The Principles of Humane Experimental Technique

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CHAPTER 2

THE CONCEPT OF INHUMANITY

A brief consideration of the outward signs of some of the stronger sensations and emotions ...

The Criteria for and Measurement of Distress

In principle, then, we can determine the presence of distress, and define a measurable amount of it in terms of rank on the scale. When we consider acute changes, any treatment which induces a mood lower in rank than the preexisting one may be thought of as imposing a measurable amount of distress. The analysis might, in principle, be further refined, perhaps via the dynamics of the autonomic system. For instance, should we think of such acute changes in absolute or relative terms? Is change from a very high to a very low rank more distressing than from an intermediate?--the sort of problem that preoccupied Juvenal and Johnson. It has its practical aspect when experimenters impose punishment while the animal is in the act of satisfying an appetite.

But such analysis would carry us far in advance of practical possibilities. Enough that we have some sort of conception of distress. At this point we may add one more category of distress states, to which definite rank may be assigned, namely states associated with frustration of a need. In this group we may include, e.g., hunger and bodily discomfort. The latter is worth noting as we enter upon metrical aspects, since it is relatively easy to assess at the sensory periphery. It is specially interesting that the fur of mammals subordinate in a dominance hierarchy or tyranny is always less well-groomed and more tatty than that of their overlord (Carpenter, 1952; Clarke, 1955; Chance, 1956a). Similarly, any degree of visceral ill-health may be assumed to entail a measurable amount of distress, via discomfort if not pain. In this connection we may notice an interesting observation. Jungle wild monkeys are reported to be much worse off in terms of malnutrition, infection, and infestation than their captive fellows maintained on high protein diets (Lewis, 1957). It is not clear whether the wild monkeys observed included individuals high in dominance status. But we may draw the important general inference that we can actually improve on nature in such respects.

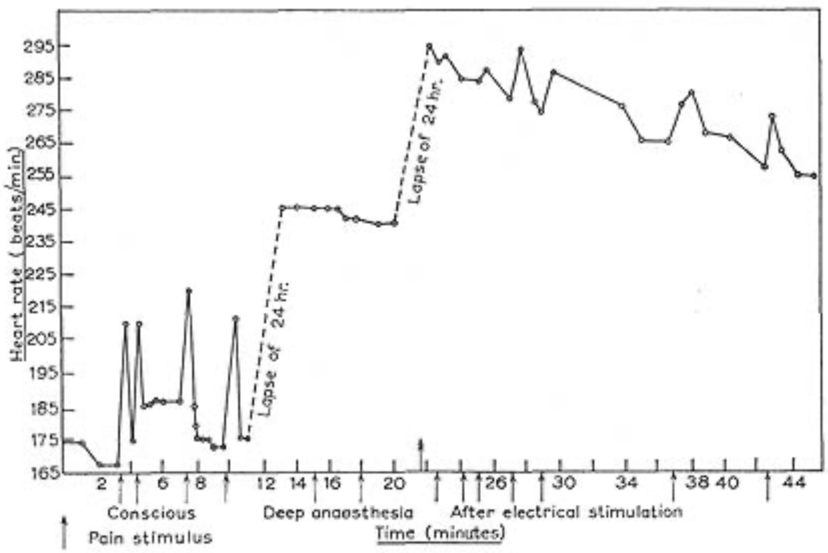
If the criteria for and measurement of distress are thus amendable to treatment in principle, their exact specification and application to a particular case bristles with theoretical and still more technical difficulties. We shall not attempt exhaustive discussion; indeed almost every individual instance may demand a separate solution of the general problem. We can, however, raise a few general issues, mainly though, not necessarily solely, in relation in mammals.

Even if we ignore husbandry outside experiment, experimental procedures themselves are highly diverse, and differ profoundly in time scale, though all gradations may be found from genetical experiments conducted over generations to analgesic assays occupying a few seconds.

In chronic experiments, the question of consciousness hardly arises. In acute experiments under general anesthesia (with or without recovery), states of consciousness become important. In such experiments, it is known that the procedure (e.g. surgical) applied would certainly cause distress if the animal were in a conscious state. The problem is, therefore, to determine when the anesthetic has taken full effect, and when it has begun to wear off. In these circumstances, it is known from human reports that somatic motor performance (e.g. reflex retraction of limbs on painful stimulation) is an unreliable guide (Hume, 1935; Croft, 1952a). Human individuals have reported the existence of a 'nightmare state', in which the subject is fully conscious and fully susceptible to the distressing effect of pain, while unable to move a (skeletal) muscle. The problem assumes special importance when curare or similar relaxants are used, which in any case preclude motor indications (Croft, 1953, 1957a). Much is known by now of the electrical activity of the forebrain in mammals during the course of general anesthesia (Croft, 1957b; Wilson, 1957; Brazier, 1954). But apart from the complexity of recording and analyzing apparatus required, the relationship is complex in the extreme. No fewer than seven stages of anesthesia can be distinguished in terms of the human electrocephalogram.

The work of Croft (1952a, b; 1953), performed under UFAW auspices, is therefore of great value here. By comparing electrical records from the heart and cortex of rabbits with data from human subjects, she was able to establish that a sudden and marked increase in heartrate in response to a painful stimulus is a reliable and accurate index of the presence of a conscious state (See Fig. 3). This cardiac pain reflex is sufficiently dramatic to require only relatively crude recording techniques. Since the response is not in skeletal muscle, the index is available when neuromuscular relaxants are in use, as well as in states of curarization due to electrical shock. (The findings have, in fact, been applied to problems of animal euthanasia where electrical stunning is employed--Croft, 1952b, 1957b.) We may note at this point that Croft has provided an admirable concise discussion of the subject of this section (1957c).

Figure 3. The Cardiac Pain Reflex



This figure shows the response of the heart rate in the rabbit to the changing conditions indicated along the abscissa. The single-headed arrows show the times at which a painful stimulus was administered--a pin-prick on the nose. The double-headed arrow records the induction of an electrical convulsion.

When the animal is conscious, the pain stimulus produces an immediate sharp rise in heart rate. Under deep anaesthesia, the animal ceases to gives this repsonse. Immediately after the electrical convulsion, the cardiac pain reflex is also missing, but it gradually returns. In fact, it returns before any pain responses in skeletal muscle (such as retraction of the paw), at a stage when the animal would normally be considered unconscious.

By comparison with the rabbit electrocorticogram, and with recordings from human hearts and brains in various conditions, it was established that the cardiac pain reflex is a better indicator of the presence of a conscious state than any somatic motor reaction.

When we are concerned with relatively chronic treatments applied to conscious animals, distress can evidently be examined via its effects either on the somatic or autonomic motor systems--in the latter case, including also endocrine responses, if these have time to appear. We may take the former first.

An interesting method has recently been developed for assessing distress in man (Sainsbury and Gibson, 1954; Annot., B.M.J., 1954a). It depends on the fact that distressing human neurotic moods are reflected in the overactivity of either all or specific muscle groups (e.g. frontalis muscle in patients complaining of headaches). The method employs an electronic integrator which sums muscle potentials picked up by surface electrodes. Clearly this technique is costly and elaborate. Yet in approaching our present problem we need a quiverful of techniques to deal with the wide variety of procedures to be studied. There are, for instance, those where we shall wish to make rapid estimates of severe but transient distress, and those where the distress to be measured is milder but prolonged. If a full account of all widely used procedures which can eventually be prepared, we may find that large groups of them can be approached by one or other method, whose use might then seriously be considered.

A greater range of possibilities arise when we consider observations on high-level overt behavior. In some species the signs of distress (both somatic and autonomic) have been efficiently catalogued, as in the rhesus monkey (Delgado, 1954, 1955); here they are, incidentally, not widely dissimilar from our own. Many social mammals have fairly elaborate patterns of even facial expression (e.g. wolves--Schenkel, 1947--though these are not popular laboratory animals!). Such signs as sudden, relatively high-pitched vocalizations turn up through most of the tetrapod groups. In 1959, the French periodical L'Evolution Psychiatrique is devoting a whole issue to the problem: "Is there an animal psychiatry?" This issue should provide much and varied information of relevance here. A considerable amount is known by now about the specific behavior patterns of many lower animals, though not nearly as much as would be needed about the commoner laboratory animals (Lane-Petter, 1953a; Chance, 1957a, c--see Chapter 7).

Knowledge of this kind could be turned to account in various ways. First, there is nonsocial behavior. Indices of well-being in this field might be certain patterns of grooming and general comfort behavior, and, in some species, readiness to explore new environments. Relaxed posture is difficult to quantify (without an electronic integrator!), but general activity can be studied in various ways, and we might take advantage of rhythmical regularities in various behavior patterns (Aschoff, 1955). Social interactions--especially those of dominance--would provide additional clues. But an extremely pertinent and valuable criterion has been suggested to us by Lane-Petter--that of the animal's behavior towards the experimenter (cf. also Hediger, 1955). One such obvious index is the animal's tameness, or, negatively, the need for restraint in transient procedures (cf. the control animals of Delgado). A great variety of indices is certainly available; what is required is their systematic investigation in the main laboratory species (for the general problem of behavior quantification, cf.

Russell et al, 1954; Russell, 1954). Many of these signs serve already as intuitive sources of confidence (or, conversely, warning signals) to all experienced workers. (cf. also Worden, 1939; Worden and Waterhouse, 1956.)

The second major object of measurement, often more convenient and quantifiable, is the autonomic behavior of the animal. In long term measurements, this will include endocrine and other slower responses. The general physical health of an animal--apart from specific disease but including susceptibility to pathogens--is itself an important index. This has long been recognized intuitively, and accords with psychosomatic principles (cf. Chapters 1, 6). The curious and almost paradoxical point has been made recently that one such index may be the amount of tolerated infections in a group of laboratory animals (Samuel, 1957). For short-term purposes, restriction of breathing has been used as an index of distress in man, though it requires apparatus for its measurement (Bromage, 1955). But the variety of autonomic and endocrine signs available is almost as great as that of behavioral indices. Professor H. Heller has suggested the use of water diuresis, because so easily observed, it is a specially useful index. This response is well known (in mammals) to be peculiarly (and rapidly) sensitive to central nervous disturbance of many kinds (Verney, 1947). It may well prove the most generally effective of all instruments for the end in view.

Finally, there is another sign (long-term situations) whose intuitive use is probably as old as domestication: the capacity of the animal to breed efficiently. Breeding taxes all an animal's resources, behavioral and homeostatic, to its fullest. It is susceptible at every stage to disturbance, signs of which will appear in the relative viability of the young. In very long-term experiments, the answer may well be what is nowadays called "progeny testing". To produce flourishing young, the animal's mating and parental behavior must be in perfect condition: capacity to breed an animal in captivity is alike proof and prerequisite of extensive understanding of its behavior (Lorenz, 1950). The endocrine responses of the mother, in those mammals with active milk let-down, are as delicately sensitive to disturbance by distress as that of water diuresis (Cross, 1953); this is natural, for both are controlled from the same endocrine unit, the neurohypophysis. Finally, the metabolic and general physiological strain on the mother is at a maximum (Medawar, 1953). The general principle applies throughout the vertebrates. It has been both a challenge and a research problem for those in charge of zoos (Hediger, 1950, 1955). It has been the basis of a method of natural, evolved population control (Chitty, 1952; Clarke, 1953a, b). So far as husbandry is concerned, the point has been well put in a recent study of rat sexual behavior by Larsson (1956): "Regarding the sexual behavior as indicating the physiological status of the whole animal, no efforts were spared to provide them with the best possible living conditions."

In default of all these criteria--and few have been applied quantitatively to any technique--we must fall back, first on qualitative impressions, which may be worth some confidence (pace Galton) when made on expert minds, and finally on analogy with effects of a given symptom, treatment or stimulus upon ourselves. Human analogy, like any other, depends on the similarity of the key factors in the two systems compared (cf. Chapter 5). This condition is not always satisfied, and the Golden Rule is not always a safe guide here (Russell, 1955). Nobody would be so naïve as to expect most fish, on human analogy, to be at their best when breathing air; however subtler species characteristics are not always even known. Nevertheless, if due care is taken, the analogy is better than nothing (Croft, 1957c). There are certainly some kinds of treatment which no vertebrate could undergo without distress. Sometimes inferences of this kind are confirmed by more objective methods. The readiness of a given procedure to occasion negative conditioning is one such objective criterion, as we have seen (though if used alone it may miss some inhumane procedures, since distress is not the only factor in successful conditioning--Hume, 1956). Now nausea is a thoroughly distressing state in man, and by human analogy we might well suppose it to be so in pigeons. This inference happens to be confirmed objectively, for pigeons repeatedly dosed with the emetic yohimbine soon began to regurgitate on hearing the cage door opened by the experimenter (Riddle and Burns, 1931; see also Lehrman, 1955).