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US ARMY MEDICAL RESEARCH LABORATORY

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REPORT NO. 760

SOME PERSONALITY CORRELATES OF TREADMILL PERFORMANCE UNDER PUBLIC AND PRIVATE SURVEILLANCE

(Interim Report)

by
Captain David L. Kohfeld, MSC
George S. Harker, Ph. D.
and
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22 November 1967

UNITED STATES ARMY
MEDICAL RESEARCH AND DEVELOPMENT COMMAND

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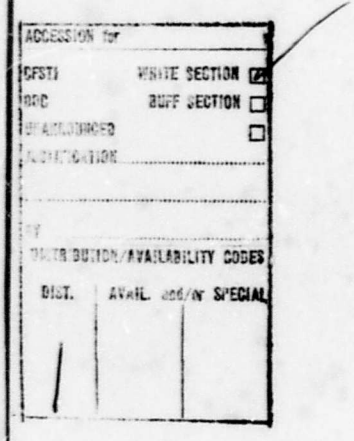

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ABSTRACT

SOME PERSONALITY CORRELATES OF TREADMILL PERFORMANCE UNDER PUBLIC AND PRIVATE SURVEILLANCE

OBJECTIVE

To study the role of personality factors in the expenditure of effort during heavy treadmill exercise.

METHOD

Three groups of 13, 14, and 20 soldiers served as subjects. Each man was instructed to walk as fast as he could for 10 minutes while under the surveillance of an audience, as compared to when he performed privately. The differences between subjects' audience and private performance were compared with their scores on the California Psychological Inventory.

SUMMARY

It was found that subjects walked faster when an audience was present than when they performed privately. The individual differences in work output between the two experimental conditions were found to be related to scores on some scales of the California Psychological Inventory.

CONCLUSIONS

A treadmill under the control of the walker can serve to generate sufficiently stable data to permit the psychological assessment of energy expenditure under different conditions of surveillance. Personality testing should be extended to include motor tasks where continuous and total involvement of the individual is a prerequisite.

TABLE OF CONTENTS

SOME PERSONALITY CORRELATES OF TREADMILL PERFORMANCE UNDER PUBLIC AND PRIVATE SURVEILLANCE

INTRODUCTION

A review of recent research on treadmill performance revealed a primary concern with physiological aspects of human energy expenditure. For example, Workman and Armstrong (9), Dill (1), and Kasch et al (6) have demonstrated that the oxygen consumption of S is directly related to his output on a treadmill (TM). Sharkey, McDonald, and Corbridge (8) have shown that pulse rate and pulmonary ventilation can serve as estimates of the energy requirements of TM performance. Clearly, the metabolic cost of TM walking can be ascertained by using appropriate physiological measures.

Although physiological TM research is of considerable importance in evaluating the metabolic consequences of exercise, TM walking may also prove useful as a dynamic task where subject factors such as motivation, cooperation, and task conformity may be examined. Indeed, the TM task was selected for the present research because TM performance requires continuous involvement of the entire body with the task. In order to facilitate this involvement, it seemed imperative that the standard, fixed-pace TM task employed by physiologists be modified so that S would be able to regulate his work output according to his judgment of the task requirements. One of the first steps in this direction was taken by Evans (2, 3) who developed a technique which required S to regulate his walking speed according to a titration schedule. That is, when S released a hand-switch, the TM belt accelerated at a constant, slow rate; depression of the switch produced a corresponding deceleration in speed. When S was instructed to walk as fast as he could, Evans found that the titration schedule forced the walker to make adjustments in his walking speed which were apparently consistent with his changing performance capacity. This process of repeated estimation on the part of Ss clearly implied that the TM could serve as a device with which to study the role of individual factors in performance decrement.

The purpose of the present research was to determine (1) whether a difference might exist between the TM performance of Ss working in front of an audience as compared to when they were performing privately, and (2) whether this difference would be related to personality differences of the S. The effect of an audience on performance was tested by comparing the walking speeds of Ss under both conditions of surveillance.

Based on Evans' work with a titration schedule, and on a subsequent study by Holmgren and Harker (5), it was anticipated that highly reliable measures of walking behavior would be obtained in a situation where the velocity of the TM was directly responsive to the walker. Secondly, in a manner analogous to that of predicting the energy cost of TM walking by means of anthropometric measures (9), the differences between Ss' audience and private TM performance were compared with their scores on the California Psychological Inventory (CPI).

METHOD

Subjects. Three consecutive groups of 13, 14, and 20 soldiers (average age = 20.3 yr.) served as Ss. The program of experimentation was such that the groups were assigned to the laboratory sequentially; thus, each group served in succession and interaction between groups was virtually impossible. All Ss had just completed basic training and were in good physical condition. Dress was standardized with regulation Army fatigue uniforms and combat boots worn during TM walking.

Apparatus. The variable-speed TM employed in this study was a modification of the one described elsewhere (2, 5). The mechanism which regulated TM velocity, and the equipment used to display and record S's walking speed were modified to give S more latitude in regulating his work output. Specifically, the TM drive consisted of a constant speed, 2 H.P. motor with an electromagnetic clutch; variations in the voltage applied to the clutch resulted in concomitant changes in TM velocity. The voltage was regulated by the interaction of two potentiometers, one controlled by E and the other by S. The full range for both potentiometers allowed TM velocity to vary from 0 - 8 m.p.h. With his control, E selected the 4 m.p.h. range of speeds over which S had continuous control. The shaft of the potentiometer under S's control was activated by a disc mounted at the rear of the TM. The 10 in. diameter disc was rotated by means of a counter-weighted cord extending from the circumference of the disc to a clip attached to S's belt. The pulley arrangement was such that as S moved forward on the TM, the potentiometer was rotated to accelerate the drive, whereas if he dropped back, the drive accelerated. The potentiometer was calibrated to provide continuous acceleration or deceleration at the rate of 0.17 m.p.h. per 1 in. of S movement. In order to allow for hip fluctuations intrinsic in walking, S's potentiometer was instrumented with a 3 in. dead zone before activation was possible. This precaution was taken in order to eliminate the jerking action (slight acceleration and deceleration of the TM with each step) which occurred when no dead zone was employed.

A continuous record of TM velocity was obtained by means of a tachometer-generator coupled with the TM drive wheel. Feedback of TM velocity was provided to S by a meter registering m.p.h., mounted at eye level. The voltage changes produced by the tachometer-generator were also fed into a voltage to frequency converter whose output was read every 30 sec. by an electronic counter calibrated to read in m.p.h. Finally, a recorder which operated at a paper speed of 4 in. per min. was calibrated to provide a continuous, graphic reproduction of S's walking speed.

Procedure. The same procedure was followed for all groups employed in the study. The first three days of TM walking were devoted to task familiarization. During this time, Ss were given at least 5 min. each day to practice accelerating and decelerating the TM, and to practice walking at various speeds, as indicated by the display meter. From the outset it was emphasized that at no time during the course of the experiment would running on the TM be permitted.

The following six working days involved Ss' walking for record. When S was performing with an audience, he was presented the following instructions:

> "This is a test to see how much you can put out for 10 minutes by walking just as fast as you can the whole 10 minutes. But since you must walk the full 10 minutes, your job is to gauge yourself so that you can last the whole time. In other words, I want you to walk just as close to your top speed as you can, but don't overdo it to the point where you have to stop before 10 minutes are up. Please do not look at your watch while you walk; just watch the black needle and try to keep it as high as you can--I'll stop you when 10 minutes are up. When I say 'ready' you step on the belt and I'll speed you up slowly until you're walking pretty fast. Then I'll say 'you're on your own' and you take it from there--I'll start scoring you then. Remember, you must go the full 10 minutes, and you must walk just as fast as you can the whole time."

During audience walking, at least six fellow Ss observed the walker as he performed. In addition, E conspicuously wrote down S's walking speed as the counter flashed it every 30 sec. Following the public session, all Ss' scores were posted where they could be read by anyone.

For private walking, the instructions read as follows:

"Since it is important that you stay in shape for this test, today I'm giving you a practice walk where I won't be scoring you. Like yesterday, watch the black needle and keep it as high as you can. Remember, you must go the full 10 minutes, and you must walk just as fast as you can the whole time. When I say 'ready' you step on the belt and I'll speed you up slowly until you're walking pretty fast. Then I'll say 'you're on your own' and the practice session is all yours."

During this session, unknown to S, the output of the electronic counter was fed into a printer which was completely hidden from Ss' view at all times. This allowed for a permanent record of S's walking speed to be taken while E sat idly either smoking a cigarette or reading a newspaper. Days 1, 3, and 5 involved audience walking, while days 2, 4, and 6 were devoted to private performance.

RESULTS

Effects of type of surveillance. Figure 1 depicts mean walking speed as a function of audience vs. private performance for Group I.

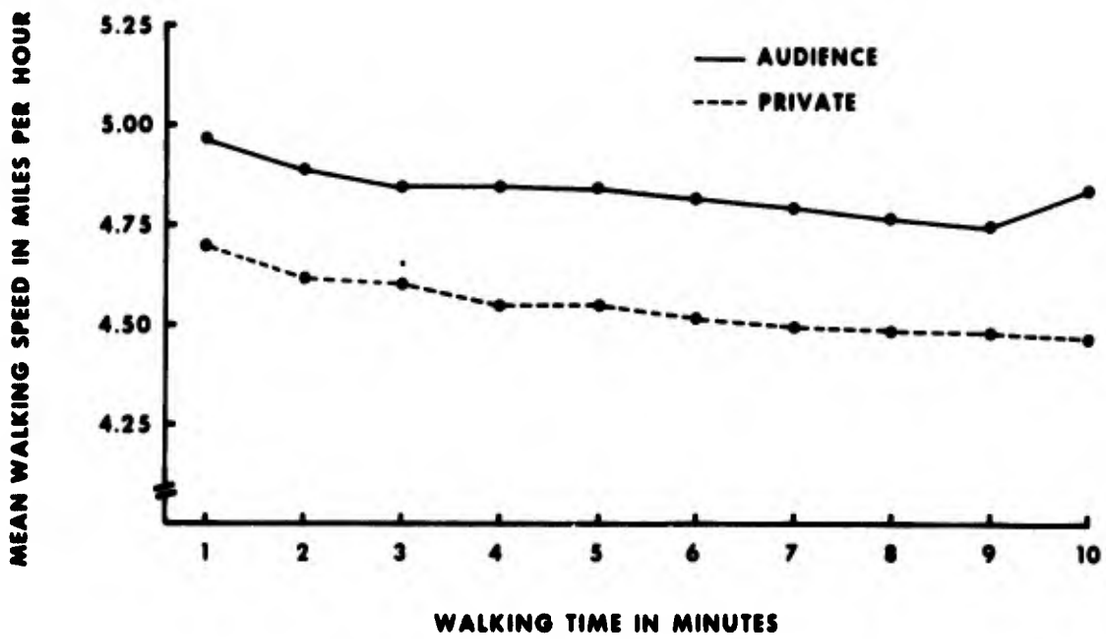

Fig. 1. Group I mean walking speed as a function of type of surveillance.

The points on the graph represent the means for minutes 1 - 10, averaged across Ss and the three sessions for each condition. It can be seen that the work output of the Ss was greater under the audience as opposed to the private condition. Supporting this conclusion were the results of a condition χ sessions χ minutes χ Ss analysis of variance which indicated two significant sources of variation: conditions, F (1, 12) = 18.29, $p < .005$; and conditions χ sessions, F (2, 24) = 6.49, $p < .01$. The lack of significant variation due to sessions ($F = 0.18$), as well as the significant conditions χ sessions interaction requires further elaboration. The upper left-hand panel of Figure 2 presents mean walking speed, averaged across Ss and minutes. The absence

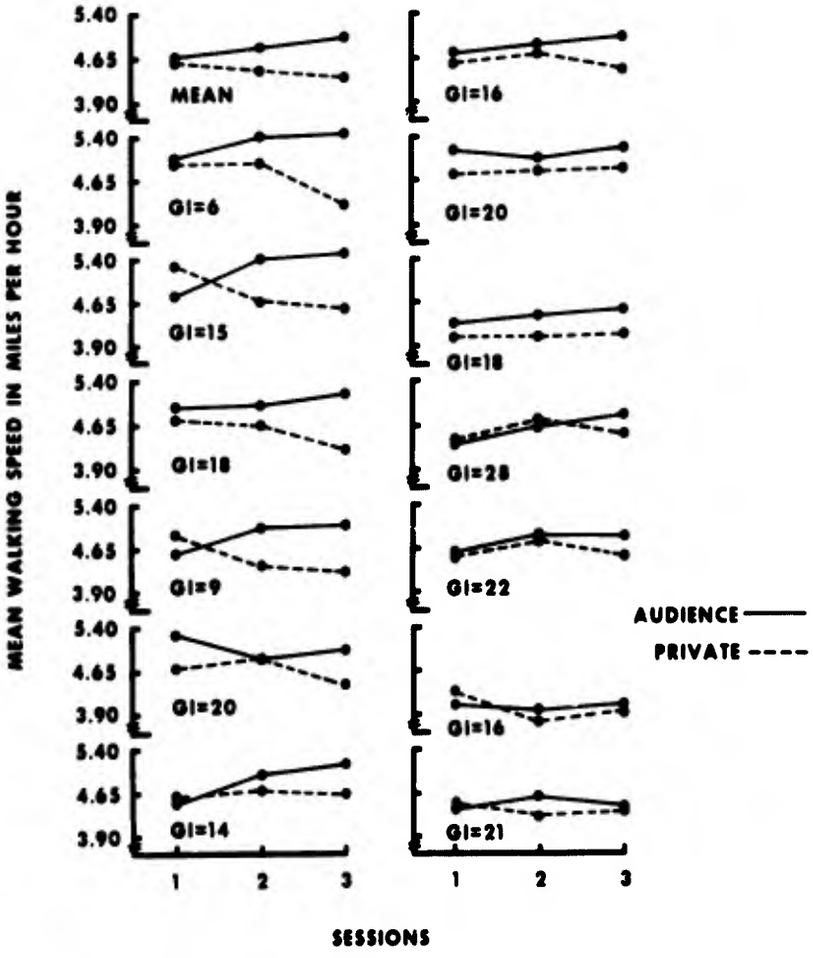

Fig. 2. Group I walking speeds over sessions as a function of type of surveillance. Gi scale scores are listed with each S's plot; the plots are ordered from most to least difference between audience and private walking.

of a sessions effect now becomes clear in that the Ss had a tendency to increase their audience walking speeds over sessions while showing a commensurate decrease in private performance. It is of interest to note that on session 1 the Ss put out the same under both audience and private conditions. This result is particularly rewarding, as it indicates that at the outset of the data-taking sessions the Ss were aware that the instructions called for a comparable amount of work under both conditions. In view of the meaningful conditions χ sessions effect, and since there was no evidence of any other interactions, it appears that the TM task can be successfully utilized as a tool for unconfounded measurement of the variables under study.

Group I correlational analysis. Figure 2 also presents the individual functions of conditions χ sessions, pooled over minutes, for each S in Group I. It can be seen that some of the Ss showed a relatively large discrepancy between their public and private performances on sessions 2 and 3 while other Ss displayed a more consistent output under both conditions. That is, there was a tendency for some Ss to give a progressively lax performance when only E was present, while other Ss were apparently more conscientious about the task requirements even though no audience was present and, presumably, no records taken. It was hypothesized that the magnitude of this discrepancy in performance was a function of the degree to which S displayed certain characteristics such as social responsiveness, cooperation, and dependability. Therefore, the difference between S's audience and private scores on sessions 2 and 3 was chosen as a criterion measure with which to compare his scores on personality scales. A test for the reliability of these difference scores, employing the odd-even method for the consecutive minutes in each session (7, p. 157), produced an r of .92.

Upon completion of TM testing each group was administered the CPI. Table 1 (next page) presents the rs of Ss' CPI scores with the TM criterion. Examination of the Group I correlations reveals a significant relationship between four scales (Gi, Ac, Ai, and Sc) and the criterion. Of particular interest was the relatively high relationship between the Good Impression scale and the criterion. Figure 2 presents the numerical Gi score of each S in Group I along with the graphic presentation of his TM performance. The correlations obtained from Group I looked very promising, however, in view of the small sample size, it was decided that more data should be collected before attempting to interpret the correlational findings.

TABLE 1

Correlations between California Psychological Inventory Scales and the Treadmill Performance Criterion for Three Independent Groups

CPI Scale	Group I (N = 13)	Group II (N = 14)	Group III (N = 20)
Good Impression (Gi)	-.78**	-.47*	-.46*
Responsibility (Re)	-.42	-.60**	-.52**
Achievement via Conformance (Ac)	-.48*	-.54*	-.25
Achievement via Independence (Ai)	-.47*	-.10	-.42*
Capacity for Status (Cs)	-.35	-.36	-.66**
Tolerance (To)	-.40	-.25	-.47*
Intellectual Efficiency (Ie)	-.29	-.28	-.40*
Dominance (Do)	.14	-.13	-.55**
Sociability (Sy)	.02	-.15	-.53**
Self-Control (Sc)	-.56*	-.09	-.15
Psychological-Mindedness (Py)	-.32	.12	-.45*
Flexibility (Fx)	-.22	.05	-.39*
Social Presence (Sp)	.10	.23	-.33
Self-Acceptance (Sa)	.16	.04	-.33
Sense of Well-Being (Wb)	-.18	-.06	-.21
Socialization (So)	-.22	-.24	-.19
Communality (Cm)	.28	.17	.14
Femininity (Fe)	-.02	-.19	-.12

*$p < .05$.

**$p < .01$.

Cross-validation: Groups II and III. The purpose of collecting data from Groups II and III was to cross-validate the Group I correlations between personality measures and performance; therefore, the result of primary concern was the relationship between CPI scores and the TM criterion. The reliability of the difference scores was .84 for Group II and .93 for Group III. Table 1 shows the correlation coefficients obtained from all three groups. Cross-validation procedures were evaluated by comparing the correlations for each CPI scale across groups. This was done by converting the rs to zs (7, pp. 139-140). If the three zs for any scale were significantly different from each other, the hypothesis of equivalent rs across groups was rejected. The CPI scales in Table 1 were arranged into three categories; four scales in category 1 (Gi, Re, Ac, and Ai), three scales in category 2 (Cs, To, and Ie), and the remaining scales in category 3. There were two requirements for inclusion in category 1: (a) the correlations among the three groups were not significantly different from each other, and (b) at least two of the three rs for each scale were significantly greater than zero. These requirements were satisfied by scales in category 2 with the exception that only one of three rs was significantly greater than zero. Correlations in category 3 were either different over groups or not significant in magnitude.

The results indicated that Ss who showed little or no discrepancy between audience and private TM performance had a corresponding tendency to score high on certain scales of the CPI. For the Gi scale, it can be said that Ss who were concerned about the social impression they made were inclined to put out equivalent amounts of work under both conditions of surveillance. This is consistent with the finding that "... subjects who score somewhat above average on Gi tend to be more cooperative, adaptable, and outgoing than those with lower scores. From the observational standpoint they do, in fact, tend to create more favorable impressions" (4, p. 19). Another finding of interest was the relationship between achievement motivation (Ac, Ai, and Ie) and the criterion. Apparently those Ss who placed a high value on achievement were inclined toward persistent TM performance, whether working for record or not. The correlation between Cs and the criterion suggests that Ss who walked equally fast under both conditions tended to possess certain attributes which lead to the achievement of status. Finally, as indicated by the Re and To scales, Ss who showed a willingness to put up with the TM task, whatever the instructions or method of surveillance, can be classified as conscientious, dependable, enterprising, and tolerant (4).

DISCUSSION

The primary finding of this research was that a TM under the control of the walker can serve to generate sufficiently stable data to permit the psychological assessment of energy expenditure under different conditions of surveillance. The correlations between seven CPI scales and TM performance for three independent samples provided evidence that the TM can be utilized as a device for studying the effect of personality variables on performance. Furthermore, the use of a walker-controlled TM permits one to examine an often overlooked aspect of performance; namely, the tendency of a man to interpret what a task requires, and then to conform in accordance with his view of the situational demands.

In view of possible use of TM walking as a means for evaluating personality attributes, there are several aspects of the present design which require comment. First of all, a preliminary study which utilized the present TM apparatus provided a valuable test of the effect of task structure on personality assessment. Although the early study employed the audience-private design, a reference marker was installed on the display meter and set at a reference level; S's instructions were to walk as close to this pace as he could for 10 min. The results revealed a significant difference between public and private performance, but this difference did not correlate with measures of personality. In retrospect, this negative result can be explained on the grounds that setting a reference pace for S structured the TM task according to anthropometric rather than psychological characteristics of the walker. It follows that studies which propose to obtain predictive power from personality scales should allow S as much latitude as possible in choosing his level of work output on the criterion task.

Secondly, some question remains as to the nature of the relationship between audience surveillance and work output. Since the CPI is designed primarily to assess personality characteristics important in socialization, it is tempting to conclude that individual differences in sociability played a large part in determining the correlations between CPI scales and the criterion. Indeed, most Ss worked harder under social pressure, as indicated by a post-test questionnaire, but this factor may have been confounded with that of Ss' disposition toward scored as opposed to "practice" performance. It will be interesting to see whether differences between practice and record TM walking will occur in the absence of an audience, and if so, whether personality measures can predict the discrepancy. Other aspects of the present design which remain to be explored are the difference between Ss' work output

and their report of that output, the role of team competition in energy expenditure of its members, and the effect of various group structures on performance. Whether or not quantitative procedures such as factor analysis and moderator variable analysis will be useful in clarifying predictive relationships is also a matter for future study.

In conclusion, the fact that a dynamic task such as heavy TM exercise correlates with responses to CPI items demonstrates that constructs such as cooperation, responsibility, and motivation can be operationally defined by motor as well as by verbal measures. Certainly, the TM offers a valuable tool for testing the validity of paper-and-pencil measures of personality attributes. Even more important is the implication that personality testing should be extended to include certain motor tasks where continuous and total involvement of the individual is a prerequisite.

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13. ABSTRACT

The role of subject factors in the expenditure of effort during treadmill exercise was tested by using a technique which gave S continuous control over his walking speed. It was found that Ss walked faster when an audience was present than when they performed privately. The individual differences in work output between the two experimental conditions were found to be related to scores on some scales of the California Psychological Inventory. (U)

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