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VARIED AUDITORY STIMULATION, TEMPERAMENT DIFFERENCES AND VIGILANCE PERFORMANCE

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Three experiments are described which investigate the effects of varied auditory stimulation (VAS) on the visual vigilance performance of relatively introverted and relatively extraverted subjects and the preferences of these two groups for such stimulation. In Expt. I, 80 db VAS was found to be associated with a significantly lower commission error rate than was 50 db steady noise, but only in the case of the more extraverted subjects. VAS had no effect upon the detection rate, possibly because the task was too insensitive. In Expt. II a preference for VAS was found to a significantly greater extent among more extraverted subjects, while in Expt. III a preference for silence was found to a significantly greater extent among more introverted subjects.

In a previous study, Davies & Hockey (1966) found that the facilitating effect of high intensity white noise on visual vigilance performance was significantly greater for extraverts than for introverts; the Maudsley Personality Inventory or MPI (Eysenck, 1959) was used as a criterion of extraversion. This finding was interpreted in terms of differential levels of arousal, extraverts being thought of as chronically less highly aroused than introverts (Broadbent, 1963; Corcoran, 1965). There is evidence which suggests that, with increasing arousal, performance improves up to an optimal point and thereafter declines (Duffy, 1957, 1962; Malmo, 1959). Since noise is generally considered to raise the level of arousal (Broadbent, 1963; Davies, 1968), it was argued that the performance of subjects who enter the task situation at a low level of arousal should improve in noise to a greater extent than that of subjects who commence work at comparatively high arousal levels. It is reasonable to suppose that varied auditory stimulation (VAS) would exert similar effects on performance to those of intense white noise, since an increase in stimulus variety as well as in stimulus intensity can be thought of as arousing (Berlyne, 1960; Hebb, 1955). The first experiment to be described was designed to examine this possibility. Expt. I of the present study investigated the effects of VAS upon indices of vigilance performance, and sought to provide some evidence of the contribution of temperament differences to such effects. Expts. II and III were intended to examine the function of VAS for different temperament groups, and in particular to determine whether extraverts and introverts would differ systematically in their utilization of VAS when it was optionally available.

Experiment I

Method

Subjects. Twenty-eight university students (14 men, 14 women) served as subjects and were paid for their services. Subjects were tested individually; alternate subjects were assigned to each of the two experimental treatments, with the constraint that the two groups should contain

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equal numbers of men and women. There was no systematic difference in the time of day at which groups were tested.

Apparatus. The type of task used has been described in greater detail elsewhere (Davies & Hockey, 1966). It consisted of a series of digits from 1 to 9 inclusive, which appeared, one at a time, on a 30-in. closed-circuit television screen in quasi-random order. Each digit remained on the screen for $\frac{2}{3}$ sec. Subjects were instructed to look for signals, defined as three successive odd digits that were all different, for example, 597, 135.

Procedure. The task lasted for 40 min., during which time 24 signals were presented, six in each 10-min. sub-period. The temporal distribution of signals in each sub-period was the same. Testing took place in a sound-deadened room, with an experimenter's room adjacent. Subjects sat in a padded chair, whose height and position were adjustable. The head-rest of the chair was 4 ft. from the television screen. At the beginning of the experiment they were given a typed list of instructions, were shown a sample of the task with no signals and were questioned about whether they understood what constituted a signal, being asked to give examples. They were also asked to remove their watches and were told that the task would not last longer than one hour. Subjects reported the detection of signals by pressing a button fixed to an arm of the chair. This button was connected to a loud bell in the experimenter's room; the bell was also clearly audible to the subject. The task was continuously followed on a television monitor by two experimenters, who had transcriptions of the task on which the incidence of signals was marked. Both correct detections and commission errors—that is, pressing the button in the absence of a signal—were recorded manually in the experimenter's room.

In the control condition subjects performed the task in relative quiet, most—although not all—external noise being masked by an electric wall fan. The ambient noise level in this condition, as measured by a noise level meter, was 50 db. In the VAS condition a tape-recording of varied sounds was played continuously to subjects via the amplifier of the television set. The noise level in this condition was approximately 80 db. It is very unlikely that the difference in the intensity of stimulation would confound the effects of variety of stimulation since intensities below 90 db rarely, if ever, significantly affect performance. The tape-recording consisted of 80 × 30-sec. segments of music and speech taken from records and from radio and television broadcasts. There were approximately equal amounts of music and speech. Each segment of sound was separated from the next by 3 sec. of silence. At the conclusion of the experiment subjects completed the MPI and Part II of the Heron Inventory which gives an 'unsociability' score (Heron, 1956). The MPI E scale was taken as a criterion of extraversion, Heron Inventory scores being used chiefly to corroborate MPI scores. Those subjects in each group whose MPI E scale scores were above the median were designated 'extraverts' and those who fell below the median were designated 'introverts'.

Results

Non-parametric analyses were applied to the experimental data since they were not normally distributed. The mean number of correct detections made by the VAS group was 22·70, representing 95 per cent of the possible total, and by the control group 21·48, representing 89 per cent. The difference between the scores of the two groups is not significant (Mann–Whitney U test, two-tailed; $P > 0{\cdot}10$). The mean number of commission errors made by the VAS group was 2·20 and by the control group 4·77. This difference is significant (Mann–Whitney U test, two-tailed; $P < 0{\cdot}02$).

χ^2 analyses of decrement were made, following a procedure adopted by Bakan *et al.* (1963); decrement was indicated by a subject detecting fewer signals in periods 3 and 4 than in periods 1 and 2. However, no significant difference was found between the control group and the VAS group on this measure ($\chi^2 = 0{\cdot}18$; $P > 0{\cdot}50$). Thus the two groups do not differ in the amount of decrement shown. As far as commission errors are concerned, the number made by both groups showed a steady and significant decline with time on task (Wilcoxon T test; $P < 0{\cdot}01$ in each case).

In terms of the criterion for extraversion mentioned above, there were seven extraverts (mean E scale score 35·50, S.D. 5·12; mean N scale score 19·00, S.D. 10·84) and seven introverts (mean E scale score 16·14, S.D. 3·57; mean N scale score 27·28, S.D. 10·96) in each of the two groups. Extraverts made significantly fewer commission errors in the VAS condition than in the control condition (Mann–Whitney U test, two-tailed; $P < 0{\cdot}04$). Introverts, however, showed no such effect. No other comparisons between conditions were significant and no direct comparisons between introverts and extraverts, either in terms of mean performance levels or in terms of the amount of decrement shown, reached an acceptable level of significance.

Experiments II and III

Extraverts apparently prefer situations which are more 'stimulating' than those preferred by introverts (Weisen, cited by Eysenck, 1966). Zuckermann and his colleagues (cited by Cooper & Payne, 1967), employing a 'stimulus-seeking' questionnaire, have found that extraverts describe themselves as seeking stimulation more frequently and in greater amounts than do introverts. On the basis of this evidence and the 'stimulus hunger hypothesis' (Eysenck, 1967), it would be expected that given the opportunity extraverts would select segments of VAS more frequently, while introverts would prefer periods of silence.

One might expect temperament differences in the readiness with which subjects utilize the opportunity to modify the task situation, however, irrespective of the nature of the stimulation. To control for this possibility two 'choice' situations were devised, constituting Expts. II and III. In Expt. II subjects performed the task in quiet conditions but were able to request and obtain periods of VAS; in Expt. III they performed the task in VAS but were able to request and obtain periods of quiet.

Experiment II

Method

Subjects. In this experiment 28 university students (16 men, 12 women) acted as subjects and were paid for their services.

Apparatus and procedure. These were the same as in Expt. I, except that instead of the tape-recording being played either continuously or not at all, 30-sec. segments of the tape-recording were supplied on demand. Subjects were instructed that their main task was the detection of signals but that, if they wished, by pressing a button they could hear a 30-sec. segment of a tape-recording. The tape-recording was then described to them. It was stressed that the tape-recording was not part of the task, but was simply there for their use if they wanted it, and that pressing the button would give them 30 sec. of music or speech. At the conclusion of the experiment subjects were asked to complete the MPI and Part II of the Heron Inventory. Thirteen extraverts (mean E scale score 32·23, S.D. 6·18; mean N scale score 21·31, S.D. 9·37) and 15 introverts (mean E scale score 15·20, S.D. 8·13; mean N scale score 26·24, S.D. 7·54) were selected on the same basis as in Expt. I.

Results

Significantly more extraverts than introverts selected at least one segment of VAS ($\chi^2 = 4{\cdot}08$; $P < 0{\cdot}05$). The mean number of segments requested by introverts was 2·66 and by extraverts 5·14. However, no significant differences in the detection or commission error rates emerged, either overall or with time at work, although both

temperament groups showed significant declines in the number of commission errors from the first half of the task to the second (Wilcoxon T test, two-tailed; $P < 0{\cdot}05$ for introverts and $P < 0{\cdot}02$ for extraverts).

EXPERIMENT III

Method

Subjects. In this experiment 22 university students (11 men, 11 women) acted as subjects and were paid for their services.

Apparatus and procedure. These were the same as in Expt. II except that subjects were instructed that while they performed the task a tape-recording of varied sounds would be played to them and that if they wished they could obtain 30 sec. periods of silence by pressing a button.

Subjects were classified as introverts and extraverts on the same basis as in Expts. I and II, except that two subjects whose MPI scores fell at the median were classified as introverts because of their high unsociability scores on Part II of the Heron Inventory. There were thus 10 extraverts (mean E scale score 34·60, S.D. 8·45; mean N scale score 24·00, S.D. 7·11) and 12 introverts (mean E scale score 14·16, S.D. 4·55; mean N scale score 18·32, S.D. 6·12).

Results

Significantly more introverts requested that the tape-recording be turned off on at least one occasion; seven out of 12 introverts and one out of 10 extraverts made such a request (Fisher exact probability test; $P = 0{\cdot}048$). The mean numbers of such requests made by introverts was 5·67 and by extraverts 0·90. As in Expt. II, no significant differences in the detection or commission error rates were apparent, although once again both temperament groups showed significant declines in commission error rates from the first half of the task to the second (Wilcoxon T test, two-tailed; $P < 0{\cdot}05$ for introverts and $P < 0{\cdot}02$ for extraverts).

DISCUSSION

In the present experiments, the only performance measure affected by VAS was the commission error rate. One reason for this, as already indicated, is that the task was perhaps too easy, detection rates being uniformly high, and there was thus little room for VAS to exert a beneficial effect on the number of correct detections. This may also account for the absence of a vigilance decrement in the control condition of Expt. I. However, there is in any case no evidence from previous studies (McGrath, 1960; Poock & Wiener, 1966) that VAS ever abolishes the vigilance decrement. In this respect VAS differs from high-intensity white noise, which has been shown to prevent decrement in the detection rate, at least in extraverted subjects (Davies & Hockey, 1966). The respective effects of VAS and white noise upon individual differences in vigilance performance may therefore merit further investigation.

The results of Expts. II and III provide some support for the 'stimulus hunger' hypothesis (Eysenck, 1967) and the findings of Weisen (cited by Eysenck, 1966) and Zuckerman (cited by Cooper & Payne, 1967). Significantly more extraverts than introverts select VAS when given the opportunity to do so and significantly more introverts than extraverts select silence when presented with a background of VAS. The implications of the 'stimulus hunger' hypothesis for arousal theory and task performance remain to be further investigated.

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