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PERCEPTUAL RELATIONSHIPS TO PERIPHERAL VENOUS TONE*

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IN AN experiment performed a few years ago [1], which involved periodic drawings of venous blood from an indwelling cournand needle, it was observed that it was more difficult to withdraw venous blood (from a superficial arm vein) in Field Dependent (FD) than Field Independent (FI) *S*s.

A variety of other investigations have suggested that these two groups differ in the degree to which they are able to analyze discrete elements of a percept [2]. FD *S*s perceive globally, tend to make major errors in the Rod and Frame test, have difficulties in finding the hidden figure in the Embedded Figures test, and also perform poorly on a variety of other perceptual and sensory integrative tasks [3]. FI *S*s, at the other end of the population distribution, tend to perceive analytically and have much less difficulty with these tasks.

Indeed our previous investigations [4] have suggested that the poor perceptual organization of FD *S*s may lead them to the necessity of remaining more chronically aroused in order to cope with the uncertainty of their environment. In experiments where stimuli are absent or unclear, FD *S*s increase in arousal. Where stimuli are discrete, FD *S*s decrease in arousal. (As our colleague Bertram Cohen has suggested this might be likened to the increased alerting and tension an auto driver experiences as he drives through a fog. When the fog lifts, permitting the perception of clear stimuli, he relaxes).

The observation that venous blood samples were more difficult to collect from FD *S*s suggested the possibility that their veins were more constricted because of the above noted tendency to be more centrally aroused; i.e. that the hypothalamus and other autonomic centeis were in these *S*s, chronically discharging impulses along sympathetic vasoconstrictive fibers leading to constriction of the veins.

Thus, it was decided to measure venous pressure in isolated venous segments, and the prediction was made that during the initial rest periods (prior to any stimulus), venous pressures would be higher in FD than FI *S*s.

Our previous work [5] and that of others [6, 7] had suggested that when specific stimuli impinge, i.e. when "uncertainty" decreases, the psychophysiologic responses of FI *S*s are greater than those of FD *S*s. Thus it was also predicted that during periods of specific stimulation, the venous pressures of FI *S*s would be higher than FD *S*s; and that resting levels would be similarly affected, i.e. resting levels after stimulation would also show the above noted reversal, presumably because of the altered set, i.e. the decrease in uncertainty.

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Experimental design

A random sample of 200 male college students was given a perceptual test battery. Of this group, 64 *S*s were available to participate in the experiment for a small fee. 17 were FI (0°–1·9°), 35 were F. middle (2°–5·9°), and 12 were FD (6°+).

All venous pressure experiments were performed in a sound attenuated experimental room, comfortably lighted. Each *S* had taken part in previous psychophysiological experiments in the same room and was accustomed to the experimental team. An explanation of the procedure was read, and the following experiment performed in a doubly-blind manner.

S reclined on a hospital bed with left arm extended through a screen, placed on a table, level with the heart, at an angle of about 75° from the body. To screen outside noises and provide a constant sensory input, quiet music was played through fitted earphones. Venous pressures were measured by a technique previously published [8] with minor modifications.

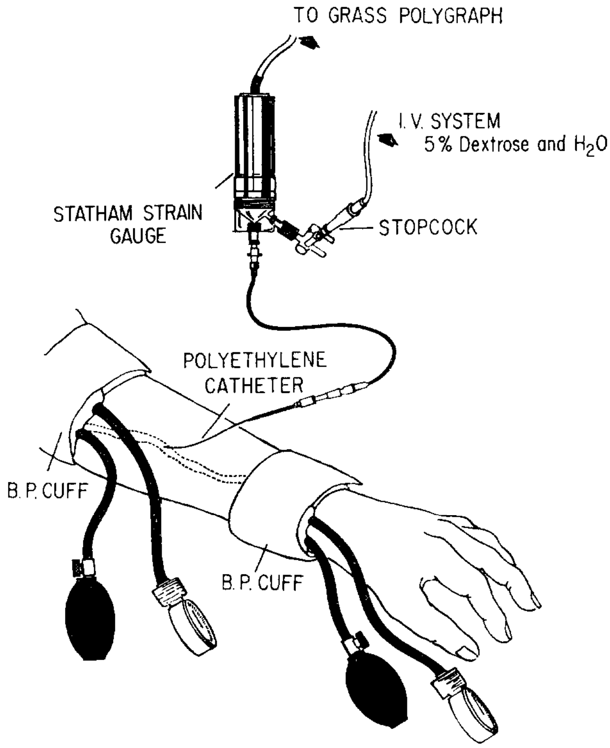

FIG. 1.—Venous pressure determination. A polyethylene catheter connected via strain gauge to a Grass PVII Polygraph, measures pressure in a venous segment, isolated above and below by B.P. cuffs inflated to 200 mg Hg.

A venipuncture site on a prominent vein on the dorsum of the mid-forearm was selected and anesthetized with a small intradermal injection of 2% lidocaine HCl. A 6 cm length of vein was selected with no apparent tributaries. Small (baby-sized) blood pressure cuffs were placed at the distal and proximal ends of the segment 6–8 cm 7 apart. A 20G polythene catheter was introduced into the segment through an 18G thin-walled needle which was then withdrawn around the catheter. The catheter thereby was left in place 1 cm into the vein segment. Venous pressures in cm of water were read directly through a sterile dextrose and water-filled system using a Statham Strain Guage, connected to a Grass PVII Polygraph.

The proximal cuff was first inflated to 200 mm of Hg and immediately thereafter the distal cuff was inflated to 200 mm of Hg. 10 sec were allowed for the system to stabilize; then venous pressures were measured for 1 min. The B.P. cuffs were then released; the distal first, followed by the proximal.

The stopcock was then opened on the Statham Gauge to flush the catheter and system with a 5% dextrose and water solution until the next venous pressure was determined, 5 min later.

After two control VP, each lasting 1 min, six more determinations were done under similar conditions, each following 30 sec of resting VP. Thus VP's were obtained as follows: (1) Rest—1 min. (2) Rest—1 min. (3) Rest—30 sec.; white noise—30 sec. (85db) (4) Rest—30 sec.; white noise—30 sec. (85db) (5) Rest—1 min. (6) Rest—30 sec.; Word—30 sec. (7) Rest—30 sec.; Word—30 sec. (8) Rest—30 sec.; Arithmetic—30 sec.

(*Note:* An initial series of $n = 22$ was performed with rest and white noise only. This was followed by a series of $N = 42$ which also included words and arithmetic. Thus, for VP's 1–4, $n = 64$ (FI = 17; M = 34; FD = 12). For VP's 5–8, $n = 42$ (FI = 9; M = 24; FD = 9).

One of the words presented was "charged" (shit), the other "neutral" (bread). Half the *S*s heard the "charged" word first, the neutral word second. This order was reversed for the remaining half of the *S*s. The arithmetic problem was moderately difficult but verbally solvable (e.g. 12 × 9–15).

RESULTS

(A) *Resting venous pressures*

Mean venous pressures during the first three resting determinations (i.e. prior to any specific external stimulation) are shown in Fig. 2. FD *S*s, as predicted, reveal higher venous pressures than FI *S*s. Furthermore, venous pressures of FD *S*s seem to increase with time, while those of FI *S*s decrease with time. Middle *S*s' responses are similar to those of FI *S*s and reveal no apparent change from the first to third determinations.

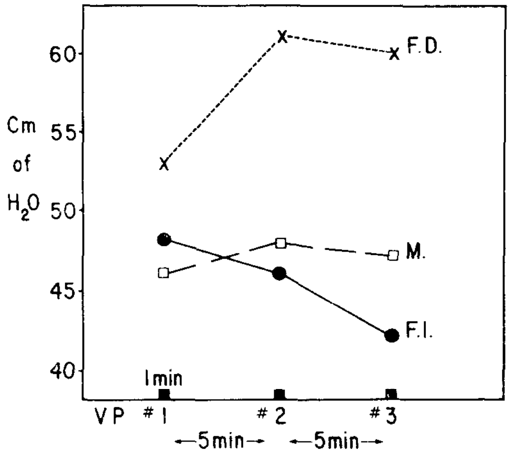

FIG. 2.—Initial resting venous pressure. Three initial resting determinations reveal progressive separation of FI and FD *S*s' responsivity during the second and third V.P. determinations. Middle *S*s are also significantly different from FD *S*s during all three determinations. ($n = 64$; FI = 17, M = 34, FD = 12)

Mann Whitney tests (one-tailed) reflect the progressive differences between the 17 FI and 12 FD *S*s; i.e. during the first determination, the differences are not significant ($U = 86$; p = NS). During the second VP the means are significantly different at the $p = 0{\cdot}05$ level. ($U = 64$); and during the third VP they are different at the $p < 0{\cdot}05$ level ($U = 63$).

The 37 middle *S*s also differ significantly from the 12 FD *S*s during all three tests (at No. 1, $U = 140$, $z = 1{\cdot}91$, $p < 0{\cdot}03$; at No. 2, $U = 147{\cdot}5$, $z = 1{\cdot}73$, $p < 0{\cdot}05$; at No. 3, $U = 140{\cdot}50$, $z = 1{\cdot}89$, $p < 0{\cdot}04$).

(B) *Resting levels before and after stimulation*

Previous work had led to a prediction that FD *S*s would, at rest, reveal higher VP's than FI *S*s but that a reversal would occur with stimulation. It was also predicted that *resting levels after stimulation had occurred* (i.e. the uncertainty of what to anticipate no longer exists) would also show this reversal.

Inspection of Fig. 3 appears to confirm the prediction; i.e. after stimulation has occurred, the resting venous pressures of FD *S*s appear to fall below those of FI *S*s, but these differences in level are not supported statistically. Further inspection suggests that after stimulation has occurred, the

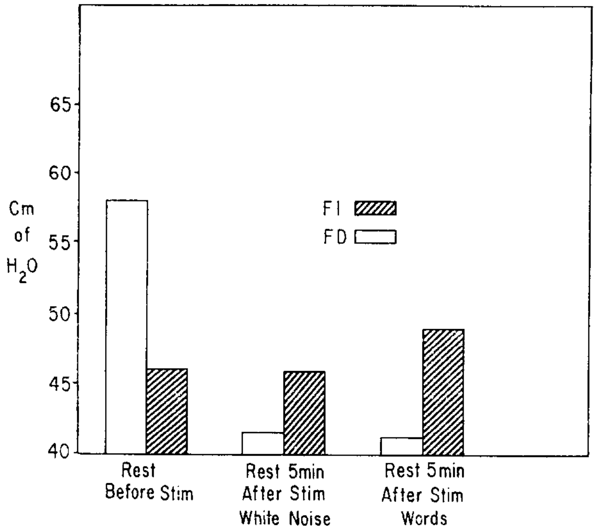

FIG. 3.—Resting venous pressures before and after stimulation. 5 min after white noise (mean of two stimulations) and 5 min after words (mean of two stimulations) the resting V.P. of FD *S*s are markedly reduced below initial resting levels, while those of FI *S*s have not changed. ($n = 42$; FI $= 9$, M (not shown in figure) $= 24$, FD $= 9$).

resting venous pressures of FD *S*s fall precipitously from their original resting levels, while those of FI *S*s rise only slightly. Thus the apparent reversal is primarily due to the lowering of FD *S*s. Wilcoxin Matched Pairs Signed-Ranks tests performed on change scores between the *initial* rest period, and the rest period 5 min after word stimulation, show no significant rise for FI *S*s but a significant fall for FD *S*s ($T = +8$, $z = 1{\cdot}72$, $p = 0{\cdot}04$, one-tailed. FI $n = 9$; FD $n = 9$).

(C) *Venous pressures at rest and during stimulation*

Initial resting levels and the pressures obtained during external stimulation are shown in Fig. 4. Inspection reveals that FD *S*s remain higher than FI *S*s during the nonspecific "white noise" sounds, but the differences are not significant.

The more specific stimuli of listening to words or performing a verbal arithmetic problem appear to lead to the previously seen and predicted reversal. The levels obtained by FD *S*s during word stimulation are in fact, *below* those seen during rest. The apparent reversal is maintained during the arithmetic problem but the differences are less extensive. Here FD *S*s show *no change* in comparison to rest, while FI *S*s reveal a sharp rise.

Statistical tests support these findings as follows: Both FI ($n = 17$) and FD ($n = 12$) *S*s rise significantly in response to the first but not to the second white noise (FI rise; $T = 0$ $p < 0{\cdot}001$; FD rise, $T = 7{\cdot}5$, $p = 0{\cdot}025$, both one-tailed). While FD *S*s appear higher than FI *S*s during both white noises, these differences are not statistically significant.

In contrast, there is a significantly different response in the two groups to word stimuli. The mean change in FD *S*s from initial resting level is $-8{\cdot}62$ cm H_2O, while the FI *S*s sustain a mean rise of $+11{\cdot}2$ cm H_2O. These changes are significantly different ($U = 9$, $0{\cdot}001 < p < 0{\cdot}01$, one-tailed). The same significant differences are found in response to the second word as compared to initial resting levels. FD *S*s' mean change $= -6{\cdot}87$ cm H_2O, FI *S*s mean change $= +12{\cdot}78$ cm H_2O ($U = 18$, $0{\cdot}02 < p < 0{\cdot}05$ one-tailed). Although the level of VP appears higher in FI *S*s than FD *S*s *during* both word stimuli, statistical tests do not support these differences in level.

In response to arithmetic, the mean change of FD *S*s is $+4{\cdot}4$ cm H_2O; of FI *S*s, $+23{\cdot}32$ cm H_2O. These differences are also significant ($U = 18$, $0{\cdot}02 < p < 0{\cdot}05$ one-tailed). However, although the *level* of VP appears higher in FI *S*s than FD *S*s, during arithmetic, statistical tests do not support these differences in level.

(D) *Response to words*

Figure 4 also reveals that the *S*s do not appear to adapt to the words; responses to the second word being as large as to the first. Further, there were no significant VP differences noted between

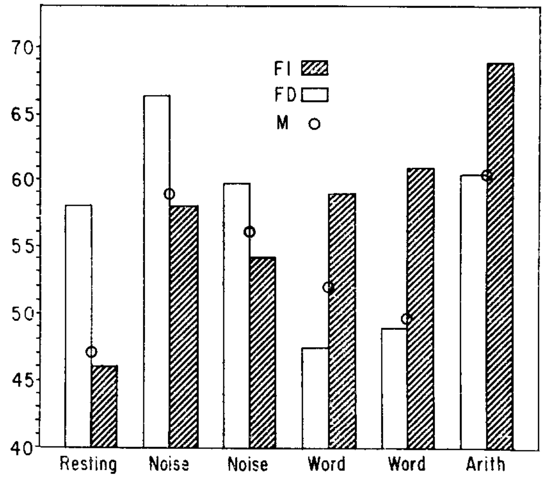

FIG. 4.—Venous pressure at rest and during stimulation. The specific stimuli of words and arithmetic are associated with higher VP responses than those seen during initial rest period in the FI group. In contrast, FD *S*s show much less of a response. Middle *S*s in general lie between the two extreme groups. (For rest and noise $n = 64$ (FI = 17, M = 34, FD = 12); for words and arithmetic $n = 42$ (FI = 9, M = 24, FD = 9).

charged and neutral words, although the mean response to charged words was slightly higher. Again, although the differences were not great enough to reach statistical significance, FI *S*s' VP's appeared greater than FD *S*s during both charged and neutral words.

DISCUSSION

In an anticipatory state, or in a situation where the stimulus cannot clearly be identified and tagged, FD *S*s reveal higher venous pressures, reflecting increased venous constriction presumably due to sympathetic activation. Venous pressures of FD *S*s fall below initial "resting" levels or rise only slightly, when clear-cut stimuli impinge or where the uncertainty and anticipatory state has subsided because of a previous stimulus. In contrast the response of FI *S*s to stimulation is a sharp rise from initial rest periods.

The differences are not due to the lower initial values noted in FI *S*s. Indeed, in spite of having much higher values during the initial rest period, FD *S*s show a capacity to react to the white noise. Further, FI *S*s show their sharp responsivity to specific stimuli even though later rest periods reveal their levels to be higher if anything than FD *S*s.

It has previously been suggested [8] that venous pressures recorded in response to emotional stimuli are of the same order of magnitude as physical stimuli, and that the associated peripheral venous constriction may play a role in a variety of vascular decompensations. The present study reiterates the considerable variability obtainable in the veins, and underlines the importance of psychological stimuli or personality variables in vascular dynamics. It also suggests that for certain individuals, so-called "resting" levels are associated with progressively more venous constriction as time goes on, than when stimuli impinge. In FD *S*s, word stimuli led to levels considerably *lower* than those obtained at rest. Apparently the initial "resting" periods which are associated with constriction, are not particularly relaxing for these subjects. A more appropriate term might be "anticipatory arousal".

When the setting changed to one of stimulation followed by "rest periods", it was noted that the rest periods after stimulation revealed significantly less constriction in FD *S*s than in the initial anticipatory state. FI *S*s, on the other hand, did not change materially throughout the rest periods.

Previous work has also identified that "uncertainty" is associated with greater arousal in FD *S*s and the suggestion was made that FD *S*s, who reveal a variety of perceptual organizational problems, may in fact be in a chronic state of preparedness because of their lessened ability to process perceptual data. In this sense, not knowing what to expect or when to expect it, may intensify this preparedness. After a stimulus is identified, there is a temporary relaxation. FI *S*s, on the other hand, were seen as individuals whose perceptual organizational ability is not impaired. Therefore, chronic preparedness is less necessary. When stimuli impinge, these *S*s respond briskly and "relax" quickly.

It should be also noted that FD *S*s have been characterized [2] as socially dependent and requiring external sources of support. This may be another expression of the requirement for external stimulation in order to decrease arousal.

The anticipatory state noted in an experimental setting is of course not the same as real life. However, if it should prove to be generally true that FD *S*s reveal a considerable degree of venous constriction (reflecting their more chronically aroused state) in uncertainty and the supposedly restful state of no stimulus situations, then one must wonder about the possible clinical implications of long periods of chronic venous constriction.

It is of course premature to ascribe specific clinical significance to our venous pressure findings. While several investigators [9–15] have found that psychosomatic symptom groups tend to be more field dependent than controls, Silverstone and Kissen [16] drawing patients and controls from the same population source, were unable to find significant perceptual differences in essential hypertension or in peptic ulcers. This suggests that the earlier reports may have been contaminated by sampling errors. Karp *et al.* [17] were able to demonstrate greater field dependency in diabetics, but also found that clinic patients were more field dependent than private patients. Further confounding this area is the recent finding [18] that asthmatics are more field *independent* in contrast to earlier studies [15] which reported opposite results.

In contrast to the confusion relating field dependency to clinical findings, are the consistencies found in psychophysiological studies with this variable on normal subjects. For example, Zuckerman [7] suggests that "field dependency predicts stress responses to unfamiliar or novel situations of any kind". Pillsbury *et al.* [6] report that FD *S*s revealed EEG alerting responses to nonspecific photic stimuli and that reversal occurred in response to the specific and "more meaningful" stimulus of a telephone bell. These findings seem consistent with our findings in this and previous experiments, thus also lending support to the hypothesis.

What relationship this will ultimately prove to have with clinical psychosomatic problems must, however, await further investigations.

SUMMARY

Field Dependent *S*s revealed progressively higher venous pressures than Field Independent *S*s during initial rest periods. These differences were abolished in rest periods 5 min after external stimulation, with FD *S*s showing a significant drop from

initial levels, and FI *S*s showing no change in level. Although during these later rest periods, FD *S*s appeared to have venous pressures below those of FI *S*s, this trend could not be statistically confirmed.

In none of the stimulus conditions can the two groups be differentiated statistically, although by inspection, FD *S*s appear to be higher than FI *S*s during the non-specific white noise, and lower than FI *S*s during the specific stimuli of words and arithmetic.

However, the change from initial rest period to words or arithmetic is significantly different in the two groups; the response in FD *S*s being either a drop or no change, and in FI *S*s a sharp rise.

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