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AFTEREFFECTS OF NOISE PREDICTABILITY AND TASK LOAD ON MOTIVATION

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ABSTRACT

The main objective of the present study was to examine the influence of predictability and task load on motivation after noise exposure. Two levels of noise predictability factors; predictable/unpredictable noise were crossed with two levels of task difficulty. A specially prepared tape of the same conglomerate noise (76 dBA) as Glass & Singers [1], was used. After noise termination, persistence on insoluble embedded figures was taken as a measure of motivation. A total of 64 female and male students were assigned to one of these four conditions. The result showed that motivation following unpredictable noise was lower compared to predictable noise. Further, predictability, not annoyance and concentration, was the key element in linking noise to motivation. The motivation decrement was not dependent on task load during noise exposure.

1 - INTRODUCTION

Physical tiredness does not disappear at the same moment as people stop their work. Similarly, exhausted cognitive functions need some rest to recover. The research tradition of noise aftereffects, as indicated by Glass & Singer [1], address the issue about the importance of noise predictability for performance deficits after noise termination. Their work was influenced by the adaptive-cost theory, which postulates that the process to adapt to an unpredictable stressor implies a greater amount of adaptive effort, and therefore would impair motivation. They inhibited adaption in two experiments and concluded themselves, that even when adaption fails, the aftereffect was still present. Cohen [2, 3] proposed an alternative explanation model, cognitive fatigue hypothesis. This theory focus on increased demands on attention capacity caused by uncontrollable or unpredictable noise stressors. Less reserve capacity is therefore available for task after noise termination, and behavioral aftereffects reflects this cognitive fatigue. While Glass & Singer [1] started out to explain the aftereffect phenomenon in the individuals' attempt to adapt to the noise, Cohen [2, 3] goes one step further. He argues that the aftereffect phenomenon has to do with both the individuals' attempt to adapt to the stressor and how cognitively demanding tasks they have been working with during noise exposure.

It can be concluded from Evans [4] review article, about motivational consequences of exposure to noise, that no uniform picture exists concerning the importance of task demands on motivational aftereffects. The main aim of the present study was therefore to clear up this issue. Hence, a task that meets the criteria of high demands on cognitive capacity was therefore chosen for this experiment [5, 6]. Furthermore, the link between self-reported annoyance and concentration on motivational aftereffects was also examined.

2 - METHOD

2.1 - Participants and basic design

Sixty-four male and female students, aged from 18 to 20, were recruited from local upper secondary schools, and paid to participate. Equal numbers of males and females were randomly assigned to one of

four conditions: (a) predictable noise/easy task; (b) predictable noise/difficult tasks; (c) unpredictable noise/easy task; (d) unpredictable noise/difficult task.

2.2 - Procedure and materials

The experiment was conducted in a climate chamber (4 x 6 m) were physical variables such as heat (21°C) and light (900 lux) were controlled. The noise was played back through loudspeakers in front of the room. Two to six subjects stayed in the experimental room at the same time, but worked on the tasks individually. The experimental session consisted of two parts, first there was an inducing phase and after that the assessment of aftereffects took part.

Tasks during noise exposure: In the first part, two levels of task difficulty were used as inducing cognitive fatigue during noise exposure; Baddeley's [1] logical reasoning task without negations (easy) and with negations (difficult). The subjects worked with one of the two versions for 15 minutes.

Assesment of aftereffects: In the second part, under quiet, all subjects were given an aftereffect test (EFT). This task consisted of four pages with one figure on each page. At the top of the page, five simple figures were shown, and the subjects' task was to identify which one of the simple ones reappeared with the same size and orientation in the complex ones. Figure number one and three were insoluble and persistence on those figures was taken as an index of motivation. In addition, the subjects completed a questionnaire about annoyance and ability to concentrate on the task during noise exposure. Altogether, the experimental session lasted for approximately 40 minutes.

2.3 - Noise

The noise was played back from a specially prepared tape of the same noise as Glass & Singer [1] used. It consisted of a conglomerate noise of sounds superimposed upon one another; two people speaking Spanish, one person speaking Armenian, a mimeograph machine, a desk calculator and a typewriter. In the predictable conditions, the noise bursts were approximately 9 seconds in duration at the same place every minute over a 15-minute period. In the unpredictable condition the noise-bursts were random and the duration were 3, 6, 9, 12 or 15 seconds. Randomization was achieved by dividing each minute of the total noise period into quarter parts, and then randomly assign a burst to a different part in each 1-minute segment. The total amount of noise was identical on the two types of tapes, with a total exposure time of 135 seconds, 15 noise bursts and adjusted to yield 76 dBA at its maximum level.

3 - RESULTS

An analysis of variance (Software SPSS-X, MANOVA) was made with the factors task difficulty and predictability as between group factors. ANCOVA was also performed to control for annoyance and concentration.

3.1 - Motivation after noise termination

The mean time spent before the subjects gave up on the first insoluble figure as a function of predictability and task difficulty are shown in Figure 1. The analysis of variance indicated a significant main effect of predictability, $F(1,60)=14.52$, $p<.001$. This result confirmed the prediction that motivation after noise termination on the first insoluble figure would decline, following unpredictable noise compared to predictable noise. It was also predicted that working with Baddeley's [6] difficult task during unpredictable noise would induce more cognitive fatigue compared with working with the easy task. However, there was no interaction between predictability and task load on motivation after noise termination.

Questionnaire: After the experimental setting the subjects filled in a questionnaire about annoyance and ability to concentrate on the task during noise exposure, on rating scales from 0 (not at all) to 10 (enormously). The statistical analysis revealed no significant differences between the groups and mediating effects on motivation (all Fs < 1).

3.2 - Other results

Effects of noise exposure: Task load during noise exposure was also analyzed. The corresponding statistical analysis yielded a main effect of task difficulty, $F(1,60)=36.00$, $p<.001$, i.e., the mean number of correct answers were significantly higher for the easy task compared to the difficult task. Moreover, the results also revealed an interaction between task difficulty and the predictability factor, $F(1,60)=4.40$, $p<.05$. On the difficult task there was less correct answers during unpredictable noise, while the opposite was true for the easy task (see Figure 2).

4 - DISCUSSION

The main finding of this study was that motivation following unpredictable noise was significantly lower compared to predictable noise. This result replicates the stable finding [1, 2, 3, 4] that unpredictable

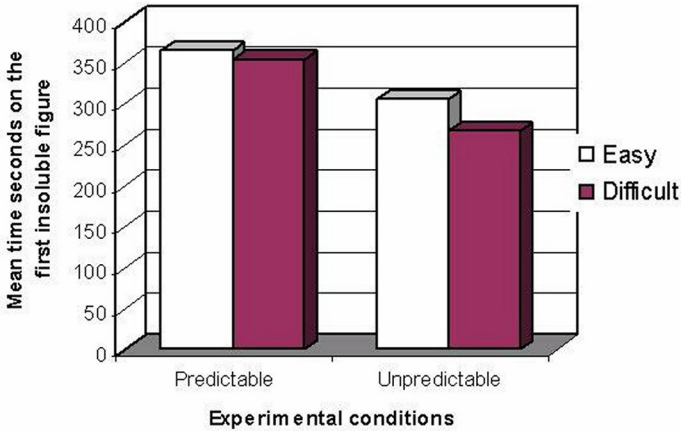

Figure 1: Mean time spent on the first insoluble figure as a function of predictability and task difficulty.

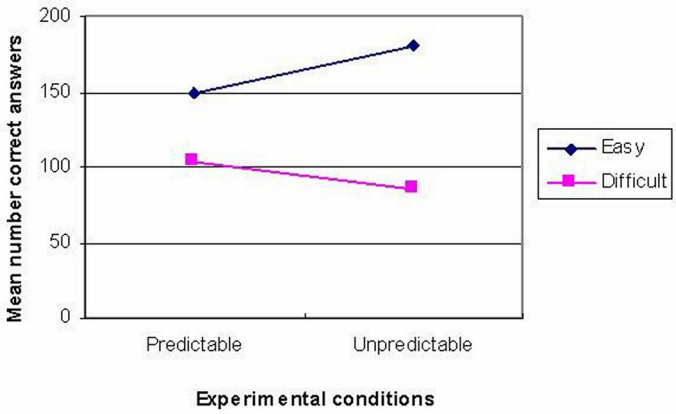

Figure 2: Mean number of correct answers as a function of predictability and task difficulty.

noise leads to motivation decrements. Moreover, annoyance and concentration, analyzed as covariates, did not change this effect. Accordingly, predictability, not annoyance and concentration, was the key element in linking noise to motivation.

Against prediction, there was no interaction between task difficulty and predictability on motivation. An explanation could be that subjects in the present study developed useful strategies to maintain attention with both the easy and difficult task during noise exposure, which lead to a successful result. According to Cohen's model [2, 3] the usual strategy to deal with overload is to focus available effort on inputs most relevant to the task. In the present study this assumption was supported, i.e., independently of task difficulty, subjects reported that noise affected their ability to concentrate on the task to the same extent. Subjects managed to keep their attention at an optimal level on the task, but the adaptation to unpredictable noise demanded attention and resulted in motivational decrements. Lack of control per se, may be a powerful threat stimulus in its own right, according to Cohen [7].

Further, Cohen [2, 3] suggests that cognitive fatigue accelerate when tasks are complex and performed under intense environmental conditions. However, the opposite is true for monotonic tasks, i.e. performance might improve during these conditions. The interaction between task difficulty and predictability in the present study support this explanation, i. e., the subjects' gave less correct answers during unpredictable noise on the difficult task, while the opposite was true for the easy task. Maybe there was too little pressure on the subjects on Baddeley's task, and the inputs to attend to were to few.

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