SOME PSYCHOLOGICAL ASPECTS OF INTRA-MUSCULAR INJECTION*

By

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INTRODUCTION

Taking the needle and *being needled* are contemporary colloquialisms which have some significance to those who administer injections for psychological purposes. They suggest that the experience of receiving hypodermic injections must be a relatively common one in our society, and also that such an experience is generally considered to be unpleasant. The corollary of these conclusions is that such a public attitude of mind is likely to foster preconceptions in relations to injections so that, whether or not the pain threshold itself is actually exceeded, the individual receiving an injection will be predisposed to regard the experience as a stressful one.

Such an attitude has in turn two important consequences in clinical practice. Firstly, some patients who are required to undergo a series of injections are likely to find the experience above their threshold of acceptable stress, and will be induced to terminate their treatment prematurely and against medical advice. As Jennison and Ellis (1954) have already found, even when maximum skill has been employed and special care taken to minimize local discomfort, there will always be a significant number of patients who withdraw from the situation.

Secondly, and of special importance to investigators of stress, we may expect a range of reactions to the noxa which will be superimposed and integrated into the overall pattern of response to the agent injected. If such a response lies within the wide range of psycho-physiological reactions which we now know to exist in stress situations, then it becomes clear that what we are measuring is not a simple reaction to the agent injected, but a complex reaction to both agent and situation. As Haward (1960, 1961) has already shown, such a complex reaction will vary both in intensity and duration according to how the subject perceives the situation and the meaning it has for him.

The problem is of practical as well as theoretical importance to psychologists using chemically induced changes of blood pressure as a measure of autonomic responsiveness and stability. A close relationship has been demonstrated to exist between anxiety and blood pressure (e.g. Rudolf, 1955; Hambling, 1959) and numerous studies have since shown that the mere experience of having blood pressure measured by means of a sphygmomanometer is sufficiently stressful to the layman to produce significant artefacts in the recorded level of blood pressure. If we then add the additional—and to some subjects very considerable—stress of the injection, it seems reasonable to conclude that the blood pressure readings obtained after the injection of a varitensive drug are unlikely to bear any consistent relationship to the chemical agent itself.

This may explain why, in the Funkenstein Test (Schneider, 1955) which consists of the alternate injection of methacholine chloride and adrenaline, the

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former agent is physiologically much more efficient than the latter. Since the methacholine chloride induces a state of hypotension, this is contrasted with the stress-induced hypertension which must be considered an inevitable concomitant of the test, and so produces a better differentiation of reaction than does the second part of the test. Here, both chemical and psychological aspects of the procedure produce changes which lie in the same direction and so make differentiation impossible. Chemically induced reactions of this type are, of course, exponential and not linear, and the degree of chemo-physiological reaction will vary inversely with the distance which the variable has psychophysiologically moved from the resting level. Thus, the higher the pre-injection (erroneously called the "resting") level of blood-pressure the smaller will be the increase produced by an hypertensive agent, while the greater will be the decrease brought about by an hypotensive drug. The converse is also true, and this follows from the fact that this process parallels to some extent the Weber–Fechner Law. This notion may also explain the contradictory results obtained in various validation studies of the Funkenstein Test (e.g. Zuckerman and Gross, 1959).

In an attempt to reduce these intrapersonal intervening variables during routine psychophysiological testing, a series of controlled trials was undertaken to examine the efficacy in this respect of a mechanical injector which had recently been invented. The more obvious advantages of the injector have been described elsewhere (Haward, 1955 a/b/c, 1957). Briefly, it consists of a pistol-type body carrying a spring-loaded carriage operated by a trigger. The carriage holds the syringe which is ready loaded, and slides forward rapidly and with great force when released, the needle passing through a vent in the baseplate which is specially designed to gather up the skin in preparation for the puncture. The depth of penetration is controlled by means of a pre-set adjustment which enables the distance between the end of the syringe-carriage slide and the baseplate to be varied. Two models are available: the Mark I, taking a 1- or 2-ml. syringe and providing a penetration depth of from zero to 0·75 inch, and the Mark II holding a 5- or 10-ml. syringe and giving a depth of penetration from zero to two inches. The gun can be operated in either hand and on any part of the body.

Methodology

Edwards' (1950) survey on recent research in pain perception makes it clear that this phenomenon is an extremely complex one. The electrophysiological studies of Clausen (1953) show that in the physiological reaction to painful noxae at least three distinguishable steps exist which refer to differences in quality rather than intensity; the processes of increasing tissue damage which occur during the administration of a painful stimulus produce a complex anatomical, biochemical and physiological matrix within which its perception is embedded. To attempt to assess this process at more than one level at a time must inevitably lead to little more than a rough approximation of the true state of the organism, and the plea for a discrete measurement of physiological and psychological reactions separately has been well made by Hebb (1954) who says: "In its own psychological universe pain is irreducible, elemental: in another universe it becomes, hypothetically, a kind of neural action. There can be no psychological identity in the other universe."

Apart from the basic difficulties of this broader issue, there are so many variables which affect pain threshold itself that any attempt to hold them all constant would mean transferring the experiment from clinic to a psychophysical

laboratory. Age (Wenger *et al.*, 1956), sex (Stengel, 1955), mood (Hemphill *et al.*, 1952), physical health (Bishop, 1944), blood pressure (Schachter, 1957), muscular tension (Eysenck, 1960), temperature (Helson and Quantius, 1934), metabolic rate of skin tissue proteins (Hardy, 1953), autonomic balance (Buytendijk, 1961), intracranial pathology (Gilliatt and Pratt, 1952), and degree of anxiety (Wenger, op. cit.) *inter alia*, are only some of the important factors which will influence the pain threshold. In view of this, it was realised that adequate homogeneity could not be achieved on a small scale, and a simple methodology was adopted which aimed at balancing the variables in both experimental and control groups. 300 psychiatric in-patients were used, collected over a four-year period as routine referrals to a clinical psychology department. They were all diagnostic problems, possibly psychotic but not obviously so, and with not greatly differing symptomatology. The age range was 20 to 45 years, and was matched for each contrasting group. Sex was equalized between control and experimental groups. Other factors were either common to both groups and thereby mutually compensating, or were excluded from the sampling. For example, since Hemphill (op. cit.) found abnormal responsiveness to pain in acute anxiety and depressive states, patients found unequivocally to be suffering from either of these conditions were omitted from the sample.

Hall (1953) has already discussed the problem of identifying and measuring the pain threshold. Although Clausen (op. cit.) found the verbal reporting of pain unsatisfactory in his own experimental work, other workers, notably Hardy *et al.* (1940, 1943, 1947) and Wolff and Wolf (1957) have used it successfully. Since in the present study interest was centred upon the subjective evaluation of the experience of the injection, each subject was asked to report verbally whether he felt anything. If the answer was affirmative he was then asked to say whether or not he felt a distinct pain, the experimenter taking care to dispel the probable set towards the non-reporting of pain as a sign of "toughness". Although it might be supposed that the individual would find some difficulty in differentiating between the various sensations (particularly since patients often describe their first experience of thermal stimulation as a prick) nevertheless, when asked in practice to differentiate clearly between the sensation of pricking and pain, no hesitation was apparent before the subject reached a decision. This is in line with the conclusions of Bishop (1944) who found that the change in quality from a prick to a pain could be interpreted readily and accurately by both well and sick individuals. Hall (1955), who first reported the "prick" response to thermal stimulation in psychiatric patients, also explains that although this is used, among other verbs, as a verbal report of pain, it is nevertheless quite different from other sensations. Since pain stimulation in the present case, if it occurrred, would be mechanical and not thermal, the physiological concomitants of the experience would be expected to be simpler, and the subjective differentiation thereby easier. Simpler because with thermal stimulation the vasoconstriction (Mittelman and Wolff, 1939) and vasodilation (Bilisony *et al.*, 1954) which occurs is the resultant of both peripheral and central activities, while in other forms of stimulation, such as those described by Bishop (1943) and Gregg (1951) there are similar complex processes involved which have their effect upon subjective judgment. Birren *et al.* (1951) and Hardy (1953) discuss specific aspects of pain threshold measurement which are relevant to the present problem, and in the light of available experience, it seemed that an adequate and valid distinction could be made by the subject, even if his perception was impaired by illness.

In order to assess the effects of experience and comparison, the following groups were used:

(*a*) 50 patients receiving an injection by hand only.

(*b*) 50 patients receiving injections by the mechanical injector only.

(*c*) 25 patients receiving injections first by hand, then by injector.

(*d*) 25 patients receiving injections first by injector then by hand.

(*e*) 50 patients receiving injections by hand only but simulated as a mechanical injection.

(*f*) 25 patients receiving injections by hand first and then by simulated mechanical injection.

(*g*) 25 patients receiving simulated mechanical injection first and standard hand injections later.

(*h*) 25 patients receiving mechanical injections first and simulated mechanical injections later.

(*i*) 25 patients receiving simulated mechanical injections first and genuine mechanical injections later.

(*j*) 100 patients receiving injections from male nurses.

The purpose of the simulated mechanical injector was to determine what effect, if any, the apparatus had upon the perception of needle penetration. The patient saw the mechanical injector being prepared and at the moment of injection, the empty injector was applied to the skin and fired, but the injection itself was by hand. All injections followed an identical procedure. A 2-ml. centre nozzle syringe was used, together with a long No. 10 needle. The site of injection was the upper outer quadrant of the right buttock, penetration being made into the gluteal muscle in an area clear of the sciatic nerve. The Z-technique was adopted, so that when released, the actual needle path formed an interrupted line, so preventing leakage of the contents of the injection and subsequent invalidation of results. The methacholine chloride was extracted from the phials by the needle used for the injection and not by the use of a special needle (e.g. a No. 1 Record) as is customarily the case. The purpose of this was to ensure that the full and exact measure of the varitensive agent was used each time. It will be obvious that in the Funkenstein Test variation in concentration of the drug will influence the subsequent reaction. For this reason, the drug, which has a medical life of only four weeks, was always used within one week of its receipt from the manufacturers, so that differences in result due to incipient processes of chemical deterioration would be negligible. All injections other than those given to patients in the last group were given by the author: this ensured that the interpersonal variation due to differences in individual skill was eliminated. The size of this variation was, however, examined in a special group of patients by utilizing the services of six nurses and comparing the differences in reactions to different nurses using both manual and mechanical methods of injection.

The verbal responses of the subjects were classified into three categories—reports of pain, reports of a prick, and reports of no feeling. A 3 by 2 contingency table was set up for each separate group, in which the three types of response were contrasted with two types of injection. These tables were then re-analysed by subgrouping the three responses into an alternative dichotomy: *pain* versus *no pain* (pricking and absence of feeling being grouped together) and *feeling*

versus *no feeling* (pain and pricking being grouped together). This analysis produced 56 two-square contingency tables which were then examined for significance by the Trites (1957) Graphical Method. For clinical reasons it was inadvisable to perform the Funkenstein Test on more than two occasions with each subject, so that the more obvious 3 by 3 table which could have accounted for the major variables could not be adopted. The rather simple statistical method adopted here appeared to be justified in view of the discrete nature of both stimulus and response, and because of the purpose of the investigation, which aimed at the evolvement of a practical technique for minimizing variations in a clinical test, and not at a theoretical study of skin perception. Nevertheless, in a smaller group of patients objective studies of reaction to injection were conducted with the use of measures of PGR, ECG, EMG, and iris reflex: these physiological responses are not being reported here.

Results

In the first experiment, 50 patients received an injection manually by the method described, and a further 50 patients received an injection by means of the mechanical injector. Table I (A) shows the distribution of verbal responses to the experience. A statistically significant trend is apparent, the manual method producing mostly sensation with some pain, the mechanical injector no pain and few reports of any sensation. Reports of a definite sensation are given by 18% of the subjects receiving mechanical injection and by 100% of the subjects receiving manual injection. There were no reports of pain from the former group but 34% of the manually injected group reported experiencing some pain.

TABLE I

Analysis of Verbal Reports on the Experience of Receiving Intramuscular Injections

	Group	Reporting	Manual		Injector		N	P∠
			Yes	No	Yes	No		
A	Experiencing one method only	Sensation	50	0	9	41	100	0·001
		Pain	17	33	0	50	100	0·001
B	Experiencing two different methods	Sensation	48	2	10	40	100	0·001
		Pain	35	15	0	50	100	0·001
C	Experiencing manual method *before* injector	Sensation	23	2	3	22	50	0·001
		Pain	14	11	0	25	50	0·001
D	Experiencing manual method *after* injector	Sensation	25	0	7	18	50	0·001
		Pain	21	4	0	25	50	0·001

In the second experiment, 50 subjects were selected to receive two injections, one by the standard manual method and one by the mechanical injector. The purpose of this was to assess the "carry over" effect of one type of injection upon the other, since Haward (op. cit.) has already shown that previous experience is an important factor in determining the subject's response to a repetition of that experience. In order to eliminate the effects of primacy and recency from the subjective comparison of the two methods, the group was divided into two equal samples, one receiving mechanical injection first, the other receiving it second. Table I (B) shows the distribution of responses. It

will be seen by comparing this with Table I (A) that although the trend in the two tables is similar the reaction to the manual method of injection is much more negative (in the sense of disliking) when the subject has the opportunity of comparing the two methods. Considering the group as a whole, irrespective of which method of injection they received first, we find that while the number of subjects reporting a sensation is similar to that found in the previous experiment (20% of the mechanically injected subjects compared with 96% of the manually injected), the latter group now show a 70% response to pain compared with the 34% pain response when no comparison was available to them. This interesting finding that psychological factors double the incidence of painful sensations can be better understood by examining the groups according to the sequence of their injections (Table II). It will be seen that when a manual injection is given first, the response to the subsequent mechanical injection is more positive: 28% report feeling the mechanical injector when given first but only 12% report feeling it when it is given second. Similarly, 44% subjects report a painless manual injection when given first, but only 16% report absence of pain with manual injection after they have already received mechanical injection. The manual method of injection is therefore perceived as more painful after the relatively painless mechanical injection has been experienced, than it is when no alternative experience is available to the subject: no significant difference in reaction to the injector was found.

TABLE II

The Effect of Temporal Sequence of Manual and Mechanical Methods on the response to intra-muscular injections

Method of Injection	Reporting	Given First		Given Last		N	P∠
		Yes	No	Yes	No		
Manual	Sensation	23	2	25	0	50	NS
	Pain	14	11	21	4	50	0·01
Injector	Sensation	7	18	3	22	50	NS
	Pain	0	25	0	25	50	NS

The fact that significant psychological factors were operating here to produce the type of verbal response raised the question of whether the difference in reactions to the manual and mechanical methods of injection was due to the objective differences in physical method or merely to the psychological aspects of the two methods. In other words, is the injector gun painless because of its mechanical features—such as the high speed of penetration—or because of its psychological aspects, such as the impersonal nature of the mechanical process? An experiment designed to provide information relevant to this question was designed. In the first part of the experiment, a further 50 patients received a manual injection, the procedure being modified by allowing them to see the syringe being loaded in the injector, and feeling the injector pressure plate applied to the buttock. The whole proceeding was designed to deceive them into thinking that the injector gun was actually used, although in fact the injection itself followed traditional manual procedure. The results are shown in Table III (A). It will be clear that this group could be equated with the first two groups of the investigation, who each received only one injection. If the physical aspects of the mechanical injector are the dominant factors in determining the perceptual experience, then the results of this simulated group should approximate to those of the manually injected group, since they shared the same

physical process. If, on the other hand, the psychological aspects of the injector are the dominant factors, then the results of simulation should be closer to those of the genuine mechanical process. 100% of the simulated group reported feeling the injection, and 42% reported pain: these figures should be compared with those derived from Table I, which show 100% and 34% for sensation and pain respectively reported by the manually injected group, and 18% and 0% reported by the mechanically injected group. For a first injection, therefore, with no opportunity for comparison, the physical factors are very much more important than the psychological, the effects of simulation producing no significant difference to the reactions to manual injection.

TABLE III

Analysis of Responses to Intra-muscular Injection by mechanical and Simulated Mechanical Methods

Group	Reporting	Simulated		Mechanical		N	P
		Yes	No	Yes	No		
A Experiencing one method only	Sensation	50	0	9	51	100	0·00
	Pain	21	29	0	50	100	0·001
B Experiencing two different methods	Sensation	47	3	20	30	100	0·001
	Pain	20	30	6	44	100	0·001
C Experiencing injector *after* simulator	Sensation	25	0	15	10	50	0·001
	Pain	15	9	6	19	50	0·001
D Experiencing injector *before* simulator	Sensation	22	3	5	20	50	0·001
	Pain	4	21	0	25	50	NS

In the second experiment, however, it was shown that there was some psychological effect upon the experience of the second injection arising from the experience of the first. It would consequently be expected that where an opportunity was afforded to the subject to experience and compare the manual and mechanical methods, the use of the simulating method would enable the psychological factor to be more adequately assessed. For this purpose, another series of patients received two injections; all received a manual injection simulating a mechanical one, fifty receiving in addition a manual injection by the normal method and fifty receiving a mechanical injection. The results are shown in Table III (B). 94% of the sample reported feeling the simulated mechanical injection, 40% feeling the genuine mechanical injection; 60% reported the simulated mechanical injection as painless compared with 88% painless injections with the mechanical injection. The important fact here is that for the first time definite pain was reported with the mechanical injector, although in all the previous trials the instrument has been found to be 100% painless. Examining the figures in Table IV we see that there is a very definite carry over effect from one method to the other. Report of pain from mechanical injection (12% compared with nil previously) occur after pain with simulated mechanical injection has been experienced. Conversely, the simulated method, which produced 32% reports of pain initially, evoked only 8% reports after experience of genuine mechanical injection. It is now possible to extract from Table III the figures which enable the strength of the relative psychological and physical factors to be assessed quantatively. Considering mechanical and simulated mechanical injections respectively, we have two procedures which

are psychologically identical but physically different: on the other hand, by comparing manual with simulated mechanical injections we have two procedures which are physically identical but psychologically different. Table V shows that, for first injections where no opportunity for comparison of methods is afforded, the response to the manual (but simulated mechanical) injections is not significantly different to the response to injections administered by mechanical injection. From this the conclusion can be drawn that in this type of situation it is the physical rather than the psychological characteristics of the injection given which account for its acceptance by the patient as the method of choice. Superimposed upon these differences between the physical nature of the two types of injection, however, are the psychological effects of experience shown in Tables II and IV. Consequently, the inter-individual factor was

TABLE IV

The Effect of Temporal Sequence of Mechanical and Simulated Mechanical Methods on the Verbal Response to Intra-muscular Injection

Method	Reporting	Given First		Given Last		N	P
		Yes	No	Yes	No		
Mechanical	Sensation	5	20	15	10	50	0·01
	Pain	0	25	6	19	50	NS
Simulated	Sensation	25	0	22	3	50	NS
	Pain	16	9	4	21	50	0·001

explored by a final experiment involving six nurses acting as the operator responsible for administering the injection. Because of a number of difficulties produced by the shift system in nursing duties, and clinical requirements, it was not possible to utilize the nurses in the administration of the Funkenstein Test. Instead, use was made of the daily routine injections of streptomycin being given to patients suffering from pulmonary tuberculosis. Nineteen patients received one injection daily from one of six available nurses, extending over an intermittent period. Because of clinical and administrative factors it was impossible to equate all conditions and the 342 injections for which reports were obtained in this way were not equally divided between the six nurses or nineteen patients. Because of this, the results are reported in terms of percentages only. The nurses were first given training in the use of the mechanical injector and later were allowed to gain some experience in using it before the experimental period commenced. The six nurses were selected from those available by reason of their equivalent periods of service in the tuberculosis ward, so that although it was known (by previous discussions with the patients) that the nurses in question varied considerably in their nursing skill, nevertheless they all had equivalent experience in administering both manual and mechanical injections. After the nurse had given the injection and left the bedside, the experimenter obtained a verbal response from the patient as in the other experiments, these responses not being made available to the nurses concerned. The responses are classified in Table VI. The inter-nurse variation is most striking, reports of pain ranging from 4% to 98% with manual injection, and of sensation ranging from 2% to 66% with the mechanical injector. As would be expected, the difference between the two methods of injection is minimal in the case of the most efficient nurse (C) and greatest in the case of the most clumsy nurse (E). The latter, indeed, provided an extremely effective demonstration of the value of the mechanical injector; his lack of skill in practical nursing

procedures had earned him the title (awarded by the patients behind his back) of "The Butcher", yet with the mechanical injector only one injection in every eleven administered by him was described as painful.

TABLE V

Percentage of Verbal Reports to Three Different Methods of Intra-muscular Injections and Significance of Inter-method Differences

Reporting	Manual	P∠[1]	Simulated	P∠[2]	Injector
Sensation ...	100	N.S.	100	0·001	18
Pain	34	N.S.	42	0·001	0

[1] Significance of chi-square value of manual v. simulator.
[2] Significance of chi-square value of injector v. simulator.

This study has been concerned solely with the respective experiences of different methods of administering an intra-muscular injection, and not with the effect of these experiences upon the Funkenstein response as such. From what has already been said it will be obvious that the injection experience is only one of the stress factors present at the time. Previous experience, the laboratory environment, the clinician-patient relationship and many other factors will each determine to a greater or lesser extent the level of sympathetic activity present in the patient at the time. The latter's own status psychologicus will be even more important—the highly anxious patient may be in such a state of sympathetic hyperactivity that additional stresses will have little further effect upon his overall response. Without a refined analysis of the sample (which will be the subject of a further communication) a simple comparison of groups with respect to their Funkenstein test would be expected to have little statistical

TABLE VI

Verbal Responses to Injections by Two Methods Administered by Six Different Nurses: N = 342

Method	Reporting	Nurses A	B	C	D	E	F
Manual	Sensation	100*	85	76	91	98	100
	Pain	43	32	4	19	98	57
Injector	Sensation	30	13	2	24	66	49
	Pain	0	4	0	0	9	2

* All figures in this table are percentages.

TABLE VII

Basimetric Response Scores[1] given by 100 Patients (Group A in table I) according to Type of Injection

Group	Manual Injection	Mechanical Injection
Response Score[2]	9·347	8·168

[1] Response Score $R = d.T(M)^{-1}$ where
d = greatest change in systolic blood pressure following gluteal intra-muscular injection of 10 mgm. methacholine chloride in aqueous solution.
T = time from injection before systolic blood pressure reaches its mean pre-injection level.
M = Mean of 10 systolic blood pressure measurements made at 1 minute intervals prior to injection.
[2] $t = 1·987$ $P < 0·05$.

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significance. Nevertheless, significant differences do exist between groups when the mode of injection is compared and one such comparison is illustrated in Table VII.

Injections play an important part in the experience of the patient. While for ethical considerations the clinician will naturally ensure that the procedure is made as least unpleasant as possible, for clinical investigations and for research purposes it is essential that the variations in the perception of the experience should be kept as small as possible. For this purpose an impersonal mechanical device such as the injector gun offers some obvious advantages. In the experiments described above, an attempt to evaluate one particular instrument has been made: the results prove unequivocally at a high level of statistical significance that the mechanical injection is superior to manual injection. It is virtually painless, so that interference in the measurement of post-injection physiological variables by the autonomic reaction to pain is eliminated. Furthermore, only one patient in five is aware that the actual injection has taken place. Provided that some reason is offered, if necessary merely by implication, why some process involving a metal instrument must take place on the buttock, it is possible to inject a patient without him being aware that this has actually happened. In cases where injections have a strong emotional meaning for the patient this is an extremely useful technique if it is necessary that the experimental situation be kept emotionally neutral. Some caution is necessary in accepting the actual figures given as possessing general validity. In the first place the sample is not a normal one but a psychiatric one. It excludes acute psychotics, whose verbal responses to this experimental situation have been found to be too inconsistent to be used, but most of the subjects are to some extent emotionally disturbed. While in the aggregate their mean thresholds for pain and sensation are no different from that of normals, they can be expected to possess a somewhat heightened awareness of the unpleasant aspects of the situation. This is an advantage in that it assists in the process of differentiation required, but may produce results which are more significant than would be the case with individuals of normal mental and physical health. In the context of this investigation the psychiatric status of the subjects was obviously an advantage since it is precisely this type of individual for whom psychophysiological testing, and in particular, the Funkenstein Test, might be required.

Secondly, the responses obtained refer (except in the final experiment) to the experience of injection by one particular individual, viz., the author. The generality of the results will therefore also depend on how closely the author's skill corresponds to the average skill of similar clinicians using these techniques. There is no easy way to determine this. Despite the use of only six operators in the final experiment, it would not be unreasonable to accept the range of skill exhibited by the nurses as representative of the range of skill to be found in general clinical practice. If the percentage results from the earlier tables are compared with those of Table V the position of the author on this range of skill can be determined. This shows that manual injection produces a wide range of skill but mechanical injection does not. This means that the use of mechanical injection reduces inter-experimenter variations, and thus emphasizes another advantage of this technique. It must also be made clear that these figures refer to a particular make of injector gun and not to mechanical injection by any other method. At present only this one type of device[1] is available, but should

[1] Palmer Injectors Ltd., Torlundy, Fort William, Scotland.

alternative types of instrument be designed and manufactured it cannot be presumed that similar results would necessarily be obtained.

With these qualifications in mind, it is possible to review the findings of this study. One patient in every three reports pain during manual injection; normally no patient reports pain with mechanical injection. However, when two injections are given separated by a period of time not exceeding one week, one by each method, an interaction of experience occurs such that perception of the second injection is modified to provide a *greater differentiation of the two experiences*. Thus reactions to manual injection are more unfavourable when this method follows that of the painless mechanical injector. Similarly, reactions to the latter become even more favourable when this method is preceded by manual injection. On the other hand, when the experimental situation is so arranged that the two methods are psychologically identical but physically different (i.e. the patient believes he is receiving mechanical injection on both occasions whereas either his first or second injection is actually by the manual method simulating mechanical injection), the effect is to reduce the difference between responses to the two experiences. This implies that the patient is more sensitive to psychological aspects of the laboratory situation than to the physical ones, and reaffirms the point made by the author (op. cit.) in his plea for greater evaluation of the subjective meaning which the situation has to the subject. These findings have an important implication in physiological measurement other than that involving injections, mechanical or otherwise. They indicate that a carry-over effect operates so that if the patient believes a previously unpleasant situation is to be repeated, he will react relative to his preconceptions and not merely to the real situation. In an extensive study of hospitalization stress (Haward, 1953) it was shown that patients in a chest hospital react to subjectively perceived but objectively non-existent stress because of a carry-over effect from previous situations. There are two lessons to be learned here. In the first place, the previous experience of the patient in connection with medical procedures is more relevant to his present reactions than many clinicians appreciate (of thirty-eight physicians interviewed by the author only eleven said they regularly asked the patient if he had had a similar procedure before (for instance, blood pressure measurement or injection) and only three of these enquired into the subjective experience of the previous occasion and then by no means consistently); secondly, in order to obtain valid measurements of both physical and psychological variables minimally contaminated with subjective misperceptions, it is necessary to make clear to the subject the precise nature of the procedure about to be employed and to point out its difference from past experiences which may relate to the present situation. The one fact which becomes increasingly clear in these studies relating to stress is that the control of external variables does not guarantee that a given experimental situation is being repeated or indeed is actually repeatable. Too often the investigator is content to record glibly his standard deviations, without considering why they should exist at all. Despite the wealth of published data derived from psychological research, there is little that the practitioner can use for prediction in his everyday problems, simply because the experimenter has been more concerned to erect some theoretical structure on the basis of statistically significant differences between group means than to explore the more important aspects of overlapping distributions and inter-individual differences. There can be little doubt that many of the inconsistencies currently existing in published work could be resolved without undue difficulty if investigators concentrated upon the individuals who provide the anomalies in data. While

we observe and record only the datum of the experimental variable we work in blinkers which cannot but limit the relevance of the study to the broader problems of our profession. The findings of this present study point, in their small and humble way, to the most important of all intervening variables—that of human apperception.

Summary

Verbal reports of experience of injection by manual and mechanical methods are analysed. Three hundred psychiatric patients were used, each receiving one or two intra-muscular injections of methacholine chloride. Mechanical injection produced a significantly more favourable response than manual injection. By manipulating the sequence of injections and the method used, it was shown that experience of the first injection modified the perception of the second one. The change in perception was such that the difference between the reactions to the two methods was increased. When one method simulated the other, so that the two situations were psychologically identical but physically different, the effect was to reduce the difference between the responses to the two types of injection. By using six operators it was possible to obtain a measure of inter-experimenter variability, which was shown to be greatest in manual injections and least in mechanical ones. The role of past experience in modifying perception and consequently varying the response to a constant stimulus is emphasized, and a plea is made for greater concern with the personal element in psychological investigations.

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