Instruction effects on watch keeping in a "simple" vigilance task*

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Two experiments were conducted to determine the effect of variation in pretask instructions on performance on a simple vigilance task. In both experiments one group was told that the task would be challenging (Group C) and the other group, that the task would be monotonous (Group M). In Experiment 1 time-related decrements were found in the percentage of correct signal detections and in the number of incorrect responses. The results of Experiment 2 indicated time-related decrements, but no group differences, in percentage of correct detections. Group M also made progressively fewer false alarms, while false-alarm rates for Group C did not change over time. Differences in mechanisms underlying performance decrements are discussed.

In a recent study, Lucaccini, Freedy, and Lyman (1968) demonstrated that changing a single word in pretask instructions affects performance on a complex vigilance task, i.e., a task that requires considerable scanning of a multicomponent display. Ss who were told that the task would be challenging correctly detected a significantly greater proportion of signals than did Ss who were told that the task would be monotonous. Consistent with earlier studies using complex displays (Smith, Lucaccini, Groth, & Lyman, 1966; Smith & Lucaccini, 1969), Lucaccini et al did not find performance decrements over time. Effects of instructional condition on false-alarm rates were not analyzed, since these rates were very low.

The present research represented an attempt to extend the findings of Lucaccini et al (1968) to a situation involving a "simple" display in which performance decrements were expected to occur (e.g., Baker, Sipowicz, & Ware, 1961; Mackworth, 1950). The pretask instructions were similar to those used by Lucaccini et al. One group of Ss was told that the task would be challenging, while a second group was told that the task would be monotonous. Of interest was the effect of instructional condition upon overall performance and upon the amount of time-related performance change.

EXPERIMENT 1

Method

Apparatus and procedure. The display was a modified version of the Mackworth (1950) clock. It consisted of a 3-in.-diam white disk, which had a black pointer extending from its center to the edge. The pointer revolved in a counterclockwise direction at a rate of 1 rpm. At randomized

intervals ranging from 15 to 105 sec ($\bar{X}$ = 60 sec, s = 27.5 sec), the pointer stopped for 0.5 sec and then resumed its normal movement. The stop of the pointer constituted the signal. Mean intersignal intervals were approximately equal during successive blocks of trials.

Both E's control panel and the display were located in a room adjacent to a sound-attenuating chamber. The display faced a window in the chamber wall so that it could clearly be seen by S, who was inside the chamber. The remainder of the window was covered so that S could not view the control room. The S was kept in darkness; a fan provided air circulation and a masking noise. The S was seated in a classroom chair with armrest at a distance of 6.5 ft from the display, so that the center of the display was slightly below eye level and aligned with the median plane of his body. The S was instructed to press a hand-held, push-button switch as quickly as possible whenever the clock pointer stopped its movement. The instructions indicated that S was not to press the button unless he thought he had detected the signal.

Subjects and design. Twenty-two undergraduates received course credit for participating. The Ss were randomly assigned to one of two independent groups given different pretask instructions. The instructions and task were identical for both groups, except for a single word in the instructions: Ss in Group C were told that such tasks are usually considered to be challenging, while Ss in Group M were told that such tasks are usually considered to be

monotonous. The 38-min session was divided into nine blocks of four trials each, with two practice trials on which data were not recorded.

The two dependent variables of interest were percentage of correct detections and number of incorrect buttonpresses in each block of trials. It should be noted that the latter measure did not represent false-alarm rates as obtained in traditional signal-detection studies, since signals were not presented during explicitly demarcated intervals. Rather, this measure reflects only the number of buttonpresses during intersignal intervals.

Results

Table 1 gives the percentages of correct detections by both groups in each block of four trials. It can be seen that there was a time-related performance decrement ($\bar{r}^2$ = 3.62, df = 8,160, p < .01). Neither the group difference nor the Group by Trial Block interaction was significant.

Incorrect response rates for each block of trials are given in Table 2. There was a significant decrease in the number of incorrect responses over time (F = 3.65, df = 8,160, p < .01). Again the two groups did not differ significantly and there was no significant interaction.

EXPERIMENT 2

Contrary to the findings of Lucaccini et al (1968), the data of Experiment 1 failed to provide evidence of instruction-related performance differences. If, as these authors note, instructional differences affect Ss' motivation to perform on the vigilance task, then there is another dependent variable that might be affected, i.e., false-alarm rate. Signal detection research has shown a relation between assumed decision criteria, which are presumably affected by motivation level, and false-alarm rate. Mackworth (1962) and Mackworth and Taylor (1963) have shown concomitant decreases in hit rate and false-alarm rate in vigilance tasks. These data suggest that time-related performance decrements may in part be due to progressively increasing strictness in S's response criterion (Green & Swets, 1966).

Experiment 2 was conducted to determine the effects of instructional differences on both hit and false-alarm rates on a task similar to that of

Table 1
Percentage of Signals Detected, Experiment 1

Group	Trial Block									$\bar{X}$
	1	2	3	4	5	6	7	8	9	
C	79.5	63.6	79.5	68.2	63.6	68.2	59.1	59.1	45.4	65.1
M	84.1	81.1	72.7	70.4	59.1	54.5	59.1	54.5	59.1	66.1
$\bar{X}$	81.8	72.7	76.1	69.3	61.4	61.4	59.1	56.8	52.2	

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Table 2
Mean Number of Incorrect Presses, Experiment 1

Group	Trial Block									
	1	2	3	4	5	6	7	8	9	$\bar{X}$
C	4.1	4.0	3.3	2.5	1.2	1.9	2.2	1.2	1.1	2.4
M	3.6	3.2	2.3	1.8	2.0	3.0	2.6	1.9	2.2	2.5
$\bar{X}$	3.8	3.6	2.8	2.2	1.6	2.4	2.4	1.6	1.6	

Experiment 1, but with clearly demarcated intervals in which Ss were required to make a forced-choice decision regarding the presence or absence of a signal.

Method

Sixty undergraduate volunteers were randomly assigned to one of two independent groups of 30 Ss each, with the restriction that equal numbers of males and females were assigned to each group. The two groups, Group C and Group M received instructions that were identical save for the same one-word difference ("challenging" vs "monotonous") used in Experiment 1.

The apparatus and display were similar to those used in Experiment 1, except that signals (0.5-sec pauses of clock hand) were presented in intervals marked by 4-sec, 1,000-Hz tones of moderate intensity but clearly heard by all Ss. The tones were delivered through headphones worn by S. Signals were presented during half of these intervals. Times between tone onsets were randomized ($\bar{X} = 60$ sec) over 40 presentations. Ss were again required to press a hand-held switch if they thought they detected a signal while the tone was on. If no signal was seen, Ss did not press the switch. The experimental session was divided for purposes of analysis into two blocks of 20 trials each. Ten trials in each block contained signals.

Results

As in Experiment 1, there was a time-related performance decrement in percentage of correct detections ($F = 23.45$, $df = 1,58$, $p < .01$). Also consistent with Experiment 1 were the absence of both significant group differences and interaction (see Table 3).

False-alarm percentages for the two groups (see Table 3) did not differ significantly, nor was there a systematic overall change in percentage of false alarms as a function of time. There was, however, a significant interaction of instruction

condition and trial block ($F = 4.19$, $df = 1,58$, $p < .05$). Further analysis revealed that there was a significant time-related decrement in the percentage of false alarms for Group M ($F = 6.94$, $df = 1,29$, $p < .025$), while there was not a significant change in the percentage of false alarms for Group C ($F = 0.60$, $df = 1,29$, $p > .05$).

Of the 30 Ss in Group M, 20 showed time-related changes in false-alarm rate: 15 Ss made fewer false alarms in the second block of trials than in the first, while 5 Ss made more false alarms ($\chi^2 = 5.0$, $df = 1$, $p < .05$). Twenty-two Ss in Group C showed changes, with decrements in false-alarm rates for 9 Ss and increments for 13 Ss ($\chi^2 = 0.73$, $df = 1$, $p > .05$). A chi-square analysis of the direction of change in false-alarm rates (omitting Ss for whom rates were unchanged) for the two groups indicated that the two groups differed significantly ($\chi^2 = 4.97$, $df = 1$, $p < .05$).

DISCUSSION

The data of Experiment 1, as expected, show that correct detections decreased with increasing time spent in watch. In addition, the total number of incorrect buttonpresses also declined over time. The absence of instruction-related differences does not support the conclusion of Lucaccini et al (1968) that changing one word in the instructions affects vigilance performance.

Experiment 2, however, did show an instruction effect. This effect was not evident when hit rates were considered alone. However, when this measure is considered along with data on false-alarm rates, a possible mechanism for instruction effects is suggested. For Group C, the time-related decrement in percentage of hits was not accompanied by a reliable change in false-alarm rates, suggesting that, for Ss in this group, performance decrements may have been largely due to progressive changes in Ss' sensitivity (Green

Table 3
Percentages of Signals Detected and False Alarms, Experiment 2

Group	Correct Detections		False Alarms	
	Trial Block		Trial Block	
	1	2	1	2
C	96.0	85.3	7.2	8.4
M	95.3	85.0	8.7	6.2
$\bar{X}$	95.6	85.2	8.0	7.3

& Swets, 1966). For Group M, the systematic decrements in both hit rate and false-alarm rate are suggestive of either changing decision criteria re the presence of a signal (Mackworth, 1962; Mackworth & Taylor, 1963) or time-related changes in attention to the display (Jerison & Pickett, 1963). While additional research is necessary to determine which of these factors exerts the major influence on performance decrements, the present data suggest that performance decrements under different levels of task incentive may result from the influence of different mechanisms.

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