlations continues to serve as an efficient detection dimension. Thus, in the present condition, the 'guilty' *S* may be able to control the second order resemblance between the suppressed profile and the actual profile by lowering the amount of correlation between the two. The over-zealous 'guilty' *S*s overshoot this control mechanism and produce negative correlations, that, even more than in Lieblich and Ninio (1972), are indicative of information suppression.

Restriction of the range also tended to free *S*s from the constraints put on their responses by the semantics of the crime items. For example, while in the Lieblich and Ninio (1972) study 0% of the 'guilty' *S*s and 2.5% of the 'non-guilty' *S*s produced 'time in country' estimates greater than the age of the victim, in the present experiment 23% of the 'guilty' *S*s and 16% of the 'non-guilty' *S*s produced such a logical contradiction. This contradiction appears even more dramatic given the fact that in the present experiment these questions were immediate neighbors while in the previous study they were separated by three items. Another example of this phenomenon is related to the fact that, in the present experiment, many *S*s tended to estimate the age of the victim as being very young, ignoring the fact that previously they had given an estimate of his income which was characteristic of an adult's income. This phenomenon was almost nonexistent in the Lieblich and Ninio study.

Table 1
Distribution of the Q correlation coefficient between the original crime profile and the first generated profile, in the two subgroups of Lieblich and Ninio (1972) and experiment 1.

Range of Q correlation coefficient	Lieblich & Ninio		Experiment 1	
	Guilty	Non-guilty	Guilty	Non-guilty
High positive ($0.70 < Q \leq 1.00$)	60%	47.5%	14%	29%
Low positive ($0.20 < Q \leq 0.70$)	20%	45.0%	40%	50%
Random ($-0.20 < Q \leq 0.20$)	10%	7.5%	28%	21%
negative ($-1.00 \leq Q \leq -0.20$)	10%	0%	18%	0%

It is of interest to note that the 'guilty' *S*s who produced either of the above mentioned inconsistencies were also mostly the ones that produced negative Q correlations between the emitted profile and the actual profile. Thus, it may be assumed that the restriction of the range of the items freed the *S*s from the need to appear consistent with the natural ranges of the items, and from the need to conform with the natural transitional probabilities between the values of the various items. The task, then, of suppressing information seems to be much easier under this condition. It seems that the strategy used in this experiment, especially by the 'guilty' *S*s, could be characterized by a tendency to randomize the numerical responses from the limited range provided by the experimental conditions. The artificiality of the limited range and the arbitrariness of the crime profile seemed to induce such a strategy. This assumption is consistent with the lower RTs obtained in this experiment as compared to the previous study. While in Lieblich and Ninio 1972 the mean sum RT for the first interrogation, across the six items, was 12.0 sec for the 'non-guilty' and 26.0 for the 'guilty' *S*s, in the present experiment the respective values are 7.0 and 5.0 sec.

The correlations between the two emitted profiles continued to serve as an efficient detection dimension. Inspection of these correlations revealed that restriction of stimuli ranges tended to attenuate the correlation coefficients of the 'non-guilty' *S*s, while those of the 'guilty' *S*s were not affected. This differential effect and the finding of the considerably more negative correlation mentioned above, in conjunction with the prevalence of logical inconsistencies, preclude the possibility that the attenuation of very high positive correlations is solely the result of a statistical restriction of the range effect. The above mentioned effects, taken together, strongly point to attempts of active suppression on behalf of the *S*s. The next experiment strengthens this point further.

6. Experiment 2: Effects of time stress and limited stimulus and response ranges on detection efficiency

This experiment explores the effects of time stress on the ability of *S*s to suppress involvement with numerical information. If the same variables as those known to operate in information processing tasks, of which time stress is an important one, operate in the suppression task too, than it could be expected that the detectability of *S*s suppressing information would be enhanced under time stress. It would seem that the cognitive task of the

'guilty' *S* is more difficult than that of the 'non-guilty' one, in the sense that the former has essentially two tasks to perform: (1) to produce numerical values, (2) to mask any relation to the crime profile. Therefore, time stress is expected to affect differentially the 'guilty' and 'non-guilty' *S*s.

7. Method

7.1. Subjects

Forty first-year Hebrew University students served as *S*s. Twenty served as 'guilty' and 20 as 'non-guilty' *S*s.

7.2. Procedure

The procedure was identical to that of experiment 1, except that *S*s were limited in their reaction time. *S*s were shown how a timer functioned and were told that a whistle would sound a short time (0.5 sec) after the *E* pressed a pushbutton. *S*s were told that the interrogator would press the button with the completion of each question and that *S* would have to reply at the sound of the whistle. Each *S* was given 5 practice trials in which he was asked simple arithmetical questions. The *S* had to provide the answers at the sound of the whistle. The *S*s were than interrogated in the same blind manner as in all the previous experiments. There were no sanctions for small deviations from the exact time interval.

7.3. Instruments

The time interval between the completion of the question and the whistle prompting *S* to answer was 0.5 sec (this was the modal RT in experiment 1). It was controlled by Massey–Dickenson modules. The pushbutton and whistle were Mallory made. The whistle was of 2000 cps for a duration of 100 msec.

8. Results

Once again three within-*S* correlations were computed in the same manner as in the previous experiments. Fig. 3 presents the ROC curves for each of the within-*S*s correlations and their arithmetic sums as the decision dimension. As previously, negative correlations were transformed into 1 plus their absolute value. In order to measure the effect of time stress on the detection in the different correlation ranges, the following procedure was employed: for each of the experiments the ratio of cumulative proportions of the 'guilty' *S*s vs. the 'non-guilty' *S*s was computed within each correlation interval of 0.1. This may be considered as a description efficiency for the different correlation ranges in a given experiment. In order to compare the relative detection efficiencies in each correlation range between the two experiments, the ratio of the above mentioned measures were computed. The values for the first interrogation appear in fig. 4.

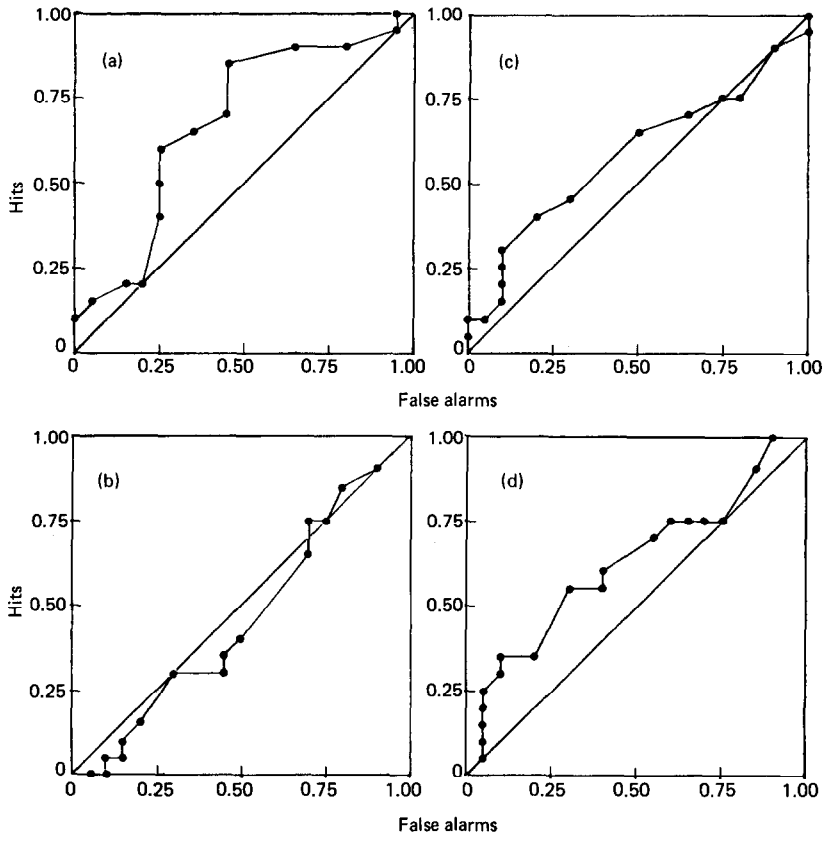

Fig. 3 ROC curves for (A) Q correlation between the 'crime' profile and the profile generated in the first questioning (B) Q correlation between the profiles generated in the first and second questionings (C) between the 'crime' profile and the profile generated in the second questioning (D) the sums of these Q correlations.

It is clear from fig. 4 that under time stress 'guilty' *S*s are detected more as a result of their producing larger *positive* Q correlations between the crime profile and the emitted profiles, while under free timing 'guilty' *S*s are detected more as a result of their producing a larger number of high *negative* correlations.

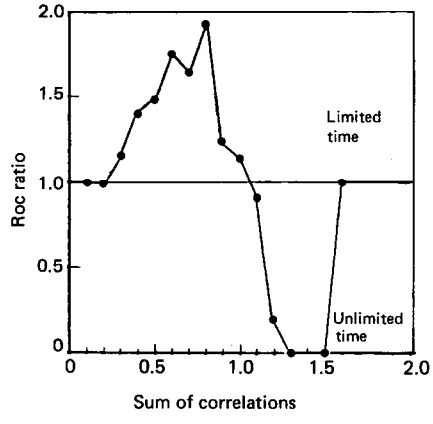

Fig. 4 ROC ratio for each sum-of-correlations category of two experimental conditions with and without time limitation.

9. Discussion

Lieblich and Ninio (1972) and the present experiments have shown that *S*s who suppressed numerical information can be detected through the forced-number guessing technique. In addition, analysis of the data produced by the 'guilty' *S*s, in comparison to those produced by the 'non-guilty' *S*s, indicated that their behavior is influenced by variables known to operate in information processing tasks. Thus, it is proposed that the task might be considered as an information processing paradigm.

In Lieblich and Ninio (1972) 'guilty' *S*s could be detected since they produced disproportionately more high positive and negative Q correlations. In the present studies, a differentiation was observed between these two correlation categories. While negative correlations seem to be directly influenced by the information load on *S*, there is no such obvious relation between load and a positive high correlation. Increasing the load either by increasing the range of alternatives (experiment 1 vs. Lieblich and Ninio) or by increasing time stress (experiment 2 vs. experiment 1) attenuates the efficiency of detection through the differential proportion of negative correlations. Positive Q correlations, on the other hand, are more efficient in the loading conditions (Lieblich and Ninio 1972; experiment 2). Thus it is possible that

Table 2
Areas under the roc curves of the different experiments and different decision dimensions (an area of 0.50 represents chance detection efficiency).
Q_{1C} = Correlation between crime profile and first emitted profile; Q_{2C} = Correlation between crime profile and second emitted profile; Q_{12} = Correlation of the emitted profiles; Q_{sum} = Sum of the above correlations. In all dimensions $-r = 1 + /r/$.

Experiment	Q correlation type	Q_{1C}	Q_{2C}	Q_{12}	Q_{sum}
Lieblich & Ninio (1972) Unlimited time and range		0.60	0.60	0.55	0.69
Experiment 1 Limited range, unlimited time		0.53	0.55	0.69	0.64
Experiment 11 Limited range and time		0.68	0.46	0.59	0.63

negative correlations represent controlled transformations, by 'guilty' *S*s, of the original data, while positive correlations appear as a consequence of the failure of *S* to avoid the original suppressed numerical factor. As table 2 shows, the overall detection efficiency is not influenced by the variation in loads, even though it is based on different mechanisms in each case. Under high load *S*s cannot avoid reproducing second order resemblances with the original profile. Under low load, the 'guilty' *S*s have enough capacity to apply a control mechanism, but an unstable one. Instead of producing zero correlations, or, even better, mimicking the behavior of an innocent *S*, the 'guilty' *S*s overshoot and produce negative correlations.

Thus, to appear innocent is an additional task which human *S*s are not very efficient in.

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