THESIS: SUBJECTIVE SPACE NEEDS IN THE BUILT ENVIRONMENT

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by

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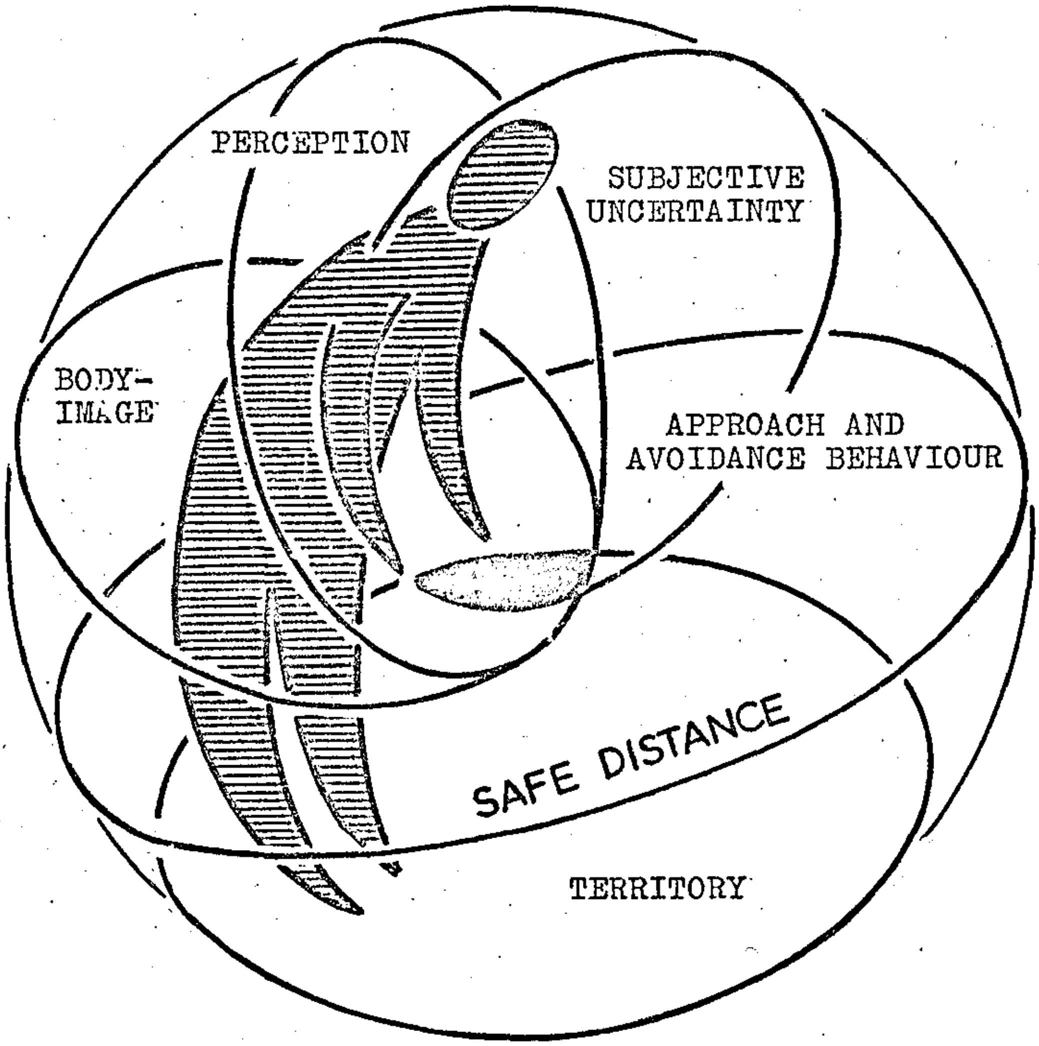
SUBJECTIVE SPACE



NEEDS IN THE

BUILT ENVIRONMENT

SUMMARY

Various references have been made in technical and popular literature to the idea that individuals regulate their external contacts with their surroundings by maintaining around themselves the intactness of a sensory spatial "bubble".

This account investigates the elusive properties of the human demand for subjective space as arising from territorial considerations, from perceptual influences, and from regard for protection of the self-image.

It is suggested that certain subjective space needs are manifest in highly structured security patterns of spatial observances. The validity of the suggestion is supported by descriptions of tests in which walking observers were confronted with stationary obstacles to their forward progress.

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W.J.Robins
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0.0
INTRODUCTION

0.0 INTRODUCTION

Space requirements for various human activities have been estimated in several ways. For example, it has been usual to equate space needs with the volumetric space that subjects have swept with their body sectors during some observation of their activities[1]; or to compute space needs from the anthropometric data of posed subjects[2]. Underlying these procedures is the rationale that human space needs are proportional to body bulk, with its corollary that big people need more space than smaller people. Perhaps such beliefs owe their origin to our nursery experiences when we vaguely comprehend that physical size, i.e. growing up, somehow gives greater access to space. Whilst the idea that the bigger we are the more room we need gains respectability from acceptance of the principle that the space we are seen to occupy is the measure of our needs. It requires an assumption that there is no pre-emption of space which is not seen to be used. No doubt this is sometimes true, but there are times familiar to most of us when our space NEEDS extend beyond the actual space we use or over which we have any kind of jurisdiction.

The dimensions of human space needs have also been sought by comparing the energy-expenditure loads that different movement patterns impose on subjects in their accommodation to variations made in the task site[3]. Such procedures follow from the postulate that optimum spatial conditions, i.e. those best suited to the needs of the individual tested, are those linked to movement patterns which entail least effort for greatest achievement. But routines which are physically less demanding are not necessarily those which require less conscious organisation or less space for their performance. Moreover, there are various benefits to be derived from unprogrammed actions which are not afforded by actions framed within a mechanistic principle of motion economy. We escape boredom and physical strain by giving variety to our movements, and we invent change for the pleasure it gives.

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Some experimenters have varied the space available for an activity systematically and have asked their subjects which arrangement they preferred. For example, one procedure requires progressive changes to be made in the task site to provide differing amounts of constraint on the required activity and the comparison of each arrangement with the last as affording improved or worsened spatial provision. In a related procedure, as used by this writer elsewhere, the experimenter has inferred the suitability of circulation spaces from the postural movements of subjects in conditions which were progressively cramped or made roomier(4).

Behind much of the effort given to estimating human space needs has been the desire to obtain information useful either to predict similar needs on a later occasion, or to provide a standard for evaluating existing space allocations. What is learnt from experiment is often widely circulated in the form of statistical frequency distribution tables setting out the objective probabilities of the recurrence of past outcomes; and, generally speaking, the belief gains ground that by collecting more and more data of the same kind we inevitably improve its authority and predictive value. Occurrences when there are relatively wide disparities between compatible data from different sources tend to strengthen the conviction that we have not measured everyone that we should; it diverts us from questioning the pertinence of the information that we have. It is suggested that the quality of our predictions about human space needs will not improve until they are based on the criteria that people actually employ in forming their everyday judgements of spatial adequacies.

We therefore set out to explain below what we believe is a prime factor affecting those judgements, and how this factor may contribute to the discrepancies which occur between observed space demands and statistical statements of the kind mentioned. Important to this explanation is an account of the emotional significance both men and animals attach to the various extended zones of space around them.

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We are possibly most aware of our space needs when we have to share space with other people since this may force us into competition for space. How well we fare in establishing our own demands may then depend on who we are, what we are doing, and our right to be in that place. It may also depend on our ability to communicate this information to others and upon the manner in which we do so. Space needs are therefore both functionally and emotionally related to the roles and activities we undertake, and to the assigned or annexed property rights we associate with those roles and activities. This subject matter is discussed in terms of human (and animal) territoriality.

Further situations involving space needs are encountered in the pathology of our emotional life such as might occur when we experience a feeling of imprisonment which we ascribe to our environmental setting although others may see no substance for our reported experience. One has only to think of families stacked like battery hens in high-rise flats. Equally illustrative are times when our mood finds expression in how we experience our body size. For example, we may feel physically smaller when crushed emotionally. Space needs are therefore related to self experience as influenced by the emotional connotations of our behavioural setting. The body-image is later described.

We also compete for space with objects and other living creatures in the sense that we may have cause to shift them or to shift away from them. What we choose to do is naturally influenced by the nature of the object or creature and the circumstances of the confrontation. The latter may involve us in considerations of role, activity, and property rights; but it necessarily involves the need for us to know the properties of whatever object or creature we confront in order to decide what it is probably safe for us to do. No less important to the understanding of human space needs is a knowledge of the processes both conscious and unconscious which precede and lead to this act of decision. This subject area calls for discussion of matters of perception and of psychological probability.

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In the last decade the literature concerned with the quality of the built environment has reflected a growing realisation that there are mental as well as physical premiums to pay for almost any human activity, such that effectively our space needs are as much governed by what we are prepared to do within a given space should it be physically possible, as whether we could achieve it with physiological economy or with economy in the spatial or other resources at our disposal.

But the nature of the relation between the emotional and physical adjustments we might have to make in accomodating ourselves to a particular physical space are perplexing. For by the process of human adaptation we can lose a dislike of or indeed grow to like particular spatial conditions. Habituation to a situation may condition us to form an attachment for the familiar. This might be because what is known is felt to be safe or at least manageable. Preferences and maybe liking are formed by a comparison with the known or imagined; and in the acceptance of given spatial conditions it is possible that we trade off perceived loss in one amenity against realised or expected gain in another. For instance, we might accept as compensation for loss of space some measure of increased security or convenience. In doing so we would have to reconcile the subjective worth (utility) of competing needs. There are circumstances, however, when pressed by events or by their familiarity we act without conscious regard for utilities. On those occasions there is one need which possibly over-rides all others in the shaping of our acceptance of spatial conditions as satisfactory. This factor now to be postulated is the gravamen of this thesis.

First of all it is necessary to distinguish the physical bounds of the contribution of subjective space needs to total space needs for some activity, and <u>the most convenient division might be to consider emotional space to be that additional to our minimum physical space requirements</u> - the latter expressed in a range of variability. Beyond the maximum of this range, subjective space needs could be expected to vary according to the situation and the mental and physical make-up of the individual; whilst conversely, they should remain stable - at least in the short-term - if the generating circumstances remain unchanged. A further requirement is a common denominator through which to express the spatial manifestation of emotional space needs in a form which lends itself to quantification[5] albeit on a psychological scale[6]. Furthermore, it would be advantageous if such an index sprang from the most basic of human emotional needs which is here postulated as the protection of self[7].

The suggestion is therefore made that such a measure might be based on the computation of the physical distance over and above our minimum physical space requirements for an activity that we are prompted to maintain between ourselves and whatever promotes our consideration of self-protection. This measure is henceforth referred to as our "SAFE DISTANCE". In terms of the psychology of decision-taking the Safe Distance is concerned with our subjective estimates as to the probability of events.[8] The "UNSAFE DISTANCE" is where danger really lies; it corresponds to the actual or mathematical probabilities of events associated with Safe Distance judgements. (See FIG.5 from Sect.1.1.9).

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Those familiar with ethological studies may see that the postulated human Safe Distance resembles the "Flight Distance" of animals as defined by HEDIGER (1950) in that both terms name a spatial relationship which a creature maintains between itself and what it fears. Hediger found that various animal species maintained a minimum distance from feared non-conspecifics (members of another species) with remarkable exactitude[9].

Animal behaviour in the defence of space has provided several models for tests of human space needs. Not only do certain animal species lay claim to the space immediate to themselves and to more distant claims just as we do, but there are similarities in the ways we each express our

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(ABSTRACTED FROM SECT.1.1.9)

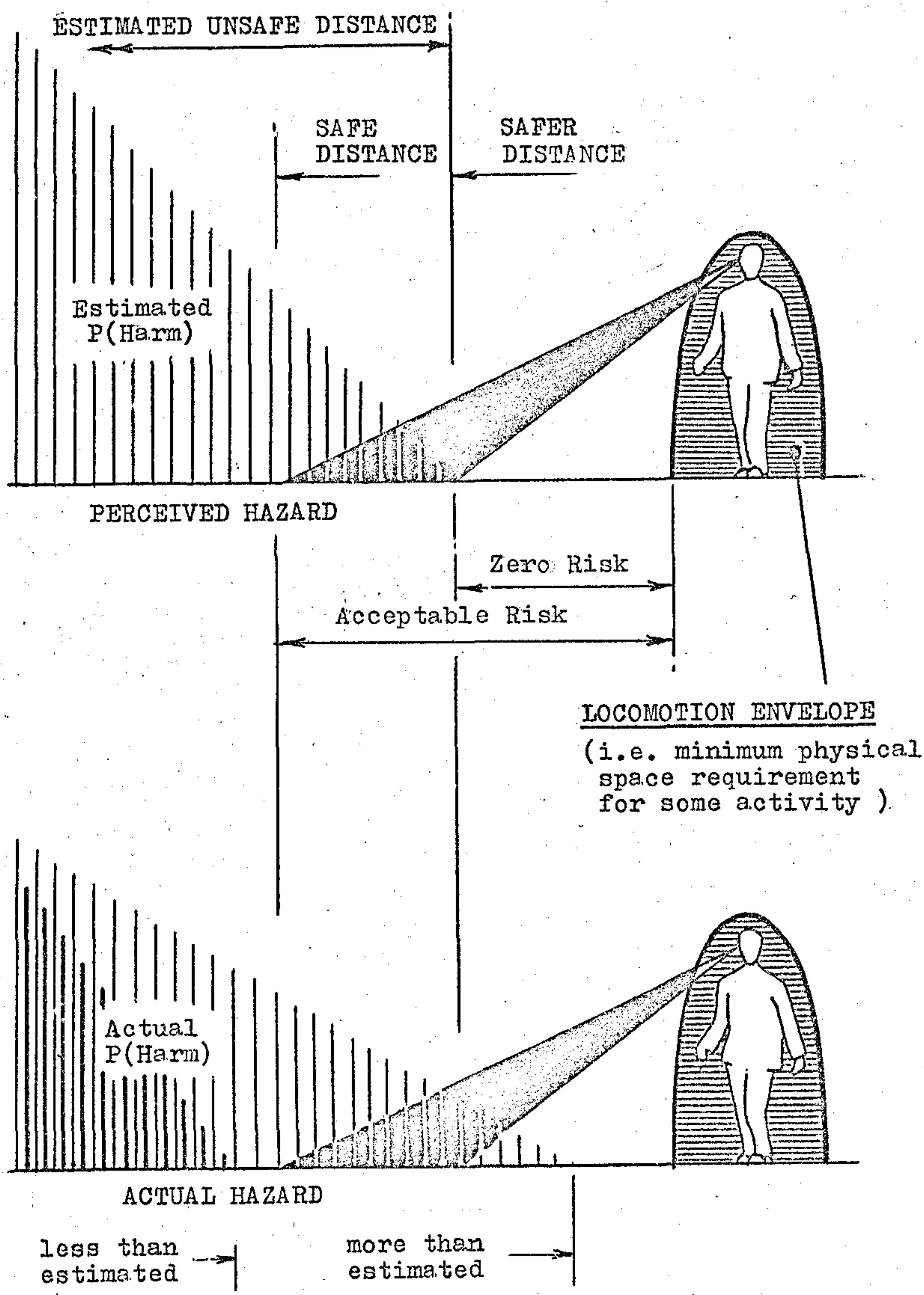

FIG.(5) HAZARD, RISK AND THE SAFE DISTANCE claims to ownership. The literature of "territory", is later discussed in detail; though here we can note that human territorial studies tend to take two forms: some are concerned with how we mark out and defend the physical boundaries of our claims to space, whereas other studies relate to the small invisible balloon of space we annexe to ourselves wherever we go within our proximal space, i.e. that space in our immediate vicinity. One term widely employed in territorial studies to denote the emotionally charged zone by which we surround ourselves in proximal space is that of Man's "personal space".

It is not always simple to differentiate one kind of subjective space need from another. Outside the usual range of territorial considerations but still concerned with the boundaries of events within our proximal space are clinical studies which have probed the nature and characteristics of the individual's body-image, i.e. his mental idea as to its physical and aesthetic attributes. In a sense the body-image is a subjective mobile territory the boundaries of which may absorb what is not-self. This introjected self is then defended as if it were self and upon that account has significance in the preservation of our Safe Distance.

By the reckoning that considerations of self-protection are more influential the nearer we are (temporally and physically) to events that have fear-inducing properties for us, it was decided to test the Safe Distance as it occurs within proximal space rather than within distal space. Human claims to proximal space have already been tested in the context of the body-image and of personal space. And since there are grounds for believing that the formation of the body-image boundary (i.e. the mental projection of the body wall) is only weakly structured from experience of confrontation with objects (e.g. the "barrier response" to Witkin's "field dependency/independency" tilting room/tilting chair tests. FISHER & CLEVELAND (1968)(10) which tend to support the claim of SOMMER (1969) that: "...a nonperson cannot invade someone's personal space any more than a tree or chair can...."(11), it was decided that the exploration of the Safe Distance would be a useful exercise to evaluate human response to "intrusive" objects.

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The experiment described in section (4.0) tests the operation of the Safe Distance in perhaps the simplest kind of encounter which is that between Man and stationary inanimate objects which obstruct his forward progress. Normally the physical environment does not compel us to act in one way or another, but the conditions of obstacle confrontation often have a "demand" character invoking a need for decision directly related to the immediate situation no less than those which may occur from interpersonal confrontation. Depending upon the familiarity of the circumstances we might decide that no special avoidance action is required from us as could be the case in our confrontation with "nonpersons" (house-servants: Sommer). But should we take consistent preventative measures when faced with specific obstacle situations, then:

i). it could provide firmer evidence of the importance of object confrontation in the structuring of our proximal space.

and ii). should the configuration of those movement patterns be revealed as largely independent of body bulk, it could provide evidence of the value of the Safe Distance as a conceptual tool to handle observed patterns of space utilisation which depart from expectations of space needs conjectured from body bulk data.

The Safe Distance may have further usefulness as considered below. Thus with regard to risk-taking in conditions of subjective uncertainty it has been pointed out by COHEN (1968,1970) that human behaviour is not wholly capricious, and that we must rule out "as totally at variance with familiar facts, the hypothesis that the degree of risk an individual takes is specific to every particular situation"(12).

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Cohen gave the opinion that two hypotheses remain although there is no present (1970) evidence to indicate which should be favoured. First, he envisaged a theoretical model with respect to risk-taking which would assert that the individual brings to every task he undertakes a maximum level of subjective uncertainty which is constant. Cohen explained that the individual's expected proportion of successes corresponding to the most difficult level of a task he would be prepared to undertake in a given number of trials would then characterise the most difficult level of <u>any</u> task that individual undertook.

His second hypothesis treats risk-taking as a variable of the class of situation. That is to say, an individual's maximum risk-taking level would be constant in comparable situations, but could be expected to vary from one kind of situation to another. Illustrative of such situations, he continued, are times such as when a man might stake either his life, his reputation, or his wealth.

Development of the second hypothesis along orthodox theoretical lines, however, would require marginal rates of substitution to be established between the different utilities of those stakes, i.e. the need to weigh ethic values. Some other theoretical approach would therefore seem to be necessary. Until we have more evidence, Cohen himself believed, his experience would intuit the validity of the second hypothesis rather than the first. The Safe Distance was tested in a single class of situation.

Overall, there would seem little that could be confidently asserted as to the procedures by which we arrive at our Safe Distance judgements beyond that they seem to be the outcome of adaptive and comparative perceptual processes which either reinforce or modify our later evaluations of what we shall come to regard as safe. And that perhaps in the execution of those judgements individuals with particular mental or physical characteristics would be consistently prepared to accept levels of risk that others would not.

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Turning now to the circumstances which surround Safe Distance judgements, it has been mentioned at the risk of repetition how better it would be to investigate the properties of the Safe Distance in some experimental mould unshaped by the utility function of value theory. This is not because Safe Distance judgements are never influenced by our thought of the expected benefits (utility) stemming from our actions, for most goal-directed activity has just this in view, but it is because by measuring the Safe Distance in circumstances where the experimental observer has - or can be expected to have - no such benefits in mind it may be possible to obtain a more accurate estimate of the effects of subjective uncertainty in everyday situations which involve mild hazards. The theoretical analysis of risk-taking has been hamstrung by the interdependence of utility and subjective uncertainty (sect.1.1.9), so perhaps a further use for the Safe Distance concept would be:

iii). the enablement of experiments allowing a "pure" measure of subjective uncertainty.

What circumstances shape the course of human actions other than their expected worth to us? In this category are simple and conditioned reflex actions as well as others not under conscious cognitive control (1.1.9).

Awareness that we make Safe Distance judgements may possibly explain the popularity of the subjective space "bubble" concept, for it is easy to suppose that we constantly scan the instabilities of our environmental setting for signs of encroaching danger. But the directional quality of visual warnings of danger should not blind us to the fact that we also possess thermal, aural, and olfactory Safe Distances, and one might also include the unease experienced through fear of falling when we realise we have proceded too far on some inclined plane.

This brings us to remark on the suggestion made later (1.1.9) that perhaps we could envisage actions in defence of our safety as occurring in response to "field forces" deriving from the attractiveness of objects in the visual field. That is to say, it seems reasonable to suppose that as we are the architects of the subjective space by which we surround ourselves, that we construct gradients within our emotional space which by reflecting the values we attach to individual events in the visual field predispose us to take particular routes between them. The dangers of assuming congruency between psychological space and physical space are realised and, it is hoped, later skirted. It may therefore be the case that the routes we take through events having emotional significance for us follow well-worn paths which confound routes predicted for us on the basis of our body measurements, and which are followed largely independent of the structural properties of the visual field. Perhaps our avoidance of persons is influenced in the same way - persons in authority over us could be seen as having steep gradients of approach and perhaps even steeper gradients of descent when we are dismissed from their presence.

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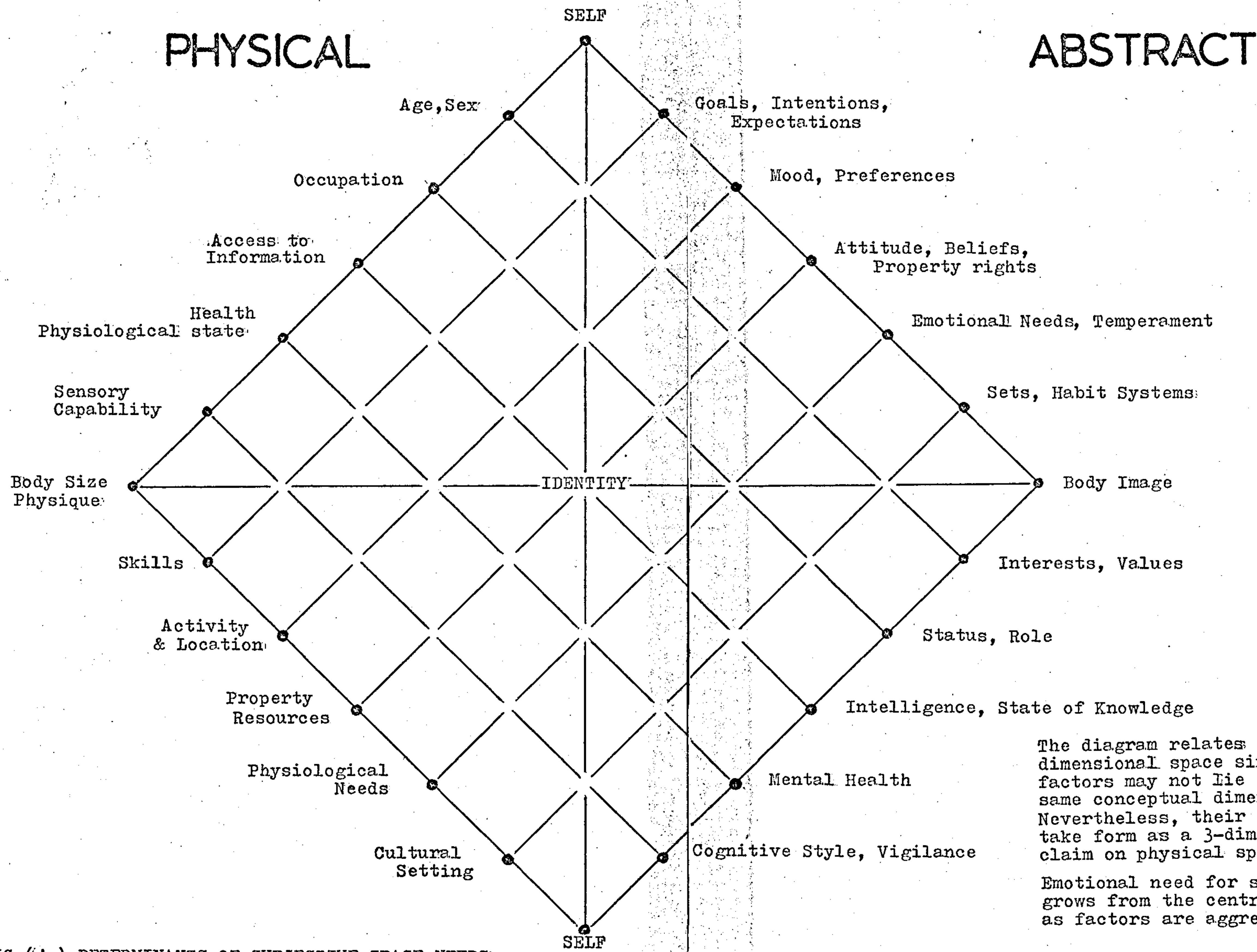
This introduction does not discuss the specific findings of the experiment in Section (4.0), because the matters are best examined after consideration of the numerous factors which can affect the dimensions of emotional space (FIG. 1), and after it has been firmly established how the Safe Distance differs from what other writers have connoted by their use of certain subjective space concepts.

Discussion of the Safe Distance has required evidence to be combed from several disciplines of study, and it is to give early acquaintance that Section (1.0) is a selective coverage of that evidence. More detailed are Sections (2.0) and (3.0). These describe the behaviour of territoriality and the influences which can shape the way we steer our behaviour.

The eclecticism of this study has fostered its own weaknesses and difficulties, and these have been compounded with terminological ambiguities arising first from the adoption of an expression "Safe Distance" which already has accepted meanings. Perhaps inevitably phenomena for which there is a broad strata of human experience are mostly named and there seems little reason to invent less apt synonyms. With regard to the expression "a safe distance" none of its widely understood meanings when applied to human affairs seem redundant to the notion of self-protection, and it should be clear from the context of the discussion when reference is being made to the Safe Distance as a projected label for subjective space needs in certain situations and when it is being used non-definitively. The terms employed in discussion of "field theory" have their own ambiguity arising from historical causes similar to that above. It should be remembered that they refer to space and forces "in the head" which allow us to construct a built environment (neuronal models, maps, and schemata) no less real to us as individuals than their physical counterparts.



The diagram relates to "n"-dimensional space since factors may not lie in the same conceptual dimension. Nevertheless, their effects take form as a 3-dimensional claim on physical space.

Emotional need for space grows from the centre as as factors are aggregated.

FIG.(1) DETERMINANTS OF SUBJECTIVE SPACE NEEDS.

1.0
SURVEY

THE SAFE DISTANCE?

"Why is it that we assiduously avoid each other as we walk around, being careful to avoid knocking into each other?

It is because we have to avoid tactile contact because it has sexual implications."

Desmond Morris in "The Human Zoo".

"That's crap. Walking is a finely balanced manoeuvre. If we knocked against each other we'd fall over."

Brian Ford in "Non-science".

(The Sunday Times, October 24, 1971.)

1.0 SURVEY

1. 1 THEORY AND SPECULATION

1.1.1 What is usually implied by a "safe distance".

Whatever the situation, we usually find life less exacting if we keep other people and the things around us at a "safe distance", for by doing so we gain more room to manoeuvre in our own protection. In subjective terms, a safe distance is the measure of our mental disquiet in relation to what we perceive as having harmful potential, and we may erect mental "barriers" to assuage that disquiet. More actively, we establish physical and spatial barriers against what we believe might hurt us and we steer clear of what we know would hurt us. How we collect or test our evidence is not clear from the available literature. Misjudgement of a safe distance can produce feelings of self-betrayal accompanied by the mental reservation that we shall know better in future; whereas if we cannot avoid having to face an unsafe situation, we may join with Shakespeare's Henry and resolutely "stiffen the sinews and summon up the blood" to arm ourselves for it.

Whether we refer to the physical or cognitive, social or isolate transactions we maintain with the non-self world, what we regularly understand by a safe distance is some state which preserves the self from unwanted experiences. To some extent we preserve ourselves from hazard known to us by choosing what we do, but we also gain some protection in our dealings with other people through our acquisition and execution of roles that give us special rights to space in particular settings. Then by the segregation effect of our roles we come to subsume those rights within our identity such that should others challenge them we view their threat as not only to our property but to ourselves and to our status placing[13]. Some conditions allow a sharper cleavage between property and personage. For example, we recognise the simple right of others "to be" although we may dispute where. And we all carry with us basic physiological needs for the space for life support. Nonetheless, our most frequent safe distance considerations involve the possibility of harm to us from environmental objects.

1.1.2 The "safe distance" as an expression of territoriality.

The exercise and defence of property rights amongst animals is known as "territorial behaviour", and few would dispute that Man is a territorial species when every back-yard fence is proof of it. Social approval of human territoriality was once exemplified in rural England by the custom of "beating the bounds" of parishes(14); though we also like to know where we stand in our personal relationships, for unless these have become encoded in some way to inhibit resentment, we object as much to social over-familiarity as to physical trespass on our private property. In particular, we are conscious of misgivings for our safety whenever we feel crowded by something near us.

As a species, such behaviour does not seem singular to Man. For it has often been observed that many animal species also mark the boundaries of their "parishes" (i.e. territories), and that they too frequently seem to care about how they rate socially among their fellows (é.g. pecking-orders). Moreover, it has also been observed many times that members of certain bird species perch at regular intervals from each other and that they are quarrelsome if this interval is reduced; the occurrence has been noted amongst other creatures.

Naturalists refer to this defence of space against conspecifics (members of the same species) as the maintenance of "Individual Distance", and its observance would seem essential to the preservation of hierarchical social relationships within the group. Individual distance in both animal and Man is behaviour based on the learning of society's expectations, and as such in Man it resembles his observance of "social distance".(15)

Wild animals are also concerned to stay away from non-conspecifics they fear. Too close an approach by such a creature will infringe what has been termed by naturalists the animal's "Flight Distance" and it will withdraw; if it cannot retreat, entry upon its "Critical Distance" will stimulate the approached animal to attack.

1.1.3 The literature of territoriality.

Human territoriality is seen at work in the defence of national boundaries, and recent times have provided new words for old ideas. We now speak of the Iron Curtain and of the Bamboo Curtain, and of buffer states and blocs, all of which have the object of keeping rivals at a safe distance. The macro-structure of territoriality has been discussed in terms of "location analysis" by economists and geographers (e.g. HAGGETT 1965)[16]; but our concern is with the expression of territoriality by the individual.

Interest in human territoriality as a spacing mechanism between individuals has only developed during the last decade, its literature is diffuse and it has as yet received little systematic documentation. Information is available from several sources: for example, it can be found embedded in clinical accounts of the mentally disturbed[17]; it is glimpsed in accounts by social anthropologists of certain cultural observances[18]; and it has been the subject of sociometric studies concerned mainly with the positioning of seating arrangements[19].

Published accounts of human territoriality have tended to be more descriptive than explanatory. This may be because purportive explanations of why we act as we do must often rest on introspection the status of which became questioned (Watson 1916) as a justification for conclusions (BROADBENT 1964)[20]; though now introspection is regaining some of its old importance (see 'Literature of imagery'). More definitive sources relating to the characteristics and functions of territoriality are therefore best sought in descriptions of animal behaviour. And since it is necessary to be familiar with those accounts to gain a fuller appreciation of human territoriality the matters are dealt with in some detail in Section (2.0).

1.1.4 The ecology of the "safe distance".

What would be the significance of the expression "a safe distance" to scientists from various disciplines ? An ethologist asked to give account of how animals might observe a safe distance is first likely to explain their territorial behaviour in relation to their conspecifics and environment. He might then describe the resemblance of specific animal behaviour to Man's own but with the added warning that whilst members of different species might exhibit similar behaviour in particular settings the exhibition could serve altogether different functions[21].

Territorial studies show that many species demand and exercise property rights over space (avian societies reviewed by NICE 1941; HINDE 1956; TINBERGEN 1957; LACK 1966; most non-human species by CARPENTER 1958)[22].

Among men it is usual to resent the "queue-jumper" who does not observe culturally established rights of precedency and their waivure for certain categories of people such as the disabled and pregnant; and children will strike, i.e. punish, objects they have bumped into. Most of the controversy which currently surrounds discussion of human territoriality centres on its connection with aggression (LORENZ 1966; ARDREY 1967; STORR 1968)[23], and though few might disagree that Man displays a propensity for aggression and violence, some deny that this is innate in animal or Man (ASHLEY MONTAGU <u>et al</u>.,1968; LEWIS & TOWERS 1968)[24].

> If, when I was a school-boy, I could not hear a drum beat, but my heart beat with it - was it my fault ? Did I plant the propensity there ? - Did I sound the alarm within, or Nature ?
>
> (Uncle Toby to his brother Tristram Shandy)
> (Toby's obsession with the paraphernalia of military defence would perhaps have qualified him as an ideal subject on which to test the Safe Distance).
>
> Laurence Stern: "The life and opinions of Tristram Shandy." 1759. (Ch.32).

The argument is an old one, and many see the nature-nurture wrangle as sterile. One of the most influential American anthropologists, S.L.Washburn, has been quoted as saying: "Nothing can be learned if there isn't an inborn capacity to learn it. And no inborn capacity can become manifest without an appropriate environment"(25).

One interest that ethologists and psychologists share is in the behaviour of the animal under stress, since disturbed people and animals often evince the same exaggerated forms of behaviour under stress (HINDE 1962)(26). Sociometric studies, i.e. studies in which people choose or demonstrate friendship or companionship tastes, have revealed that schizophrenics have erratic ideas as to a safe distance in their personal relationships (SOMMER 1959) (27); whilst it has been noted that psychopaths are often unconscious of the fact that they may be in danger (STORR 1968)(28); alienists also encounter patients with claustrophobia and agoraphobia(29).

The study of animal societies subject to natural (LACK 1954) and artificially-induced conditions of overcrowding (CALHOUN 1962)(30) has especial interest for those who share the prognosis of Malthus(31). Architects, town-planners, and indeed all those who are concerned with the quality of human community life and who are well-placed to shape it, need to know the population densities at which social co-operation begins to break down, the rule of law is overthrown, and the disintegration of society begins.

Some think it foolish to extrapolate the human condition from that which prevails in a collapsing animal society: "...arguments based on fish, birds, and other animals are strictly for them. They have no relevance for man"(32). A more temperate view attaches importance to the limiting conditions outside which theories applicable to animals are not expected to hold for Man. As BROADBENT (1964) noted:

> Amongst the simpler animals it is easier to form a general view......the lessons drawn from them

apply to some extent to man, although other principles need to be added to deal with human behaviour (33).

The results of experimentation on animals by psychologists have perhaps been too easily generalised to human behaviour on occasions, but there have been times when research on animals has shed light on human behaviour. One such instance (MILLER 1944) has led to the formulation of concepts of approach and avoidance gradients to express the drive state of the individual motivated by conflicting tendencies[34]. Miller derived four principles held to apply for most events involving the individual in approach - avoidance conflicts.

i). The closer the goal the stronger the tendency of the subject to approach it. (Approach gradient).

ii). The closer the place or object avoided the stronger the tendency of the subject to go away from it. (Avoidance gradient).

iii). The strength of avoidance increases more rapidly with nearness than does the strength of approach. I.e. the avoidance gradient is steeper than the approach gradient.

iv). The strength of the tendency to approach or avoid varies with the strength of the drive motivating them. An increase or decrease in drive can thus raise or lower the entire corresponding gradient.

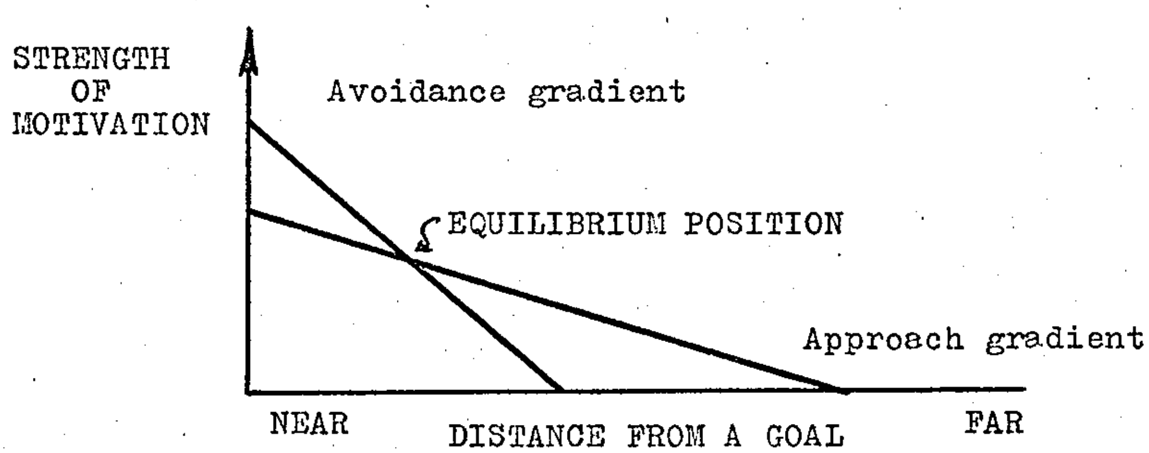


FIG.( ) APPROACH-AVOIDANCE CONFLICT & EQUILIBRIUM POSITION.

In Miller's diagram (Fig. 2) goal satisfaction is represented by the vertical axis. The further from the goal the less similar are the stimuli to the stimuli of the goal and so both gradients decline with increase in distance. But fear occasioning avoidance is mostly triggered by environmental stimuli whereas approach behaviour is lrgely governed by internal stimuli (e.g.affiliative need); thus since internal stimuli might be expected to be less different between near and far positions than the experience of fear the approach gradient is shown as less steep. It was found in animal research that an animal vacillated unable to proceed on reaching the point of intersection of the approach and avoidance gradients. ARGYLE (1967) has remarked that a very similar process occurs between individuals who are attracted to each other but who also fear each other: "...if the avoidance gradient is steeper than the approach, it follows that people will move together until the equilibrium is reached, and then stop." He has suggested that this equilibrium point is a function of certain forms of expressive behaviour[35].

Not only have the factors which promote our actions received the attention of experimenters (e.g.VERNON 1969)[36], attention has also been paid to human perceptual ability. Our primary mode of obtaining sensory information is through vision, and there is no doubt that what we see of the world influences and is both influenced by our actions (e.g.HOWARD& TEMPLETON 1966)[37]. But the safe distance also applies to those who do not possess a full sensory complement. Experimental work on guidance aids for the blind and deaf-blind has uncovered some of the less well-known difficulties they encounter[38] and it has exposed the false hope that their spatial orientation is achieved by some Lamarckian development[39] of a compensatory sensory mode or latent tropism, e.g. facial vision[40].

Interest in partial sensory deprivation has extended to the victims of thought-indoctrination[41]. Enquiries have now widened to forecasting the effects of prolonged confinement on future astronauts and sub-acqua explorers. Interest in sensory isolation also lies in its relevance to penology, the operation of remote-controlled industrial plants, travel and work in windowless environments and elsewhere. Conditions of social isolation as enforced by occupation, residence, or infirmity display evidence that the safe distance has cohesive as well as divisive properties. For though the safe distance usually sets the measure of our preferred non-involvement with our physical surroundings, we normally prefer not to be too far from assistance should we need it in emergency.

Perceptual ability includes the capacity to form discriminatory judgements, and people may disturb this capacity by the use of alcohol and drugs or by rhythmic dancing and gymnastic exercise. The effects of alcohol as a depressant of the central nervous system, as an euphoric releaser of tensions and, sometimes, as a wrecker of vestibular mechanisms are notorious. Its sinister influence on our evaluation of a safe distance has marble memorials. Drug-taking has also had its serious chroniclers from Quincey to Huxley [42]; whilst contemporary society does not lack advocates of the practice. Dancing and gymnastic exercise as a preliminary to revelatory experience is as old as organised religion[43].

A neurologist might say that we judge a safe distance by comparing the circumstances of our involvement in a particular social or physical relationship with a mental concept (a model or "schema") built from similar past relationships, and that our conclusions upon which we would base our behavioural response would be influenced by the pertinence and favourability of this comparison (HEAD 1920; and BARTLETT 1932; OLDFIELD et al.,1942; and later commentators)[44].

To a social anthropologist, a safe distance might be that which conformed to local customs and taboos [45]. Most societies have their hierarchical structures and ceremonial precedencies, habiliments, forms of greeting, proscribed foods, consanguineal prohibitions, and so on; and the person who disregards the rules of social conduct which a society lays on its members is unlikely to gain easy acceptance therein and may expose himself to harm. Yet whatever prescription is adopted to express conformity or "togetherness", it is characteristic for us to desire recognition of our unique identities, and in return for recognition we give the same to others. From this grows a system of "social distances" through which we express by word choice, voice inflexion, our actions and spatial positioning, how we view our social role in relation to that of others. Social distances are learnt and are culturally determined (HALL 1955,1959), and an infringement is often regarded as more than a breach of manners inasmuch as it can be interpreted as a denial of the role we accord ourselves and as an expression of hostility towards us[(46)]. Social distances are maintained by regulating our informational and physical contacts according to the "hat" the occasion calls on us to wear (GOFFMAN 1959)[(47)]. So there might be occasions when we are prepared to sink our private identity in that of the crowd, and we may cheerfully join in such promiscuous pushing and jostling as would in other circumstances earn us strong remarks from a magistrate. In British society these occasions appear to be largely those involving sport or which have a sporting flavour as, for example, womens sales, or rush-hour travel.

In a final category of scientists who might be asked what they understood by a safe distance are those from various disciplines who are interested in how we make up our minds in conditions of subjective uncertainty involving risk. The category would comprise individuals from two distinct groups: those concerned with the mathematical modes of decision theory - which is not our concern; and those interested in the reliance we place on our reading of an unsafe situation as a basis for action and the factors effecting our interpretation - the area of psychological probability.[( )]

1.1.5 The embodiment of the SAFE DISTANCE.

If a "safe distance" means so many things to people with such a wide diversity of interests, which concept most closely captures the essentially protective nature of the SAFE DISTANCE ? The answer may reside in neurology and in the concept of the "body-image".

The body-image is the mental idea we possess as to the physical and aesthetic attributes of our own body at rest or in motion. An important property of the body-image is that its contours (boundaries) do not necessarily concur with those of the body proper, but they may incorporate contiguous space and objects.

It is suggested that the SAFE DISTANCE is of the same genus as the body-image, and whilst they may not be congruent in Cartesian terms, that both are evoked by similar if not the same perceptual mechanisms.

The nature of the stimuli which contribute to the promotion of our ideas as to a Safe Distance is a matter for conjecture. CRITCHLEY (1950) has said that chief among the body-image stimuli are visual factors, tactile impulses, and the proprioceptive stimuli; but that none of them is essential is proven by the phantom limb sensations of amputees (KOLB 1954)[48]. There would appear to be an additional stimulus that requires identification. Evidence of what might be such a stimulus has recently been claimed (Novosti Information Service, Moscow)[49].

1.1.6 The literature of imagery.

A history of the development of the body-image concept extending from the nineteenth century has been sketched by CRITCHLEY (1950); a good account of the different formulations concerning the body-image in various theoretical systems has been given by FISHER & CLEVELAND (1968) (50).

The body-image experience is only one of many different forms of imagery. RICHARDSON (1969) has categorised mental imagery into four major sub-classes of experience: eidetic imagery, after imagery, memory imagery, and what he terms imagination imagery in which class he placed the body-image experience. He has discussed the nature of mental imagery and the theoretical,practical and methodological problems that are raised by its existence.(51)

In his presidential address entitled "Imagery, the return of the ostracised", HOLT (1964) drew the attention of the American Psychological Association to the way practical problems in engineering had led to a revival of interest in imagery after its long decline under the attack of behaviourists who anathematized imagery as introspective. The source of this interest, he saw, arose partly from accounts of problems of an ergonomic kind which have involved such persons as radar operators, long-distance lorry drivers, jet-pilots and polar-vehicle drivers in danger through the emergence into their consciousness of "vivid imagery, largely visual but often kinaesthetic or auditory, which they may take momentarily for reality". He remarked that as a consequence:

> ...when serious accidents can occur (through imagery), practical people are not likely to be impressed by the argument that imagery is unworthy of study because it is 'mentalistic' and virtually impossible to experiment on with animals.

Holt described other factors that had brought imagery back to notice among which were studies of creativity and experiments on the effects of marginal and subliminal stimuli. He saw that many had now become fascinated in the processes of thought employed by highly original and productive minds in the arts and sciences; and that there was also reawakened interest "in the possibility that stimuli of which a person is not focally aware may nevertheless affect his cognitive processes"(52).

1.1.7 Differentiating the SAFE DISTANCE from other subjective space needs.

The Safe Distance has been introduced as the spatial interval we are prompted to set between ourselves and the real or imagined properties of an object we regard as having potential to harm us. Because we observe a Safe Distance within the boundaries of the claims to ownership we make on the space around us as well as outside those boundaries, it is a measure of our subjective space needs which can be differentiated from two kinds of human claim to space that writers have already distinguished. The latter relate to the space we claim for our personal use - our territorial claim (Section 2.0); and to that space occupied by our bodies and what is immediate to us which we incorporate into our body-image (Section 3.0). Various terms have been used to label those claims[53]. Let us here consider some of their important features.

Firstly, we maintain a Safe Distance between ourselves and any object or event we believe to possess intrinsic or acquired properties harmful to us. Safe Distance judgements arise mostly in response to perceived threat to us (see 3.1.10;otherwise). The precautions we take depend on the circumstances in which we find ourselves. For example, if we are directing our own locomotion we might make a detour around an object we see as threatening our safety, or perhaps retreat from it. Whereas if we are stationary and wish to hold our ground we might arrange for the perceived threat to be removed; alternatively, we might barricade ourselves against it. But whatever initiative we take, we show a defensive concern for our well-being which is present even in solitary or physical-contact sport where we seek hazard for stimulation. We show a similar concern to preserve our body-image boundaries and territorial boundaries. The difference is that our invitations to intrude upon our body-image or upon our territory are not usually accompanied by unacceptable expectations of harm, whereas by consciously ignoring our Safe Distance we are normally aware of flirting with danger and unacceptable consequences.

Secondly, there are similarities between the body-image percept and the Safe Distance in that each operates only in the presence of its owner who is the locus of his ensuing claims, whereas territory can be claimed in the absence of its owner.

Thirdly, territory is frequently delineated by boundary markers intended to serve as notification to others of a claim to space, and whereas territorial markers are usually fixed and patrolled the boundaries of the body-image and the Safe Distance are usually invisible to others although their presence as a claim on space may be inferred and tested.

Fourthly, there are various reasons involving role-playing or self-aggrandisment which could govern the dimensions we set to our territory holding and to our body-image, whereas the dimensions of our Safe Distance are established principally by the desire for self-protection.

Fifthly, territory can be jointly owned and occupied, and we can extinguish our claims or transfer them to others by sale, gift, or rent. Joint occupation of a body-image might occur in Siamese twins and perhaps in copulation, but only a psychotic would extinguish his claim to a body-image or would normally lack concern for maintenance of his Safe Distance.[54]

The relationship between the Safe Distance and the body-image seems essentially closer than that between the Safe Distance and territory. Yet the wish to maintain a Safe Distance can prompt the acquisition of territory, and since occupied territory is sometimes indistinguishable from the extended body-image as with the car and driver, it is often difficult to disentangle our overlapping claims to space (Fig. 3). We can however distinguish between a claim to space and a claim to a place when the latter is accompanied by site attachment, for whilst both kinds of claim are defended there are differences in the form of defence. Body-image boundary studies give importance to the evidenced and reported self-experiences revealed by the sub-

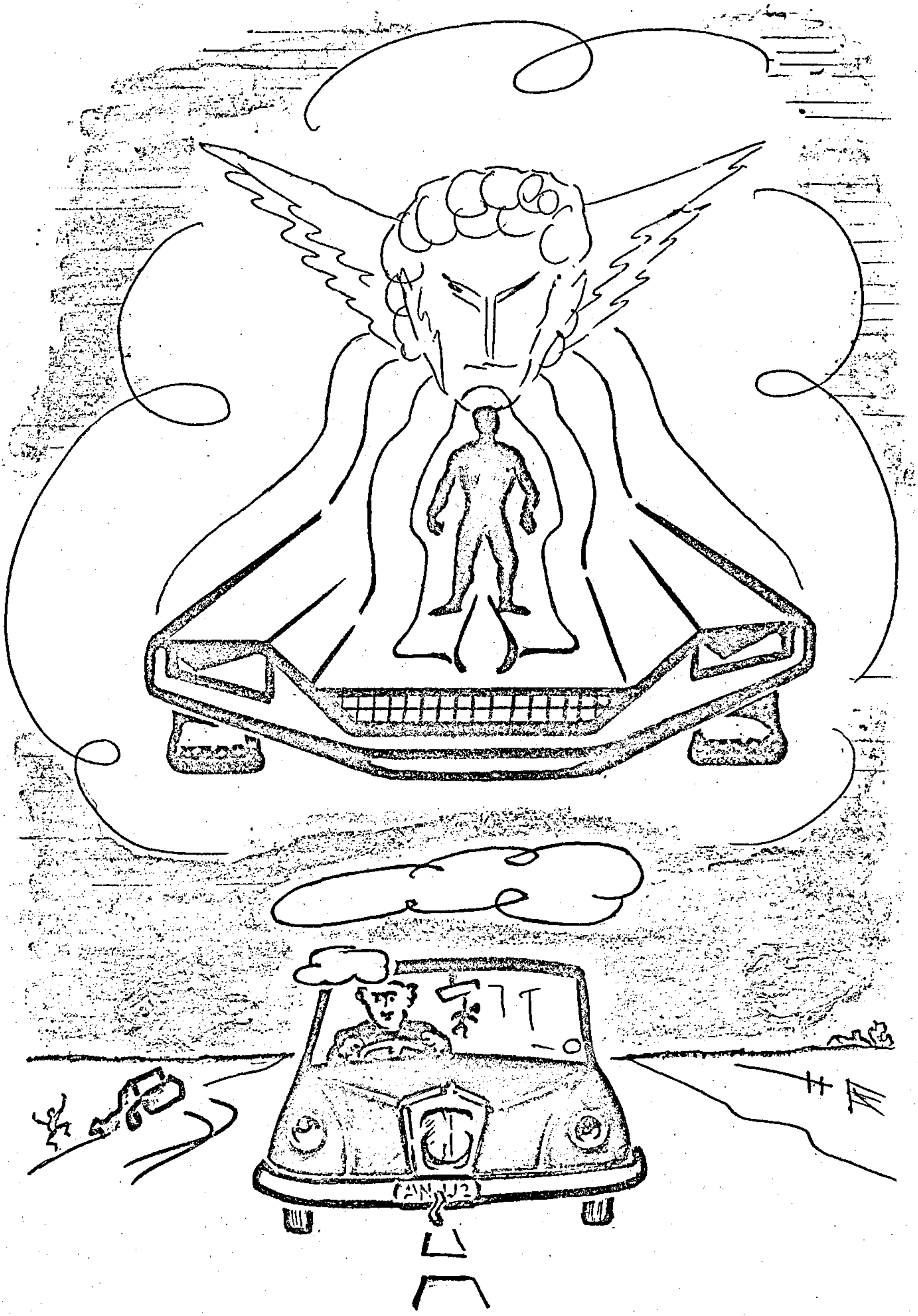


FIG. (3) TERRITORIAL ATTACHMENT ARISING FROM THE WISH TO MAINTAIN A SAFE DISTANCE BECAUSE OF THE BODY-IMAGE

-ject in making his claim to space; by contrast, investigations of territory have tended more to trace the province of such claims and the tactics adopted to preserve their boundaries intact. As a result, the body-image has come to be viewed as a mechanism of ego-defence amenable to the clinical procedures of psycho-analysis and of neuropathology, whereas most human territorial studies have been concerned with site attachment and its defence.

Yet whilst the defence of the identity of the individual can be differentiated from his defence of property, both relate to the maintenance of the integrity of the whole and to the differentiation of what is "us" and "ours" from what is not. The meshing of these ideas in practice can be seen in the way we "personalise" our belongings and indeed our appearance so as to emphasise their uniqueness. To deny people the right to express their uniqueness is perhaps to reduce their stature as persons in their own eyes. Maybe for this reason we often resent restrictions on our freedom to make our own Safe Distance judgements as might be imposed by such factors as road speed limits and crush barriers, although we might simultaneously approve the need for such restrictions upon other people.

A point of a different kind involving defence of subjective space in its various forms is the conjunction of subjective space with privacy [55]. Yet whilst the desire for privacy can arise from calculations of personal safety, privacy and safety are need-states not necessarily sharing the same antecedent conditions. Again, in the event itself, what is safe is not necessarily private nor is that which is private necessarily safe. It can be safe to be in a crowd, it can be private to walk down an alley at night. At the emotional level, it can be safe for a politician to mouth platitudes but not what he believes privately. Our safety can be hostage to events unconnected with other people, our privacy invariably relates to the actions of other people.

1.1.8 The operational characteristics of the SAFE DISTANCE.

A basic similarity between the body-image and the Safe Distance is that both are never far from awareness except when cognitive control is lost, since both are intimately concerned with self-protection. Another similarity is that both are psycho-physical phenomena, i.e. of the mind and body, which would appear to be amenable to the test procedures of sensory psychophysics. Perhaps we test the intactness of our Safe Distance by projecting a threshold, i.e. an invisible curtain, between ourselves and a non-self object. Possibly such an act of projection towards a perceived object would be basically determined by our attitude as affected by our prevailing mental and physiological states, and there would be a symbiotic relationship between the act of projection and our idea of a Safe Distance such that each would be of the other a consequence of past tests and a model for future tests.

Thus one could suppose that different objects would each have their own thresholds for us as would the different parts of our body, for we take greater care to avoid proximity with objects of known harmful propensity than otherwise, and it is more important for us to look after some body parts than others. The permeability of a threshold could be expected to vary according to the valency of the object perceived, for there are social occasions which require us to grant a limited class of objects a license to enter; but, in the main, an impingement on a projected boundary threshold should provoke in us a compulsive urge to move away from the perceived threat. The range of these projected thresholds seems subject to change, and whilst some factors affecting their adjustment are mentioned below, a major influence is surely whether our past fears or expectations were realised. Rewarding expectations seem to make us no less discerning of an impingement on a boundary threshold but seem merely to reduce its range of projection, whilst unwanted expectations appear to increase this range. The outermost range of a projected boundary with ourselves as locus is probably an imaginary one - an obvious instance is to consider what we would regard as a safe distance in the event of an imminent nuclear attack. But within the perimeter of our controlled privacy, i.e. the area in which we can take effective countermeasures, an increasing category of objects become unacceptably close as they draw near. At some stage, the impact of a spatial relationship precipitates our uneasiness. The "tensions" this promotes in us might well be signs of pressure on a subjective sensory envelope or "bubble" we project outwards from ourselves as an integral feature of our personality, where the shape of the bubble is moulded by the whole pattern of forces acting upon it such that any one sector both fits with and effects the remainder, and where its boundaries are set by our constantly changing assessments of what we believe is a safe distance.

The idea that we surround ourselves or are surrounded by a transparent "bubble" is familiar currency in discussions of Man's spatial relationships. Von UEXKULL (1935) used the idea of a bubble to denote the "Umwelt" of an animal, i.e. the limits of its perceptual world.(56) The bubble also has an allegorical connotation. For example, Pieter Bruegel the Elder (1525/30? - 1569) represented human conceit in his painting "Dulle Griet" (Mad Meg) as a transparent sphere enclosing its possessor(57). In the matter of keeping social distance, GOFFMAN (1956) quoted:

> Although differing in size in various directions and differing according to the person with whom one entertains relations, this sphere cannot be penetrated, unless the personality value of the individual is thereby destroyed. A sphere of this sort is placed around man by his 'honor'. Language very poignantly designates an insult to one's honor as coming 'too close': the radius of this sphere marks, as it were, the distance whose trespassing by another person insults one's honor.(58)

On a similar theme, HALL (1966) has explained:

> ...each organism, no matter how simple or complex, has around it a sacred bubble of space, a bit of mobile territory which only a few other organisms

> are allowed to penetrate and then only for short periods of time. The size of the bubble varies according to a complex set of rules and formulae. Basically, however, its size and therefore how much space is required per individual, is a function of four sets of variables: position in a social hierarchy, activity, emotional state, and the culture in which one grew up. (59)

That we translate our involvements with the outside world into a conceptual system of spatial referents is seen in the terms commonly used to describe our social relationships as well as the circumstances which might surround us. For a man will say that he is a "close friend" or "distant relative" of someone and that he prefers to keep his acquaintance with another "at arm's length". In the same vocabulary, he may also describe a near collision as a time when something came "too close for comfort" or that he felt "overwhelmed" by the presence of something else(60). It is clear even from these few examples that <u>we tend to describe such events and relationships in terms of the mood which the reference evokes in us(61). We also describe them either directly or implicitly in terms of some notion we hold of our body size.</u>

It follows that our mood probably influences our concept of our body size, and so what we consider to be a safe distance will partly depend on our mood. English metaphor is rich with examples of the human topological distortions which originate this way. There are moments when we "feel big" or "get above ourselves". At other times, we feel diminished in stature either in our relationship to others or in relation to the environment itself. We feel "small" when we have been caught out in some deceit or have been rebuffed or are fearful; and there are instances when we "swell" with gratification, importance, or anger. Our mood also appears to influence the size of what we perceive. This can occur when we invest sacred or supra-normal qualities in other people so that to us their perceived size has no congruency with their true dimensions regardless of the perceptual constancies. We also have periods of empathy with our physical surroundings when we seem dwarfed by our association with a super-human scale. The reverse of this happens when we are liberated from the discipline of a social situation, or when we emerge from a restricted visual or spatial environment into a world of receding boundaries. Vehicular travel can also promote a disassociation with our immediate surroundings, so that a sudden stop in progress and the stabilisation of visual impressions may be accompanied by the sensation that our body dimensions have shrunk [(62)].

Our estimate of a safe distance depends greatly on what we are doing, how intensely we are engaged in its pursuit, and where it is being performed. How we view the penalties of failure may vary according to our temperament, physique and sex. Again, as JORDAN (1968) has pointed out: "... when (psychological) certainty exists (i.e. belief and confidence as distinct from logical certainty) the taking of risks and chances becomes exciting otherwise they are threatening"[(63)]. By taking risk we incur hazard, i.e. a statistical probability of failure (COHEN 1968)[(64)]. The realism of our judgement of a safe distance therefore depends on reducing the discrepancy between subjective and objective probabilities to a minimum. The greater the discrepancy the more likely we are to have an accident.

What is regarded as a safe distance will alter as we age, for the passage of time modifies our views in the light of the confirmations and contradictions which succeeding experiences provide. The child learns where danger lies by accident, instruction, and exploration, although there is some evidence that depth perception might be innate (GIBSON & WALK 1960)[(65)]; the adult adds to this a repertoire of protective reflexes prompted by a whole inventory of learned cues, as well as a confidence to predict in terms of psychological probability the likely consequences of a particular course of action. But sensory receptivity usually becomes impaired with age as do the motor responses it initiates, and the acceptable spatial tolerances of youth then no longer apply. The caution of the elderly reflects the adaptative adjustments they make to their ideas of a safe distance as compensation for this impairment. This shows in the greater leeway they give to obstacles both temporally and spatially as the penalties for misjudgement become more severe. The stumblings of adolescent youth illustrates that there can be difficulties in making these adaptative changes through the persistence of earlier spatial referents which are inappropriate to their rapid growth of body dimensions, and it is worth passing notice that it is during adolescence that the "territorial" insistence for a "room of one's own" and other forms of independence are so clearly marked(66).

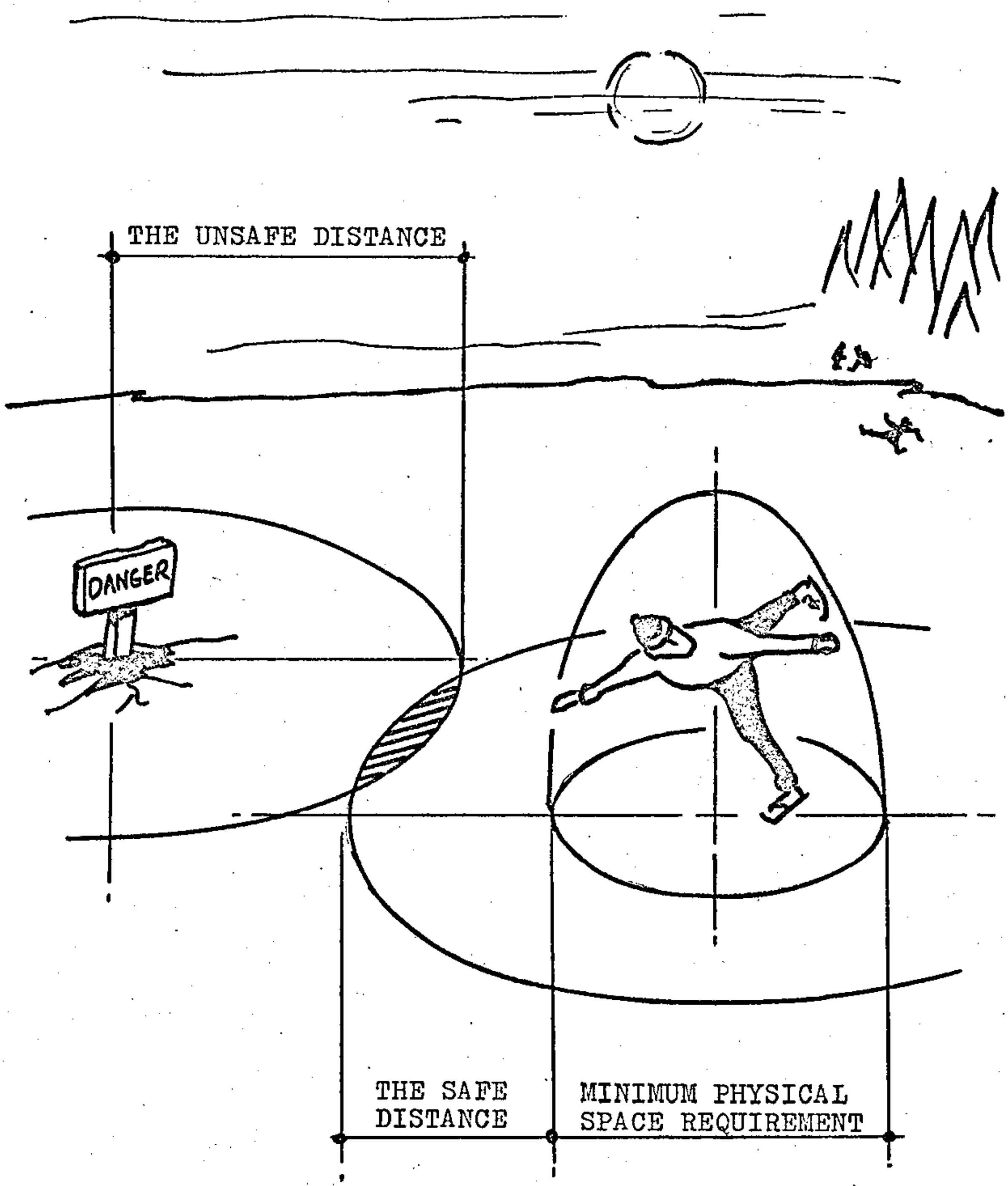
It could be inferred that we build up our frames of reference according to the circumstances of our normally prevailing state of health, and that departures from this state would promote corresponding changes in our spatial referents. The desire for solitude frequently exhibited by Man and beast when they are ill or injured may be linked to the changes in the magnitude of those referents. Fatigue would also seem to affect our assessment of a safe distance. As we tire our judgements become less sharp, our reaction times slow down, and there may be a loss of muscle-tone. In non-clinical terms, we feel less "outgoing", and we may show by heightened irritability a new lack of tolerance for events external to us; possibly our efforts to maintain a projected threshold escalates our fatigue in a self-reinforcing loop.

1.1.9 The "UNSAFE DISTANCE".

The Safe Distance could be seen as a measure of a human boundary condition of a probabilistic kind, for it denotes in spatial terms the level of risk (Est.P(Harm)) we would be prepared to incur by occupation of some location under the assumption that our action exposed us to zero or neglible harm. But occupation of a Safe Distance location is an insurance against harm carrying no guarantee that we shall not be harmed because in our transaction with the event we also incur hazard. Hazard is an objective property of the event, i.e. its actual capacity to harm us. So complementary to the Safe Distance is the UNSAFE DISTANCE. Judgements of unsafety being complementary to those of safety have neither more nor less accuracy. The Safe Distance is the distance we are prompted to set between ourselves and a situation perceived as dangerous; the Unsafe Distance is the measure of where danger lies irrespective of whether we can recognise danger or assess its magnitude correctly.

The UNSAFE DISTANCE lies between the object or event and the closest point we can approach them without incurring hazard for which they are responsible. Whether we are aware of hazard depends on several factors. Influential among them is whether we recognise an object or event as of a class having intrinsic harmful properties or capability to acquire them. It also depends on our alertness. But hazard can be concealed through our sensory inability to detect properties harmful to us, e.g. micro-wave radiation, or by an object's non-visible characteristics, e.g. load-bearing. Moreover, we cannot usually compare in advance of action our estimate of risk with its related hazard but only with its estimated hazard or with past hazards. The Safe Distance and the Unsafe Distance can therefore overlap, and the extent of accidental overlap is the error content of our Safe Distance judgement (FIG. 4).

Figure (4) is drawn to suggest overlapping probability distribution fields, for whether the overlap is accidental



NOTE: THE PROPERTY OF THE OBJECT FEARED IS THIN ICE HENCE THE SAFE DISTANCE EXTENDS TO THE ESTIMATED BOUNDARY OF THIN ICE AND NOT TO THE SIGN POST.

FIG.(4) THE SAFE DISTANCE AND THE UNSAFE DISTANCE or deliberate (e.g. for thrills or rescue) the inadvisability of our actions in terms of self-protection is a function of how far we enter the unsafe area, the nature of the hazard, and the rate of progressive increase in "unsafety" to which we become exposed. Once we have entered hazard, our safety or unsafety is not usually a two-state condition, but one in which we can substitute varying amounts of one quality for the other such that there are safer and less-safe distances between certainty of safety and certainty of harm (Fig. 5).

Let us first consider the Safe Distance as demarcating a boundary within which the chance of harm occurring to us from some object or event is perceived as absent <u>or acceptable</u>; so any location we willingly occupy knowing it to be relatively unsafe is within the margin of expected costs acceptable to us, as would be our willing occupation of a location arising from our wrong belief of what is wholly safe. Where there is no perceived danger to ourselves either real or imaginery - whether or not we are in hazard - there can be no Safe Distance judgement, for by definition such judgements are made only after we have asked ourselves Is it safe ?

<u>Perhaps we can therefore postulate the Safe Distance as an interface between our experience of either safety or unsafety in relation to perceived danger where the marginal rate of substitution between those experiences is in equilibrium</u> ? That is to say the Safe Distance is stabilised when the expected utility (satisfaction to be gained) from any further incremental progress would be accompanied by an unacceptable loss in safety as measured by our estimate of the probability of us coming to harm. Could not the Safe Distance be considered as a maximised (perhaps optimised) function of utility moderated by the estimated probability of the occurrence of some event ? Behavioural decision theorists have postulated such equations with regard to models of risky decision-taking in certain gambling situations.

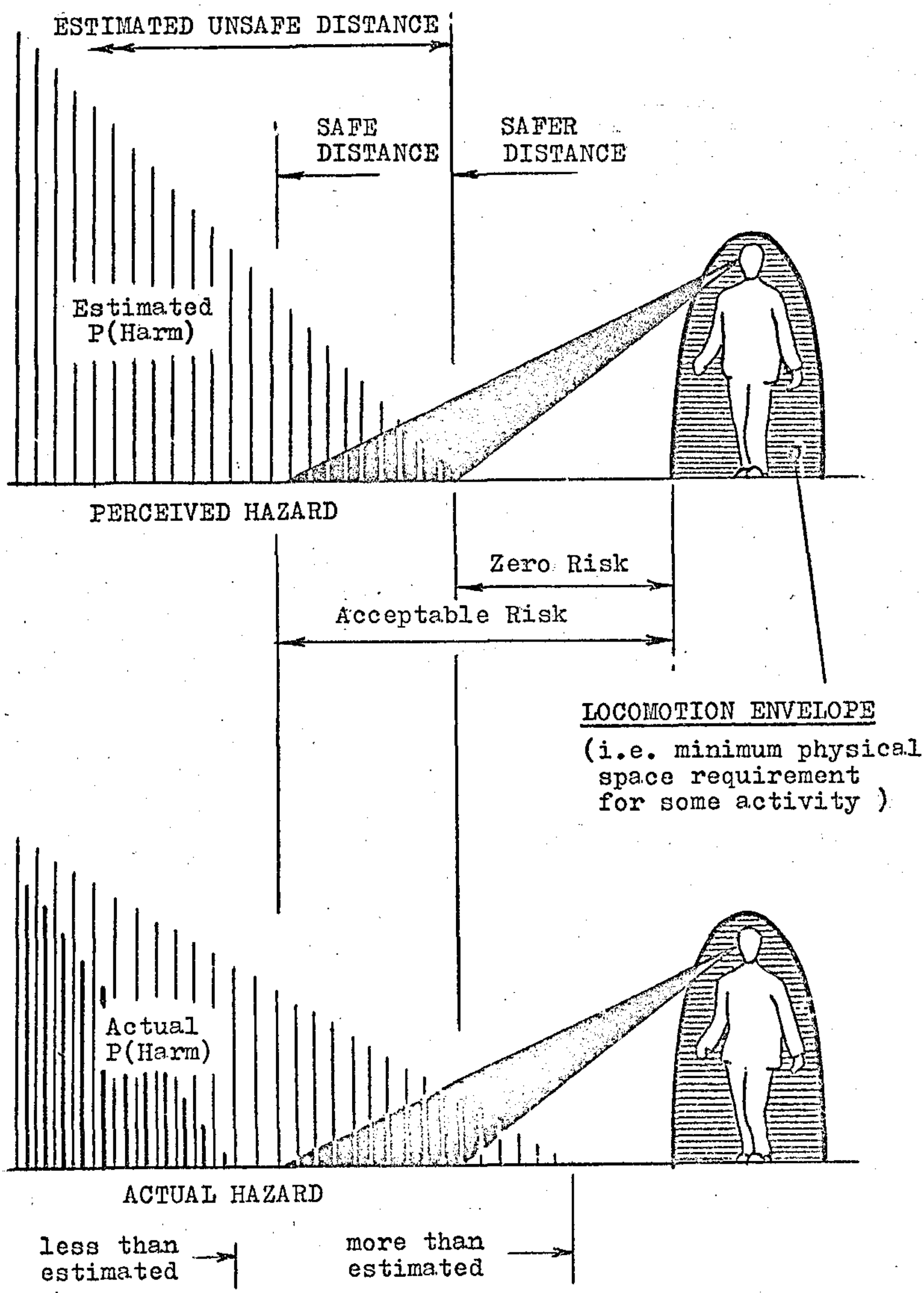


FIG.(5) HAZARD, RISK AND THE SAFE DISTANCE

However, there are great difficulties in furthering such a line of enquiry which EDWARDS in EDWARDS & TVERSKY (1967) revealed as both logical and mathematical. More recently, COHEN & CHRISTENSEN (1970) have explained:

> ...it is very difficult to separate the utility an individual attaches to an outcome from the degree to which he expects that it will materialise. In other words, μ (utility) and ψ (psychological probability), generally speaking, are not independent of each other. (67)

And, referring back to Edwards:

> If utilities and subjective probabilities are not independent, then there is no hope of predicting risky decisions unless their law of combination is known, and it seems very difficult to design an experiment to discover that law of combination. (68)

As to the use of the term "psychological probability" in the more recent citation and linked to the difficulties mentioned by Edwards, Cohen and Christensen provide convincing illustration of the conceptual inadequacies and ambiguities of the term "subjective probability". They suggest that psychological probability has to do with "the uncertainty entertained by individuals about the truth or validity of their statements and about the wisdom, usefulness or safety of their decisions or actions" (69).

. . . . .

More encouragingly, it has been noted by Edwards, an engineering psychologist, that the notion of utility(70) has appealed to psychologists by virtue of its similarity to the Lewinian idea of valence, i.e. the attractiveness of an object or activity to a person, and he stated that they "might consider the experimental study of utilities to be the experimental study of valences, and therefore an attempt at quantifying parts of the Lewinian theoretical system(71). In the value theory of economics (which psychology borrows) competing utilities can be represented on "indifference curves" which portray contour levels of satisfaction associated with different combinations of utilities. And one can imagine a behavioural "field" in which Safe Distance judgements are made as having stratified regions composed of different valence strengths ascribed to perceived events within that field. The path taken by the operator would be governed by the dimensions of his subjective space envelope and by the direction and strength of his goal motivation. One might conjure the Safe Distance as a squashy transparent globe within which we encapsulate ourselves as we locomote amongst perceived events in a modern Pilgrim's Progress, inclined to seek the valleys between non-goal events and to traverse the lower slopes of difficulty, whilst by impetus, i.e. strength of drive, overcoming obstacles to our progress or by inertia, i.e. lack of resolve, failing to do so. Such imagery (FIG.6) is not inconsistent with the idea of gradients mentioned earlier, and now below. Let us examine whether we can determine the Safe Distance as a resultant vector path between competing valences.

One must tread warily when representing subjective space in pictorial terms since position and structure in representations of the subjective "field" are analogous and not homologous to physical space. Yet there are coincidences when physical direction and distances in physical space are sufficiently close to their psychological counterparts as to allow their use as frames of reference for representation of an individual's "life space". Lewin spoke of them as "quasi-physical" representations(72). Instances of their occurrence he saw as arising typically in conflicts between driving forces which lead to "locomotion" away from a negative valence and of restraining forces, i.e. physical or social obstacles, which do not lead to locomotion but which influence the effect of driving forces. He held that the strength of the force towards or away from a valence depended upon the strength of that valence and the psychological distance between the person and the valence; and that where positive and negative valences were in opposition there was an equilibrium between them where their strengths were equal.

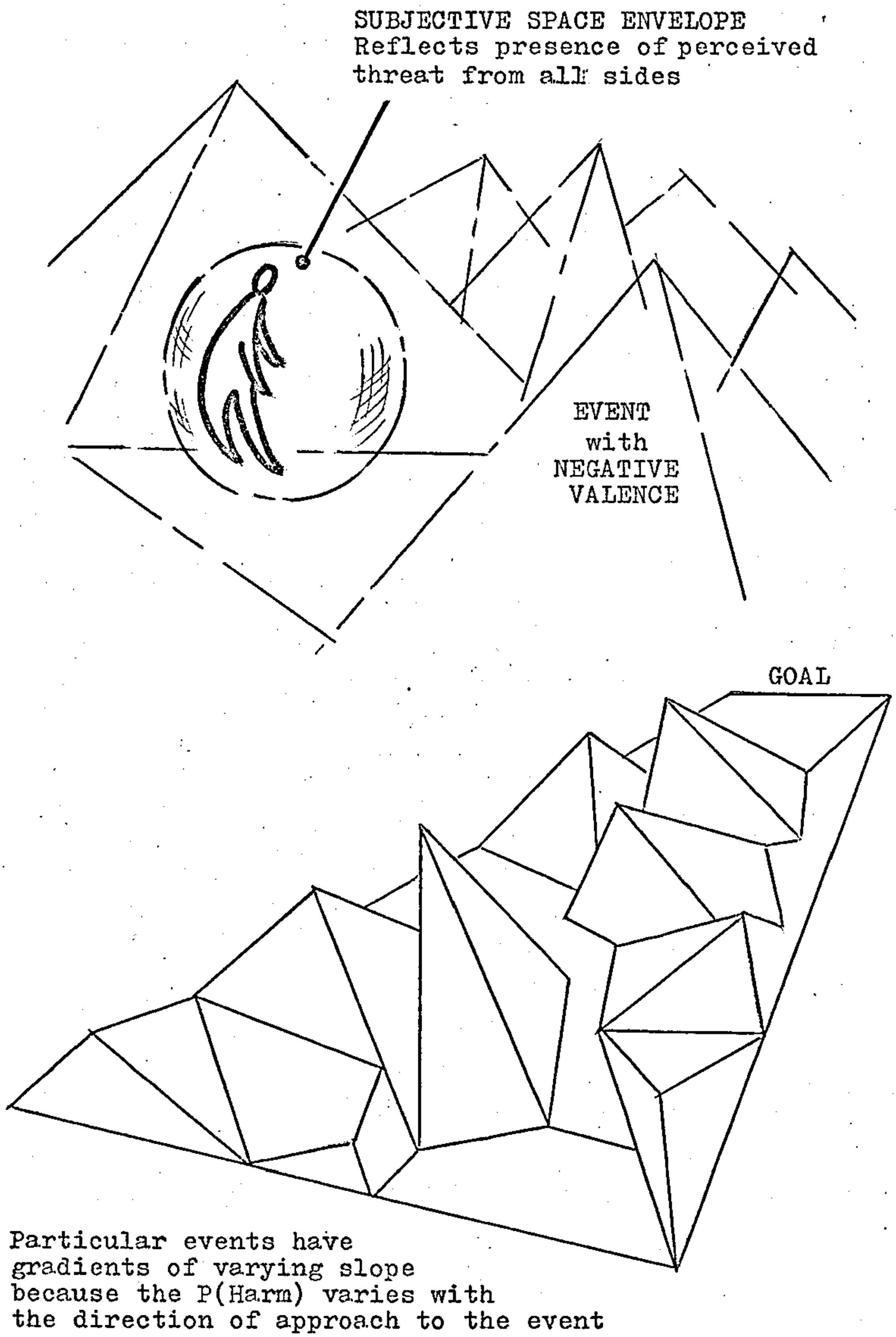


FIG.(6) BEHAVIOURAL FIELD IN WHICH THE CONTOURS REPRESENT THE UNATTRACTIVENESS OF VARIOUS EVENTS.

Both propositions suggest conditions which attend Safe Distance judgements. Moreover, his diagram(73) is clearly based on the same relationships expressed in Miller's diagram (FIG.2 ;p.20) repeated below. (Miller, an associate of Lewin employing Lewin's conception of conflict). With Miller, the Y-axis is associated with goals and places avoided; with Lewin, forces toward and away. What is gained from this comparison is the idea that valences can be regarded as gradients and that gradients have valence.

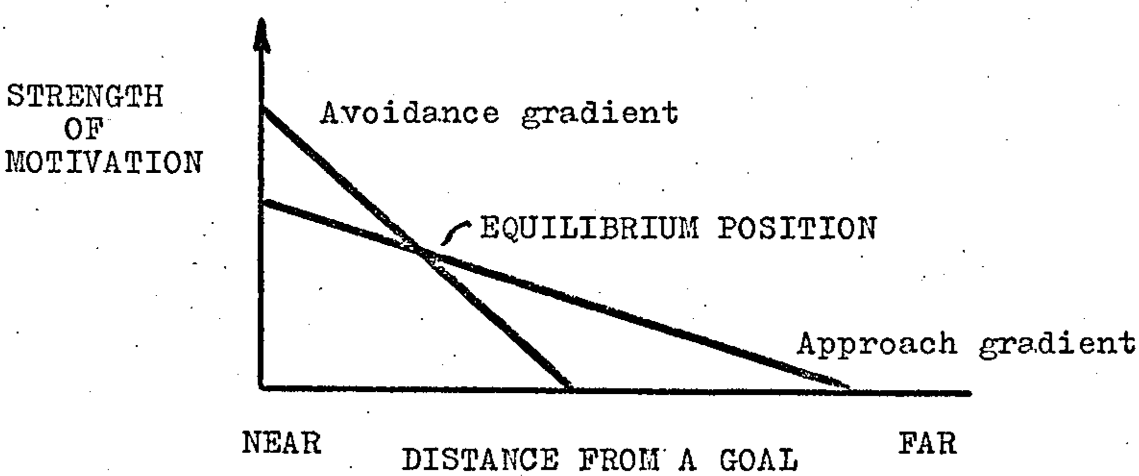


FIG.(2) repeated.

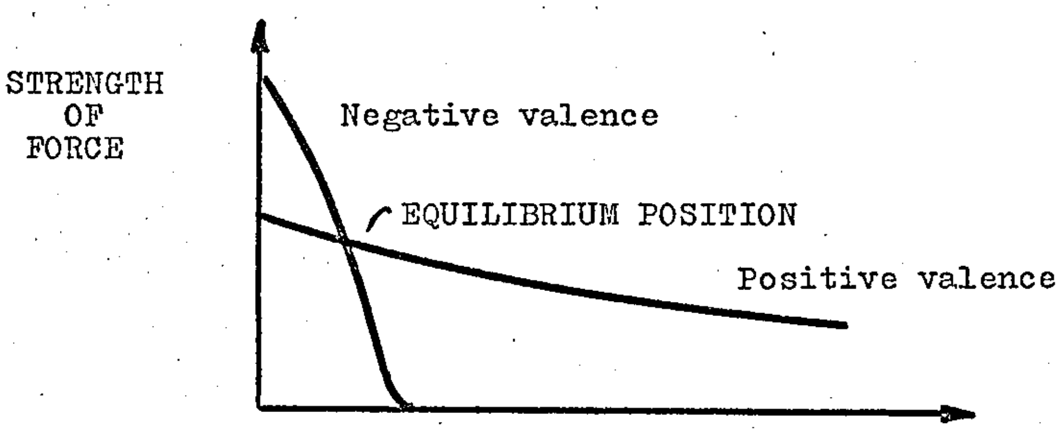


FIG.(7) LEWIN'S REPRESENTATION OF THE EQUILIBRIUM OF FORCES CORRESPONDING TO POSITIVE AND NEGATIVE VALENCES.

The idea of combative valences enables us to conceive a goal-directed route as mapped by an interplay of motive forces moderated by subjective uncertainty rather than as a product of a decision process wherein utility is offest against subjective uncertainty. Yet we are not the shuttlecock of events.

The forces originate in ourselves once an event within our behavioural field ("life space") becomes imbued with valence. What promotes valence? Valences are closely related to utilities in that both depend on the nature of the object considered and the need-state of the individual; yet the terms are not interchangeable. Utility denotes an expected or realised capacity to give satisfaction; whereas valence has to do with the direction and compulsiveness of the drive to gain that satisfaction. The reverse holds when utility and valence are negative. Either can be zero.

The circumstances where we act without conscious reference to utilities need defining. First, they occur in surprise confrontations where we react automatically and instantaneously to perceived danger. Such are the innate "emergency reactions" described later (Section 3.0). Added to these are our actions in response to stimuli to which we have become conditioned to respond. Of another kind are confrontations we expect to occur as when walking a pavement against other pedestrians. Such situations by their familiarity frequently do not require premeditated plan - which may indeed lead to "dodging" - but merely a decision to take suitable and timely action, the moment for it being indicated by the almost imperceptible eye or body intention movement of a partner to collision. At the far end of the time scale, the value of foreseeable outcomes can be attenuated by their distance from us so that they may have no influence on what we do; moreover, their probability of occurrence can seem less likely - Cohen and Christensen cite attitudes to cigarette smoking(74). Our actions are also influenced by our emotional state and we may seize at the chance to do something long desired or, in a spirit of rivalry or daring we may act with no thought but our ascendancy. Of another class are the serendipitous actions of the prospector bound by his belief in luck and by the lure of gold. But his actions border neurotic obsession.

What conditions hold when we act in response to competing valences? Valence can be regarded as a projected force field of attraction (positive) or repulsion (negative) which emanates from an environmental object or event. And because expectations of physical harm normally have negative valence a region of negative valence arising from an object's perceived potential to harm us physically must have the same boundaries as the associated estimated Unsafe Distance (FIG. 8). In terms of sustaining emotional harm, the boundaries of negative valence may be different from those of expectations of physical harm as when we prefer not "to touch things with a bargepole" or "go within a mile" of some physical event. The boundaries of negative valence and the estimated Unsafe Distance are the same if we relate emotional risk to emotional hazard.

In its weak form negative valence may simply refer to dislike, but where it is compounded with fear or anxiety for our safety one could assume we make judgements regarding its boundaries irrespective of our eventual actions. But though we can misjudge the boundaries of the Safe Distance and the Unsafe Distance, we cannot misjudge the boundaries of negative valence. We set them. What we can misjudge is the degree of correspondence between the boundaries of the region we ascribe negative valence and the boundaries of the actual Unsafe Distance. But fear of an object is real irrespective of whether it is justified in light of faulty judgements, so in terms of intention to follow a path of zero or acceptable risk we would regard and desire a region of negative valence to be co-terminate with the boundary of the corresponding Unsafe Distance.

On the view that the boundaries of negative valence associated with the risk of physical harm are the same as the boundaries of the estimated Unsafe Distance, the analysis of Safe Distance judgements taken without conscious regard for utilities, devolves to separating the behavioural effect of the drive force of a negative valence on the route of a goal-directed path via examination of vector components. Of course it might be argued that expectations of physical harm are negative utilities, and that use of the term valence is only a semantic distinction. But if harm is unwanted

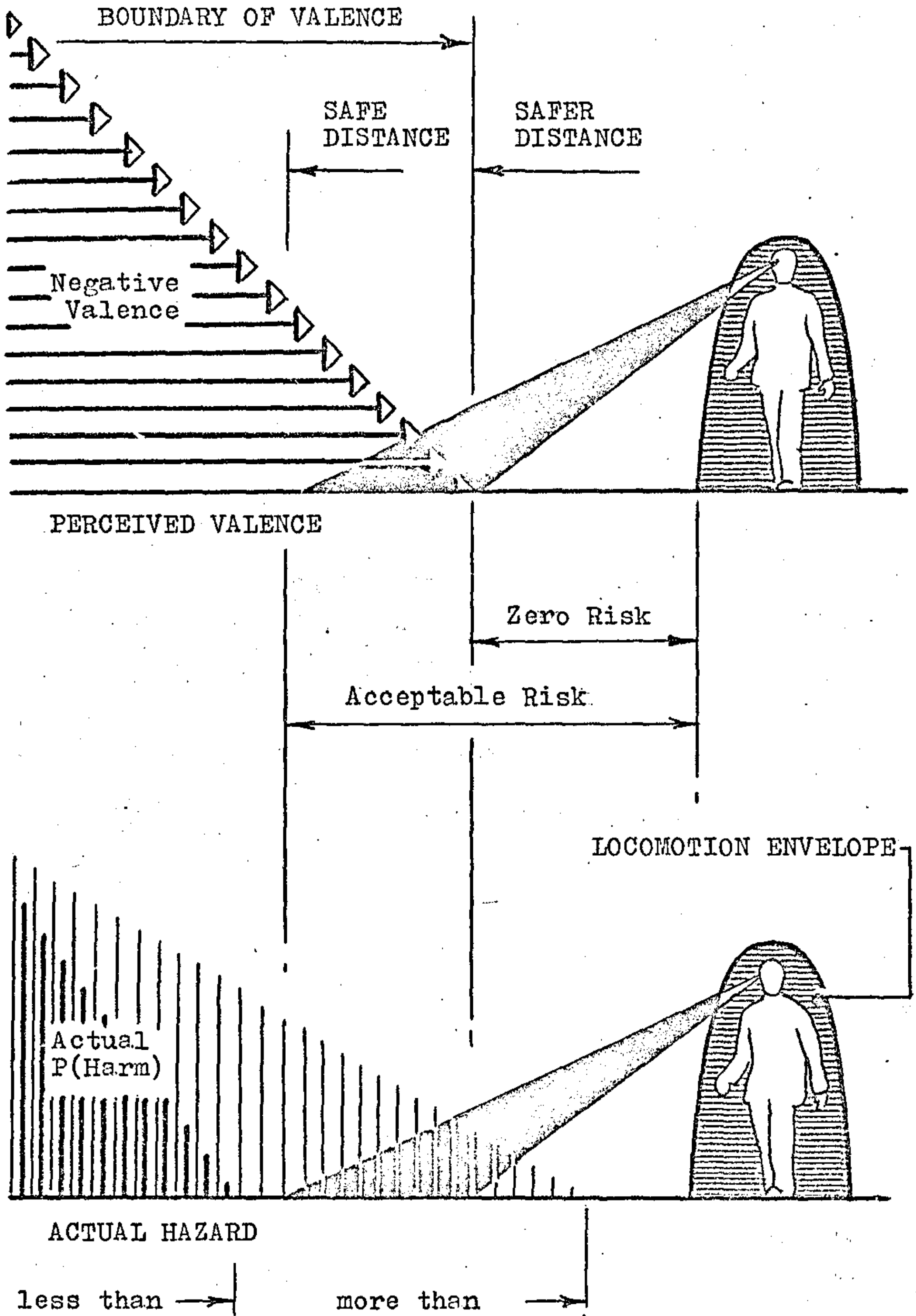
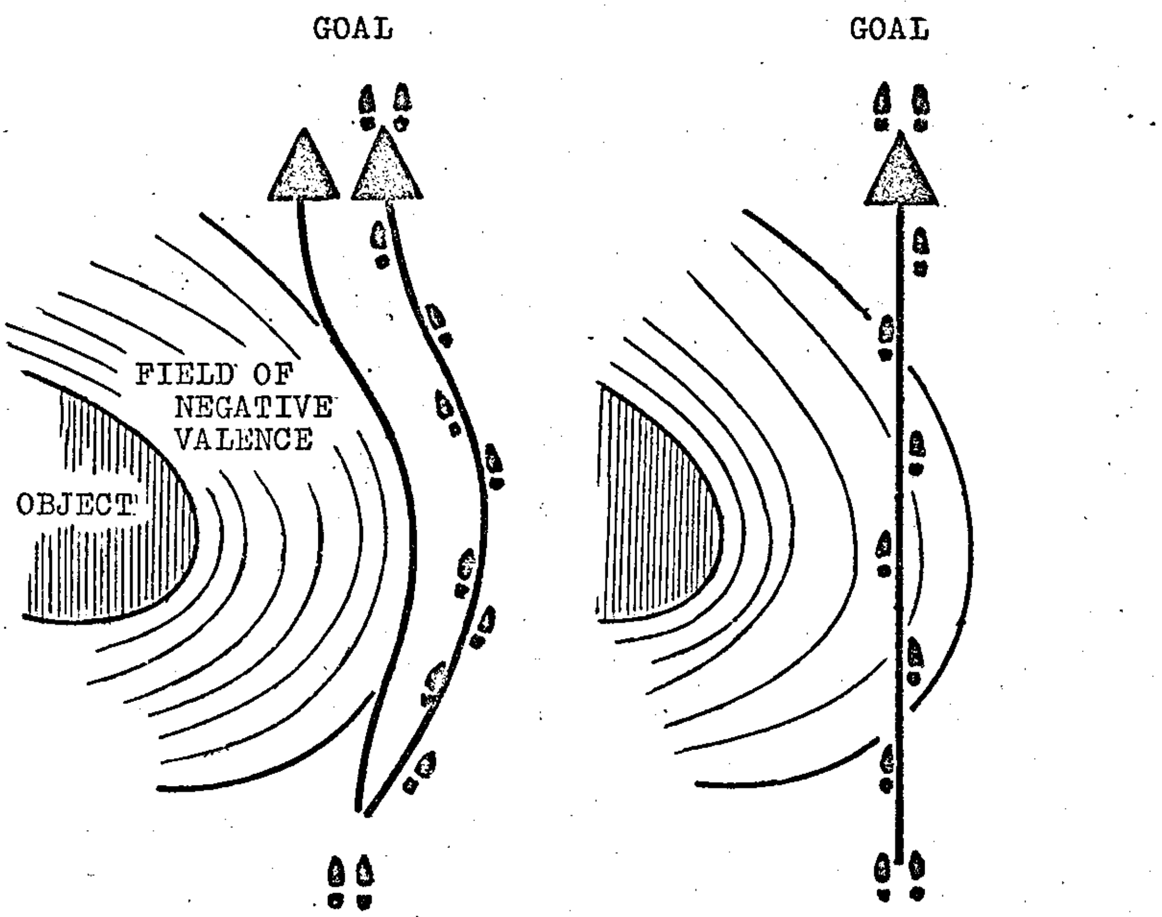


FIG.(8) VALENCE, RISK AND THE SAFE DISTANCE pain, in what category are placed dental appointments (with negative valence) which result in positive utility (satisfaction with the bridgework)? Moreover, we can fear for our safety without expectations of harm, so if expectations have utilities it is implied that judgements of the kind described involving a region of negative valence are made without conscious expectations of physical harm. This is a picture of real life for our accidents almost always surprise us. We can be aware of the possibilities of harm which exist regardless of whether we give them utility but accidents happen to other people. In this writer's view, most body adjustments to avoidance actions (change in pace, direction, and accommodation to gravity, etc.,) taken whilst walking and on encountering familiar objects are at a level of consciousness approaching the automatic, and that is why surprise so effectively disturbs our equilibrium. But can we discount the utility attaching to the goal event in the analysis of avoidance behaviour, for surely purposive actions implied by goal-directed activity are executed in light of their expected value to us? Perhaps a reminder is needed that we are trying to establish how we arrive at Safe Distance judgements; such judgements constitute discrete events in the time perspective of goal-directed behaviour. Again, in this writer's view, it is the immediate situation we deal with in avoidance behaviour notwithstanding the fact that we might be brought to that point by actions influenced by the utility of the goal. Expectations of goal satisfaction undoubtedly influence the strength of the driving force to the goal - and to the sub-goal if the former cannot be achieved otherwise. But in daily life we make many detours around physical objects having all kinds of characteristics without conscious preoccupation with the purpose of our journeys.

The size of those detours, the configurations they take, their degree of constancy, their information content as to the person who executes them and how they are affected by individual differences in the manner of execution were among questions which influenced the design of the experiment in Section (4.0).

1.1 (1.1.9) SURVEY: THEORY AND SPECULATION

Most human locomotion is goal-directed, and in our confrontations with objects of the kind we avoid and when we are not prevented from taking avoidance action, it seems not unlikely that the path of our avoidance also maps the transitory path of our psychological distance from a negative valence. The detours we might take could possibly be tested against the principles held by Miller as applying to events involving the individual in approach - avoidance conflicts. Miller based his findings on experiments in which animals were literally harnessed to measure the pulling forces they exerted in approach and avoidance behaviour (see BROWN 1948), whereas it is assumed here that the magnitude of a detour would reflect the strength of the driving force away from the negative valence as moderated by the pulling force of the valence of the goal event. The Safe Distance might then be regarded as a transitory path of equilibrium with direction and force obtaining from the resultant of forces emanating from the negative valence of the object and the positive valence of the goal event (FIG. 9). An obvious question is whether it would be possible to distinguish the individual contributions to the resultant path by the respective valences. It is important that whatever units are employed to measure valence strengths should measure positive as well as negative properties. But this does not seem to present any difficulty, for if avoidance detours ensue from negative valence then approach detours, i.e. short cuts, could be associated with events of positive valence. The essential measure is the change in the rate of approach towards the valence. A final comment on the effect of driving forces requires reference to their time-scale. Illustratively, the strength of a goal-directed drive might "tail-off" as achievement of the goal came within grasp; or, alternatively, it might increase if the goal receded either independently or through us raising our sights. Interpreting valence in terms of gradients, individuals might relax effort in the "goal area" as a

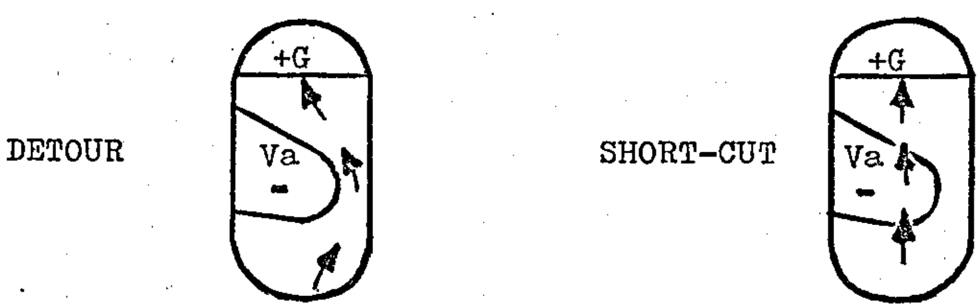


(1) DETOUR ROUTES

Route of zero and better-than-zero risk.

(11) SHORT-CUT ROUTE

Route of acceptable risk.



COGNITIVE STRUCTURE OF LIFE SPACE

(After Lewin's manner of presentation)

FIG.(9) LOCOMOTION ROUTES AND PSYCHOLOGICAL DISTANCE THROUGH VALENCE FIELDS OF DIFFERENT STRENGTH of viewing subsequent progress as "all downhill"[75], whereas in following a receding goal they might cut corners and so ascend the gradient of risk.

1.0 SURVEY

1.2 METHODOLOGY

1.2.1 The methodology of studies in human territoriality.

Human relationships are central to the study of human territoriality since our claim to territory is a claim against other people. Property rights over space may be asserted aggressively as when we drive away those who would challenge our established tenure of spatial resources or who would impinge too closely upon our person; though with equal determination we also erect spatial, physical, and social barriers between ourselves and the outside world to discourage or obstruct our accessibility to others.

HALL(1966) has noted many cross-cultural differences in the degree of tolerance individuals show towards the close proximity of neighbours in various social situations, and he has described how we utilise "a silent language" of demeanour, gesture, and spatial positioning to convey our sovereignty over the space around us[76]. SOMMER (1969) has conducted and collated interview and observational studies of the more active tactics we adopt to preserve our territory holding as well as of those tactics we use when we are the aggressor[77].

Perhaps without exception, the studies quoted by these and other investigators of human territoriality were designed expressly to test the efficacy and communicative value of boundary markers which symbolised a property claim, or to test the attitudinal warnings displayed by one person to another in connection with such a claim. Territorial studies therefore seem to offer little guidance as to how we might test the Safe Distance with respect to objects, since we cannot usefully warn objects to keep their distance from us. We could of course warn experimental subjects of hazards which could place them in danger and observe what they do. But would not such warnings test their suggestibility as much as their Safe Distance?

1.2.2

The methodology of studies in interpersonal relationships.

Although at present the Safe Distance is not promoted as relating to meetings between people, it would be sensible not to overlook the methods used to record the experiential effects of interpersonal confrontations upon the individual(78).

Some of the ways in which we express "social distance" have been referred to earlier, e.g. by spatial positioning, looks, gestures, tones of voice and word choice, each of which is a social technique expressing an emotional state. But whilst variations in autonomous physiological functions, e.g. galvanic skin response (GSR), have been correlated with changes in emotional state consequent on particular interaction patterns between individuals(79), it would seem that individual differences in the responsiveness of autonomous systems limit the value of such observations.

With regard to object perception, the unreliability of GSR as a measure of anxiety is mentioned by COHEN (1968) who has questioned the claim that the constancy of a motorist's GSR reflects constancy in his experience of risk, that GSR measures objective hazards, and that increased GSR indicates increased anxiety. Cohen conceded that very menacing situations could evoke anxiety and heightened GSR, but he held that as a rule the more anxious an individual the less need he has to respond with increased physiological reaction: "(the driver) does not need to "pay" mentally and physically. Only when he cannot tolerate subjective mental stress will his hands begin to sweat, his heart beat faster, and his face lose its colour"(80).

Other methods used to assess the emotionality of a confrontation between people have required registration of the amount of eye-contact that takes place between them (ARGYLE 1967) or of their gaze direction (KENDON 1966)(81). But the spontaneity of eye-contact can be forced, i.e. bogus, as when one person wishes to deceive another (EXLINE et al., 1961), or when simply we want others to give us their attention[82]. Besides, the nuances of eye-contact are extremely subtle in that the eyelids are used to modify as well as to convey the message of our gaze in a way that women have used fans and parasols. Furthermore, the message content of eye-contact is frequently modified by accompanying facial grimaces. With regard to the Safe Distance, it is possible that we would be as likely to avert our gaze from what we find disturbing as we would be to stare, although exceptionally our response to the suddenly alarming event is marked by the "orientation reflex" and the way we focus our gaze on the specific cause of our alarm. What captures our interest can be detected sometimes by observation of our eyes for their <u>pupil dilation</u> (HESS 1956)[83]. It is also likely that <u>eye-blink rate</u> has been used to detect the emotionality with which individuals have responded to particular circumstances but this writer found no pertinent studies.

1.2.3 The methodology of body-image studies.

Fisher and Cleveland (1965) commented how it had become a "challenging task to formulate the major dimensions of the body concept that each individual evolves and to devise methods for measuring these dimensions"(84), and in their later work (1968) they provided an extensive review of the procedures that have been used to tap such qualities of self-experience as anxiety often manifested in the perception of the boundaries to self(85). They discerned three main trends in the direction of research into body-image parameters. These trends are discussed below in terms of their relevance to possible investigations of the Safe Distance. The procedures described relate to four avenues of approach:

a). physiological reactivity.
b). clinical analysis.
c). projective tests.
d). subjective evaluation.

Trend one.

We begin by considering what are termed body-image "boundary studies" which relate to the idea that we learn to demarcate our body from its surroundings and that the clearness of this demarcation can have significant behavioural implications.

a) and b). Physiological reactivity and clinical analysis.

For example, if a Lewinian psychologist was asked to test someone's reaction to the specific proximity of a particular stimulus object either to find the boundaries of his body-image or to test his Safe Distance, we might expect him to arrange procedures which would produce muscular and visceral "tensions" in his subject, and presumably he would attempt to relate the physiological correlates of those tensions to to the characteristics of the stimulus object(86). In this approach he would differ from the Freudian whose enquiries might lead him to obtain familiarity with his subject's toilet training, i.e. the Freudian might suppose a subject's idea of a Safe Distance to be coloured by his emotional attitude to the stimulus object as determined by his infant libido crises[87]. In either case, the intentions of both clinicians would be to measure the involuntary nature of response to fears aroused by the stimulus object the proximity of which would test both the locational and defensive properties of subjective space boundaries.

Yet as a method for establishing the Safe Distance either approach would be dogged with problems. For although the Lewinian would appear more pragmatic in assuming a shorter time-scale in the provenance of cause and effect, the correlation of physiological and psychological variables is still largely unsolved[88]. As for the Freudian, VERNON (1969) has remarked: "...it is doubtful whether, except perhaps in children, they (the Freudian mechanisms of defence) can be set in action by artificial causes such as those available in laboratory experiments...."[89]. Of course it is possible that individuals might betray their inner conflicts by small restless movements, and that these might be some index to their feelings concerning the proximity of a fear-provoking stimulus object in a static situation. But the difficulty then is in deciding whether such movements are the result of postural discomfort or emotional unease[90]. Furthermore, whilst VERNON (1970) noted that "according to Freudian theory the ego is continually obliged to defend itself, even during its ordinary interaction with the environment, against the onslaughts of the id", she suggested that the non-Freudian belief would place greater significance on individual personality traits "such as those suggested by Witkin"[91] as more probable determinants of the manner in which we perceive[92].

c). Projective tests.

The mainstream of current experimental procedures concerned with defining the parameters of the body-image draws on projective tests. Some tests such as the "Draw-a-person test" have required subjects to draw body shapes which are then interpreted as reflecting their self-view in some way[93], although the bulk of investigation has been concerned with the interpretation of ink-blot responses prepared according to Rorschach or Holtzman protocols. As for using paper-and-pencil tests for establishing a person's Safe Distance it is perhaps sufficient to quote COHEN and CHRISTENSEN (1970):

> ...the numerous attempts to devise paper-and-pencil 'tests' or questionaires as measures of risk-taking.....seem totally devoid of any validity. It has yet to be shown that the replies that people give to written questions bears any relation to risk-taking as independently measured.(94)

Interest in the body-image boundary derives from the finding that there are individual differences in the experience of its clarity and firmness. It is held that differences in the permeability of our boundaries as well as in their sharpness of articulation to us reflect the way we view our vulnerability to both internal and external experiences.

The Safe Distance has been considered as a threshold; Fisher and Cleveland have made similar observations with regard to the body-image boundary:

> The idea presents itself that the body-image boundary corresponds in some ways to a screen on which is projected the individual's basic feelings about his safety in the world. It is the screen which he interposes between himself and outer situations and which he can carry with him at all times.(95) (Emphasis added)

In the widely adopted interpretative procedures initiated by these authors, the qualities of a subject's body-image boundary are projected by the experimenter from the nature of the subject's response to ink-blots which are presented to him as stimuli and which he describes in terms of the forms the blots resembles for him.

The procedure is essentially a measure to tap the personality characteristics of the subject, and as such it is a qualitative rather than a quantitative measure. Thus we might expect people with certain identified personality traits to have a greater or lesser demand for space to accommodate their body-image than others without those traits.

Fisher and Cleveland distinguish the properties of the body-image boundary in terms of "firmness" and "weakness". And they consider that people evidencing firm boundaries, i.e. who have boundaries resistant to penetration, generally show capability for independent thought and action, whereas those with weak boundaries tend to be people who are easily influenced and who look to others for direction. But they make many more distinctions.

They evaluate the relative firmness or weakness of a subject's body-image boundary in terms of his "barrier score" and his "penetration score". (96)

A barrier score is compiled from the number of responses obtained in the descriptions provided by a subject which emphasise protective or encapsulating properties observed in the imagery of the ink blot. Examples are references to clothing, animals with armoured or unusual skins, and to certain landscape features.

A penetration score is based on the number of references which emphasise the penetration, disruption, or wearing away of the outer surface of things. Examples include rotting wood, body openings, and such objects as have the candyfloss surface of clouds.

Fisher and Cleveland cite extensive corrobatory evidence that their categorisation of boundary definiteness in terms of firm or weak barrier response is linked to many aspects of human behaviour in health and sickness. But a serious criticism of the validity of tests which require subjects to imagine forms in ink blots is that the nature of the subject's response may be a function of his cognitive style of thinking rather than - in this case - his sense of vulnerability. That is to say there is evidence (BARTLETT 1932) that some people tend to think in visual terms whereas others tend to verbalise their thoughts. There are other differences in cognitive style which could be equally influential(97).

Bartlett provided material for this objection when he found that "visualisers" produced characteristically different responses from "verbalisers" in the task of imaging ink-blots. In comparing the nature of these differences it was observed that verbalisers had slower reaction times and that they adopted a problem-solving attitude of "rummaging" for images exactly congruent to the blots, and that their responses were more abstract, more impersonal, and lacking in both discrimination and sensitivity.

Whilst there is no implied correspondence made here between Bartlett's typology and that of the authors mentioned, it is interesting to compare how the latter have associated firm boundaries with the "go-getter" admired in a business society, with reality-coping behaviour, and with internal strengths they see as lacking in the weak barrier individual whom they propose as typically seeking guidance from others, as seeking stability in a clearly defined social structure, and who is seen to tend to abstractions and to be less considerate of another's needs.

In denoting which personality traits they find consistent with a specific "barrier score", the authors recognise that most of us have neither wholly firm nor wholly weak body-image boundaries "per se", but that we frequently adjust the permeability of our boundary to suit the circumstances of the moment. Yet they consider that the barrier score provides an accurate index to our <u>enduring</u> propensities regarding the way we view ourself as vulnerable to life's experiences: "...the barrier score (has proven) largely a measure of persistent attitudes rather than of short-term variations in state". But since our attitudes would seem subject to the influence of such variables as our changing moods, one must question the prognostic value of the barrier score unless there is supporting evidence from longitudinal studies (i.e. from tests of the same person over time). However, the barrier score might be predictive of behavioural response where action or no action has foreseen and drastic long-term consequences.

By contrast, Fisher and Cleveland consider the "penetration score" to be sensitive to immediate situational conditions involving boundary percept experiences although: "...this differentiation .....is tentative.....and awaits confirmation."(98) One cannot but fail to observe that the Safe Distance and the "penetration score" appear to be measures that tap the same personality spring.

Trend two.

d). Subjective evaluation.

The second trend of interest discernible in the literature concerned with deriving measures of the body-image boundary relates to our imaginal body size.

Examples were given earlier of how we tend to experience body feelings and mood in terms of our body size such that a change in their state could be accompanied by impressions that we have grown larger or smaller. There has therefore been interest in our imaginal body size in different spatial settings.

For example, WAPNER & WERNER (1965) have described how subjects have been asked to estimate the size of their body parts and how discrepancies between their actual size and reported size could be associated with the presence or absence of adjacent physical features in the test site. They have shown that the length of an arm or the width of the head has been over-estimated in unconfined space; and how when pointing to an object the limb used has been perceived as longer than its counterpart but when touched it has been perceived as shorter than the untouched counterpart(99).

Simple apparatus for determining imaginal body stature and body width has been described by DILLON (1962)(100).

Trend three.

A third line of research has explored the developmental effects of social interaction upon the parameters of the body-image. How we see ourselves as well as how we believe others see us can shape the way we behave (GOFFMAN 1966; BANTON 1965)[(101)]. The explanations of human behaviour made accessible through examination of the characteristics of the body-image have therefore enlarged the more general field of personality studies.

1.3 STATEMENT OF EXPERIMENT

Preliminary considerations.

Concerning the nature of the Safe Distance it emerges from the preceding discussion that it is a value judgement made by individuals who are apprehensive about their personal safety. There are several stages to the process of making a Safe Distance judgement. It requires the discernment of perceived threat to the self, a comparison of the threat circumstances with desired circumstances, a judgement based on expectations of where safety lies, a decision on whether to take countermeasures, the taking of risk and the possibility of incurring hazard. Each component of the process permits the individual to make his unique interpretation, and because of this certain objections can be raised against attempts to quantify Safe Distance judgements.

First, it may be argued that value judgements have ordinal values and therefore cannot be added. Thus we can only experience greater or lesser amounts of the quality to which a judgement refers but we cannot specify by what amount a change has occurred in that quality. Attempts to do so would be on a par with quantifying beauty in terms of milli-Helens - the amount of beauty required to launch one ship. Nevertheless, with regard to the Safe Distance it is possible to measure the extent of changes in ostensive behaviour (that which can be pointed to) arising from repeated encounters with a specific situation although we may not know why an individual's actions should have a particular magnitude of expression. A further objection arises from the nature of individual differences. Thus it could be asserted that the safety of different individuals cannot be compared objectively since comparisons are essentially those of value judgements. What is safe is a personal opinion which need not be shared by other people. The effect of this would be to abort the purpose of any comparison since conditions of safety are a normative study concerned with standards for action, i.e. they are prescriptive. More damaging is the charge that value judgements obtained in the short-term are not necessarily those obtaining on later occasions. However, it can be counter-claimed that Safe Distance judgements are unlike many value judgements in that faulty judgements may be attended by physical consequences. Judgements of safety are therefore bounded in the direction that matters. Moreover, they are so bounded for all individuals, and thus it is a matter of interest to establish the level of recognition that is given to this. It may be found that the magnitude of Safe Distance judgements is unrelated to the physical proportions of the individual, to the colour of his eyes, or his liking for fish and chips, but this does not matter. Prescriptive standards of safety are usually framed to include all those who are likely to encounter a situation of hazard. The nature of individual differences has no pertinence except in establishing the range of judgements. As for the fact that value judgements are susceptible to developmental changes in the individual it could be claimed that this is merely a matter of selecting representative subjects from appropriate age, sex, and experiential categories.

All kinds of environmental factors can initiate the need to make Safe Distance judgements, for what we view as a threat to our safety is influenced by our accumulated experience operating upon and modified by our current motivational, emotional, and cognitive states. But essentially variations in body-environmental relationships which are seen to possess possibilities harmful to the self are guarded against. Our guard has various lines of defence. We can, of course, take care what we do so that our exposure to the more extreme forms of hazard is limited to accidental exposure. But apart from this, Safe Distance judgements would seem to be mostly spontaneous to the immediate situation, and they would appear to have the character of discriminating the self more sharply from its environmental setting. This factor suggests that the Safe Distance is a boundary condition testable as a psycho-physical threshold.

1.3 STATEMENT OF EXPERIMENT

<u>The line of inquiry.</u>

Perhaps the most reliable evidence of a boundary condition to that human behaviour which is inherently variable is a constancy in operation.

VERNON (1970) has described how from the basis of our everyday judgements of the apparent sizes and distances of natural objects we build up strong probabilities as to their expected features, and how these greatly influence the particular cues we select at any time for perception and judgement. She noted that this was especially so in judgements of distance[(102)]. Among those expected features is possibly the potential for harm possessed by the natural object; and there seems no reason why the familiar artefacts of Man should not also promote the same process.

It was said above that the forming of a Safe Distance judgement appears to be characterised by a sharper differentiation of the self from the not-self than may ordinarily obtain, and it will have been noticed (1.2.3) that much the same condition has been found to apply in the discernment of the body-image boundary. It needs to be stated now that the Safe Distance is regarded as a function of the body-image (cf. 3.0), but it is not the mental projection of the body surface for this is the manifestation of the body-image, <u>the Safe Distance is the protective threshold which mostly surrounds the body-image</u>. The distinction has significance which extends to the manner in which each might be appropriately tested. Thus the body-image boundary has been tested for its permeability since this property is assumed to characterise an individual's ego-identity (how he sees himself as vulnerable to life's experiences), and it has also been tested as to its locational properties in terms of imaginal body size. Our intention has been simply to test the locational properties of the Safe Distance and no claim is made that individual differences might reflect particular personality traits. Furthermore, although the Safe Distance and the body-image are both subjective assessments of self-experience, their measurement is open to several procedures. First, we could ask the observer to report the subjective magnitude of the variable under study. This is the procedure for obtaining imaginal body size. Second are inferential procedures. The permeability of the body-image is ascertained by the experimenter inferring that quality from his subject's descriptions of ink-blots. Alternatively, we could assume a model linking the variable under study with observable behaviour and use the model to calculate the variable. This latter course was adopted.

In planning the experiment the view was taken that the defence of emotional space could be tested by observation of our approach and avoidance behaviour, such that when persons approach an object which has known and obvious harm potential then the magnitude of their avoidance detour is a register of the emotionality of the stimulus object. Put another way, we steer clear of objects that might harm us, and from the configuration of the detour we could calculate the Safe Distance judgement. The experimental design took the form of requiring a moving observer to negotiate stationary obstacles of various sizes presented along a corridor at various intervals from the point of departure.

GIBSON (1950) mentioned how Lewin initiated enquiries into the processes of orientated locomotion in the 1930's, and how through his interest in using locomotion as an analogy for higher forms of behaviour Lewin lost the opportunity to examine the literal process experimentally. Gibson believed that much could learnt by simply observing how people reached their destination where this was a visible goal: (103)

> ...(because) locomotion of this sort (walking) is oriented directly towards the goal. The body movement is a function of optical stimulation which yields the perception of a visual world with the goal object in it. Body movement is modified only by the necessity of avoiding obstacles, or directing the movement into the field of safe travel.

2.0

TERRITORIALITY

2.0 TERRITORIALITY: THE ACQUISITION, USE AND DEFENCE OF SPACE BY ANIMALS AND MAN

Two related aspect of animal behaviour are discussed in this Section, namely the physical and social dimensions of an animal's living space. Emphasis is given to the similarities which exist between animals and men in their demarcation of space, and comment is made on the social procedures each adopt to enable them to live in tolerable harmony with their fellows. The characteristics of animal systems of land tenure and its associated phenomena are known to students of animal behaviour as "territoriality". The discussion includes reference to analogous human behavioural systems where these appear to serve an equivalent function.

2.0.1 Definitions.

A law of survival. The old saying that "possession is nine points of the law" has a Darwinian truth if nothing else, since for many species the possession of territory is a law of survival. TERRITORY provides the resources which fulfil their biological need for food, shelter, and breeding ground: and TERRITORIALITY is the term applied to the wide variety of behavioural systems these species display in relation to their territory, to the space they annexe for their activities, and to the intruders upon that space. In his classic review, CARPENTER (1958) remarked that:

> It would seem advantageous to view territoriality primarily as a behavioural system which is expressed in a spatial-temporal frame of reference. The organismic mechanisms, the drives and incentives or motives, and the sensory-response and learning processes are all different aspects of the behavioral systems of territoriality. These are expressed with reference to loci in space, and to the topography of habitat areas. Behavioral systems change over periods of time. Those which constitute territoriality in animals are so complex, and involve so many adaptive and even non-adaptive mechanisms, that they defy adequate description by condensed definitions. (104)

2.0(2.0.1) TERRITORIALITY: THE ACQUISITION, USE AND DEFENCE OF SPACE BY ANIMALS AND MAN

The territory of non-human species has been briefly if somewhat loosely defined as "any defended area", or in mammal societies, as "any area of such familiarity that an animal feels safe from attack"[105]; and territoriality expresses both the drive of an animal to obtain a living space which promises life support, and the urge to defend it against conspecifics and sometimes against members of other species.

Zoologists have given the term "territory" a technical meaning which is partly conveyed by our idea of an animal's home or lair. The vernacular use of the word "territory" as in "British territory" is more closely conveyed in zoology by the phrase "the home range" of the animal, i.e. the area which provides its subsistence and which it may share with others of its kind as well as members of different species. Large grazing animals such as the gorilla and elephant have home ranges without necessarily possessing territories, but any portion of the home range which an animal defends is referred to as that creature's territory.[106]

In writing about territory, authors sometimes use the word in a general sense when the facts under discussion apply equally to "territory" and the "home range", and this is probably because for some species the home range is also known as the animal's "food territory"; but it is also because "territory" is the generic term whilst "the home range" is merely a specific term within the genus "territory". Moreover, the terms "territory" and "territoriality" are frequently used interchangeably, the writer's use of one term automatically implying the presence of the characteristics of the other.

2.0 TERRITORIALITY: THE ACQUISITION, USE AND DEFENCE OF SPACE BY ANIMALS AND MAN

2.0.2 The study of territoriality.

Pre- and post-Howard. The earliest record of space ownership by animals is a widely quoted reference in the literature to Aristotle's observation (4th century B.C) that "eagles cannot allow other eagles to quarter themselves in close neighbourhood". Yet although by 1868 Altum had foreshadowed modern interest, the study of territory was still an esoteric pursuit at the turn of this century. Today, territory as a concept "underlies all presentation and development in modern ethological papers".(107)

The study of bird behaviour has long fascinated Man partly because he envied their power of flight, but perhaps also because for him they symbolised an unfettered freedom of movement which birds do not really possess. It is therefore hardly surprising that early studies of territoriality are predominantly concerned with the behaviour of birds. Many writers take as the watershed of the modern study of territory the appearance of Eliot Howard's "Territory in Bird Life" in 1920. Howard may not have been the first to study territory in birds, but he "rang the bell that called the wits together" by focussing attention on an unappreciated aspect of animal behaviour which was later found to underpin much of what animals do. In their foreword to the 1948 edition (1964 printing) of Howard's book, Julian Huxley and James Fisher pay tribute to his contribution to ethology and themselves provide a summary and selective bibliography of the progress of territorial studies of birds from the time of Aristotle. Carpenter has traced a similar history dating from Willugby's reference to the nightingale's "friehold" in 1678. The study of territoriality in mammals according to Carpenter probably began about forty years ago. The exploration of territoriality in individual Man has an even shorter history, although territoriality in Man as a species in a general sense is the substance of history.

2.1 THE VALUE AND FUNCTIONS OF TERRITORY

Territorial behaviour has been ascribed with many functions some of which have yet to be proved. Carpenter, for instance, collated thirty-two separate functions from published studies; whilst HINDE (1956) has produced a more manageable grouping of ten.[108] The perpetuation of animal aggression in connection with the dominance of space demonstrates the biological advantage that territorial behaviour must confer; and among the advantages claimed for territory-holding have been the regulation of population densities, the protection of food supplies, protection from predation, selective breeding, and the reduction of disease.

2.1.1 <u>The dispersion theory</u>.

<u>Territory and the optimisation of population size</u>. Not all species share the same putative advantages from territorial behaviour. In recent years much interest has been aroused by the proposal of WYNNE-EDWARDS (1962) that intraspecific hostility associated with territory is <u>primarily</u> a dispersive mechanism which adjusts population sizes to the available resources. Case studies are quoted in the literature when this mechanism was evidently inoperative, whilst criticism is also levelled that hostility between conspecifics can occur apart from quarrels over tangible property. Another view gives greater importance to the social mix of a population and to its environmental circumstances as the prime determinants of population dynamics. Nevertheless, the argument that territorial behaviour is a natural regulator and distributor of population densities is forceful since it would appear to have the support of overwhelming evidence from field studies.[109]

2.1.2 <u>The dispersive effect of territory</u>.

<u>In captivity</u>. HEDIGER (1955) has described how even captive animals will set aside special areas for eating,

sleeping, defecation (some species), look-out, play and sun-bathing. Indeed, the mature animal that did not attempt to organise its surroundings in this way might be suspected of illness as we should be.[110] Captivity for an animal is perhaps not always the burden commonly supposed, for there are factors (Sect.2.4) which tend to prevent it from pushing out its territorial boundaries. In the wild or captive state the animal will swop its territory for a better endowed area if it can do so, but generally such opportunities are few.[111]

In freedom. If it has enough to eat and feels safe in its surroundings the animal has little incentive to forage further afield than is necessary; nor can it make extravagant claims on the available resources since abundance has the effect of reducing the size of individual property holdings. This is because territories have an homeostatic, or self-regulating, effect on many if not all population densities quite contrary to that of the human condition. The richer the resources, the more encouragement is there for the animal to breed - unlike Man, animals do not breed to provide economic security in their old age; the poorer the resources the wider must an animal search for them.

The possession of territory therefore provides selective advantage to the species as such and to its individual members, for not only does it usually disperse populations in relation to food supplies, but through the creation of conditions whereby the less fit or forceful individuals have reduced opportunity to feed, breed, or survive predators, territory acts as a filter in the genetic stream.

More subtly, territory, according to Wynne-Edwards[112] is an evolved system whereby competition between conspecifics for limited resources is replaced by "conventional competition" for the space which contains those resources. The value of this substitution is that the conventions, or inhibitory checks, which govern competitive striving for space effectively reduce aggression between conspecifics to a ritual series of threats and counter-threats. Animals may kill their own kind in these encounters when their bluff is called, but for this to happen demands unusual circumstances (Sect. 2.5.2).

Nomadism among most species of land creatures, ethologists have observed, is very rare, for once an animal has an established address it normally stays there or returns to it at the same season throughout its life.

Size of territories. The size of an animal's claim to property is determined by its habits and powers of movement. NICE (1941) found that among birds the size of territory generally increased with the number of functions (e.g.feeding, nesting, mating) that it subserved.[113] As a rule, a large animal has a bigger home range than an animal of smaller species, and size for size predators need bigger ranges than the herbivores on whom they prey. The home range of a large animal or predator can therefore encompass those of several smaller species which in their turn like Swift's fleas encompass even smaller species.[114]

The boundaries of territories. Wynne-Edwards illustrated four main types of land tenure on which territories are held by a diagram on which Figure (10) is based; Figures (10.a,b,c) refer to land creatures; Figure (10.d) represents a group of islands inhabited by sea-birds. The diagrams have no dimensional significance.

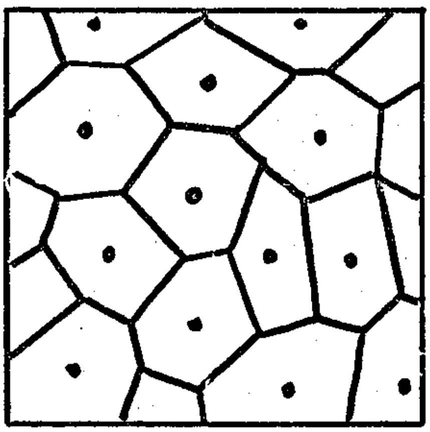
It should be noticed first that a distinction can be made between species (10.a,b) which lead solitary lives (except when breeding or rearing young) and species (10.c, d) which live in social groups. Secondly, a home range can be held exclusively by an individual (10.a) or a social group (10.c), or it may extensively overlap the ranges of other individuals (10.b) or social groups (10.d). These divisions, emphasised Wynne-Edwards, are flexible, as one type of organisation may give way to another according to the season or for other reasons.

Creatures which maintain exclusive title to type (10.a) properties are said to possess "food territories"

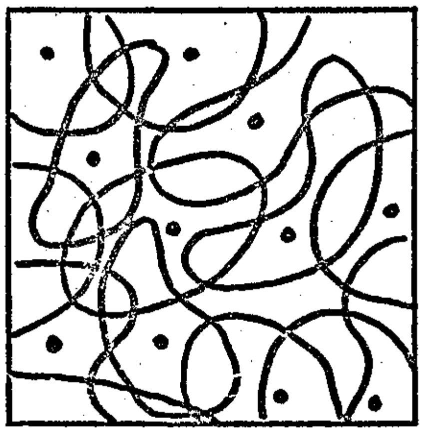
(After V.C.Wynne-Edwards (1962). Animal Dispersion in relation to Social Behaviour.)

(10.a) SOLITARY EXCLUSIVE

(10.b) SOLITARY OVERLAPPING

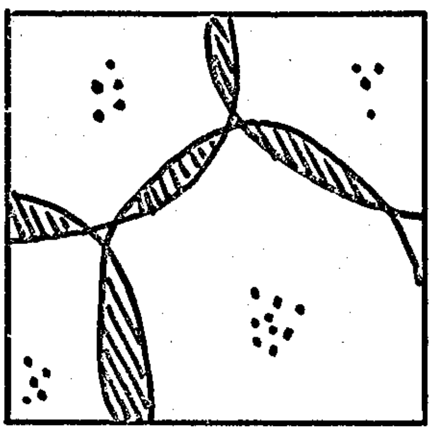


(e.g. robins)



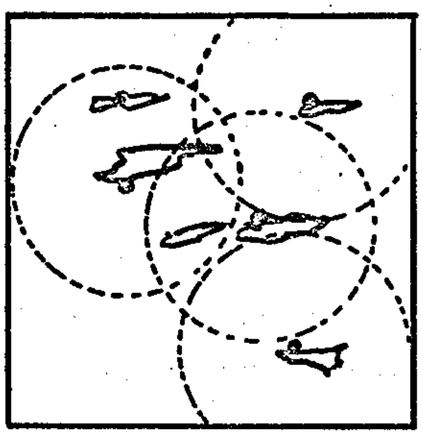
(e.g. foxes & bears)

(e.g. rabbits)



(10.c) GREGARIOUS EXCLUSIVE

(e.g. sea-birds)



(10.d) GREGARIOUS OVERLAPPING

FIG.(10). THE FOUR MAIN TYPES OF ANIMAL LAND TENURE since they are centered on a home base which is normally defended. Figure (10.b) illustrates how solitary members of a species share access to overlapping home ranges provided they are recognised property owners in the neighbourhood. The equivalenct ranges for gregarious species (10.c and 10.d) have the same basic configuration as types (10.a and 10.b) except that the former are held in common with other conspecifics belonging to the community[115].

2.2 SYSTEMS OF ANIMAL LAND TENURE

2.2.1 The location analysis of human settlements.

Various theoretical models have been devised by geographers, economists, and other social scientists to explain the forces which shape the boundaries of human settlements. The literature is worth reference for the pertinence it could have to the manner in which the individual - the Robinson Crusoe - shapes his spatial boundaries. Reference was made to HAGGETT (1965) and ISARD (1956). It is beyond the scope of this discussion to enter description let alone criticism of the economic postulates and assumptions which are the bedrock of the theories mentioned, they are referred to simply for their importance in the development of locational theory, their interest, and for record purposes.

The shape of human territories.

The earliest attempt to develop a theory of location has been accredited to von Thünen (1826), and from his work has derived the concept of "ring" development. Thünen's model is that for an isolated agricultural settlement set in a uniform plain having uniform fertility and production possibilities. At the centre of the plain is a settlement possessing potential transport facilities the utilisation of which would have equal cost in all directions. Production arranges itself around the settlement in rings according to the transport costs of the product in question.

In our own times, great interest was aroused by the general theory of location proposed by Lösch (1944). In common with other theorists, Lösch's essential task was to find means of defining the boundaries of the market area for the goods and services a community provides. Lösch is remembered for his adherence to the hexagon as the ideal form of market area. The argument for the hexagonal form is that should we first suppose a single producer's area of influence to be characterised by a Thünian ring, then the introduction of a competitor causes contraction at some point where both rings overlap. Thus with many producers in competition a net of hexagonal market forms will completely cover any area under consideration whereas circular ones would leave empty corners.

Of all the regular polygons (square, triangle, and hexagon) by which a given area can be subdivided without remainder, the hexagon deviates least from the circle and so minimises transport costs and incidentally maximises consumer demand within that area. It is interesting to note how in Wynne-Edwards' diagram (FIG.10a) he has illustrated the territory holding of solitary exclusive creatures as forming a typical honeycomb Löschian network. All the same, it is well to realise that the postulated hexagon refers to the boundary characteristics of interacting tendencies and not necessarily to topological features associated with those tendencies. We should not expect to see regular hexagonal territories on the earth's surface. In human affairs, Haggett noted, this morphological characteristic is related more to "population space" and "income space" rather than to shape on the ground[116]; that is to say, the cartographical representation of properties in proportion to their occurrence as for example in the representation of London's population as occupying a quarter of the land surface of England. Finally, in our own search for the boundary characteristics of subjective space in which we have referred to intersecting valence gradients, it is of interest to note that one of the major criticisms of Lösch's boundary concepts noted by Isard is that "...a conception of a continuous field of price gradients would be much superior"[117].

Regularities in human spacing.

Isard has also referred to the search for significant regularities in the distances between settlements and in their spatial patterning. There is a rank-size rule ($r.P^q = K$) where (q) and (K) are constants for the given group of cities, (r) is the rank of a particular city in population, and (P) its population, which when applied to the data for population growth in major American cities has had linear distribution in Log-log form ($\log r = -q \log P + C$). Work of importance in this area is attributed to G.K.Zipf (1949)"Human behaviour and the principle of least effort".

2.2 (2.2.1) SYSTEMS OF ANIMAL LAND TENURE

As a final note, we can mark the pervasiveness of the idea of force fields in connection with the distribution of human activities. Thus Isard has recounted the hypothesis of J.Q.Stewart concerning demographic gravitation and whose work would seem to be well received:

> "Stewart advances the thesis: (1) that the demographic (gravitational) force F of attraction between two groups N_1 and N_2 average Americans separated by r distance is given by $F = N_1N_2/r^2$, where F acts along the line joining the two groups; (2) that accordingly their demographic energy by virtue of this force field is given by $E = GN_1N_2/r$, where G is a constant;
> (3) that the potential which the group of N_1 individuals produces at the point where the second is located is given by $V_2 = GN_1/r$;
> and (4) that the potential at any point produced by the entire population of any given terrain is given by $V = \int 1/r\ D\ dS$, where D is the density of population over the infinitesimal element of area dS, the integration being extended to all areas where D is not zero. The potential at any point, according to Stewart, may also be taken as an inverted measure of the proximity of the point to people in general."

Using these formulations, Stewart has computed equipotential contour lines for the United States enabling the deduction of various log-log linear associations between potential and economic development in different forms.

The sight of an animal patrolling or "working" its territory itself gives warning that a property has been taken, while an animal's aggressive approach towards an intruder can indicate that its territorial boundaries have been overstepped. But in an owner's absence or concealment other ways of communicating its claim to property are needed. Animals therefore employ boundary markers which are meant to be heard, smelt, or seen by potential rivals.

2.3.1 Animal boundaries.

Aural boundaries. It seems agreed by ornithologists that male bird-song acts as an intended warning to conspecifics that the owner of a territory is in residence. Male lions reveal their presence to their brethren by frequent roaring. Whether animals consciously choose a reverberant space to amplify their claims is not known, but barking dogs appear to enjoy their discovery of them.

Visual-olfactory boundaries. Marking is essentially a male prerogative among animals although bi-sexual marking has been known. Many mammal species are equipped with scent glands which transfer the distinctive odour of an animal to the terrain it crosses, and it is lucky for them that their predators usually have a stronger scent. Some animals are so equipped that they can blaze their claims by depositing a quantity of their scent mixed with urine. The pungency of the tom-cat's odour and the frequency of the dog's irrigatory proclivities are well-known[118]. But it is not implied that every marking of this kind by animals is a claim to ownership, for urination also has the social function of a news-letter informing the interested of the animal's age, sexual condition, and time of visit.

Creatures high on the evolutionary ladder tend to make less use of "localised" urination and defecation as markers as their ability to communicate become more vocalised. Apes and monkeys can rarely be "house-trained"[119].

Hediger (1962) reported that sick animals with localised habits of urination and defecation will even drag themselves to their customary places for evacuation. He remarked, significantly: "...here again the inner physiological organisation (of the animal) is topographically reflected in the organisation or foundation plan of the territory .....(and) a territory can, in a certain sense, be considered the projection of the organism over and above the body proper".(120)

<u>Visual-utilitarian boundaries</u>. Many species mark their boundaries more permanently than by urination. For example, all large and small cats (Felidae) and the grizzly bear are known to use "scratch-posts" to hone their front claws and these posts notify their presence in the area. Whether the incised marks on the animal's scratch-post serve yet another function analogous to that of Man's posted warnings which proclaim the <u>severity</u> of the fines or physical punishment upon those who would disturb his property is not known.(121)

2.3.2 Human boundaries.

There is ample evidence of human territoriality to be seen in national boundaries and in the history of war. But we shall only consider how the individual attempts to carve his foothold on particular areas of space.

As individuals we too use aural, visual, and olfactory markers to define the boundaries of our territory, although our repertoire of means is much larger than those available to animals through our ability to use and understand imagery. The employment of imagery requires the ability to reason and it is debatable whether animals possess this power in more than rudimentary form. Some animal boundary markers such as scratch posts might be interpreted as indicating an animal use of imagery but such a view is perhaps anthropomorphic. Can we ever know an animal's thought processes?

As regards ourselves, besides speech human auditory signals include warnings conveyed by throat-clearing noises, whistling, and - in Western societies - by the hiss of sharply indrawn breath. A curious feature of the human whistle and the hiss is that either may be used to create "white noise" in order to hide our activities or their location. We also use certain sounds of body movement, e.g. footsteps, and the noises caused by our displacement of objects to proclaim our tenancy of space. Sometimes we amplify our capacity to create warning noises by use of artefacts, e.g. the siren or the car horn.

We, too, make use of olfactory signals. Smell stimulates what is probably the most primitive part of the emotional areas in the sub-cortical brain, and olfactory memory is acutely evocative. Yet whilst we have largely lost our olfactory acuity the remnants we possess still allow odours to have human sign-values. Not only do they advertise our emotional and physiological states, but they can embody human aspiration for status (given by the smell of newness), for sexual attraction (via astringents and perfumes), and our control over the atmospheric mix in our immediate neighbourhood (air-fresheners). Domestic disputes over "fug" exemplified in smoke-filled rooms and perfumed boudoirs are perhaps rooted in the veiled challenge they are seen to present to the shared use of space.

Human visual markers can be utilitarian or symbolic or they may serve both functions. The practical value of fences, walls, and the like, is plain enough to the propertied and unpropertied. They exclude and contain; a notorious instance is the Berlin Wall.

But the effectiveness of symbolic markers may depend on whether they are backed by patent or implied penalties upon those who ignore them. Moreover, the meaning of the visual marker must be readily understood as representing a territorial claim. Thus the temporary tenancy of public, i.e. commmunally-owned, space can be hard to maintain in the claimant's absence unless he has deposited markers which in themselves have intrinsic worth. The markers must signify to others that they have not been abandoned.(122)

Without discounting the value of boundary markers, the claim to territorial rights is even more clearly expressed in the vocal and physical protest of those threatened with the loss of their claims; faced with this possibility animals and men act in much the same way.

2.4 THE BEHAVIOUR OF TERRITORIAL DEFENCE

Fights between animals of different species are not frequent outside the predator-prey relationship, but when they occur it may be the result of misidentification when by chance an animal presents some sign interpreted within the vocabulary of another species as an attack signal. Interspecific fighting can also occur when an animal bullies another of lower biological rank (2.5.3). Interspecies competition for nest sites may result in attacks on another species as the Sparrow has been observed to attack Martins and Bluebirds (COLLIAS 1944).[123] But though animals (and men) generally do not appear to mind a creature of another species wandering onto their property provided it poses no threat to them or to what they own, the intrusion of a stranger of the same species is almost invariably cause for inquiry. Territorial animals show both attachment to a site and hostility to conspecifics usually of the same sex. Either tendency can occur without the other (TINBERGEN 1957).[124] The concern here is with the more familiar joint presence of these tendencies.

2.4.1 Fighting between conspecifics.

Inhibitory checks. Among animals, the intrusion of a stranger of the same species is cause for alarm. Such concern is not remarkable for in sharing its needs and appetites a conspecific is a direct competitor for the resources they both seek. Having acquired the means of survival an animal might well be reluctant to share or surrender them if only upon the principle of "first come, first served", but it would clearly jeopardise the future of a species if a quarrel between conspecifics led to the inevitable serious injury or death of either of them. Natural selection has ensured that this rarely happens for within a species hereditary components have developed which allow an animal to react aggressively only to certain stimuli. It is likewise inhibited from attacking a conspecific not displaying those stimuli, or one which offers a pacificatory display.

<u>To have and to hold</u>. The operation of this behavioural system tends to preserve an animal's ownership of its territory, for whilst the defender is imbued with fighting spirit drawn from the familiarity of its surroundings the invader has no such advantage. TINBERGEN (1953) has described how the confrontation of rival male Sticklebacks (in Spring) leads to the flight of the intruding fish:

> When in its own territory, it (the Stickleback) attacks all trespassing rivals. When outside its territory, it will flee from the very same male it would attack when "at home". This can be nicely demonstrated in an acquarium, provided it is large enough to hold two territories. Male A attackes male B when the latter comes into A's territory; B attacks A when A trespasses voluntarily on to a strange territory, but one can easily provoke the situation by capturing the males and putting each of them in a wide glass tube. When both tubes are lowered into territory A, A will try to attack B through the double glass wall, and B will frantically try to escape. When both tubes are moved into territory B, the situation is completely reversed. (125)

Equally matched animals seem rarely to lose fights on their home ground. Why an intruder shows weakened resolve in face of the owner's defence of his territory is less easy to explain. Lorenz has pointed out that we should not anthropomorphise a morality among animals.[126] An alternative explanation might be found in self-conditioning brought about by an animal losing its juvenile fights with older and stronger conspecifics. Lack of resolve is quickly sensed among men and the man who hesitates is often "half-beaten" before he has begun. This may also be true of animals. As HINDE (1962) has said in relation to avoidance conditioning, the avoidance respose is well-known to be resistant to extinction even when punishment is no longer administered.[127]

The rules of behaviour. Animals evolve procedures, signs, and "rules" to govern fights between members of their own kind. For example, fights between the European lizards (Lacerta agilis) begin after an introductory display. One lizard will then grasp the other's neck in its jaws whereupon the attacked lizard waits for the grip to loosen and his turn to bite. The exchange continues until one runs off "... the loser appearing to recognise the superiority of the winner not only by the strength of his bite but by his unyielding resistance to being bitten".

Among fallow deer (Dama dama) it is reported that rival stags march along side by side watching each other from the corner of their eyes. The fight begins when they stop, face each other, lower their heads and charge. If there is no decision after a brief wrestling match with their antlers they resume marching and fighting until the winner emerges. It was noticed by one writer that when a stag turned to attack another which was inadvertently facing the wrong direction it did not attack its unprepared adversary but waited until it faced him and had lowered its antlers, i.e. the first stag was inhibited from attacking the other until it had been presented with the triggering sign stimulus.

Animals also have "rules" about the weapons used in fighting conspecifics. This is important when a species is equipped with lethal weapons. For example, the rattlesnake can kill conspecifics with a single bite; but when male rattlesnakes fight they do not bite each other but rise side by side and merely attempt to force their opponent to the ground. The loser is allowed to slide off unharmed.[128]

Fighting between conspecifics is nearly always resolved by a trial of strength from which the losers probably emerge with more psychological damage than physical hurt. If a challenged animal decides not to fight, then it must either run away or it must make the appropriate signs of appeasement to its challenger.

2.4 THE BEHAVIOUR OF TERRITORIAL DEFENCE

2.4.2 Threat and appeasement.

Fighting talk. It was said earlier that an animal will only react aggressively to conspecifics presenting certain stimuli (2.4.1), and that interspecific fighting can happen when by coincidence a member of one species uses the "fighting talk" of another (2.4.0). Threat display is the preliminary to fighting. It is first marked by physiological changes in the animal of which the external signs may include respiratory turbulence, sweating, changes in colouration, and the tensioning of body muscles. Autonomous changes then give way to the animal's positive attempt to intimidate its rival by such means as staring, hair-erection, howling, and among some birds and fishes by the inflation of air-sacs. If a rival is unimpressed, the animal will show its intentions more clearly but at the same time it is subject to an urge to run from danger. It will make intention movements of attack which it modifies immediately the motivation to run gains dominance. In the course of evolution within a species the posturings of an animal in this predicament have become stereotyped into patterns of movement having signal value. Quite often these movements are insufficient to release all the nervous tension built up within the animal and it will then resort to another category of behaviour known as "displacement activity" (2.4.3).

Appeasement. An animal can usually avoid a fight with a conspecific by making suitable placatory gestures. It can also use the same gestures to signal its acceptance of defeat should it join issue. LORENZ (1966) listed examples of the submissive or appeasement gestures which various animals use to avoid stimulating aggression from conspecifics. He described, for instance, how wolves and dogs when losing a fight will expose their throats to their opponents who are thereby inhibited from further attack, and how certain bird species will similarly expose their vulnerable nape.[129] Further examples are provided later in a comparison of animal and human behaviour(2.4.4).

2.4 THE BEHAVIOUR OF TERRITORIAL DEFENCE

2.4.3 Threat and displacement activities.

Mixed emotions. As a rule animals are rarely single-minded since the causal factors for more than one type of behaviour are usually present in their environment. In an earlier example it was seen that a Stickleback alternated between attack and defence of its territory according to whether it was placed in its own part of an acquarium of that of a rival fish. The behaviour of the Stickleback was clearly determined by one or other of two conflicting tendencies, but animal behaviour is often apparently quite irrelevant to the situation. For example, how do animals show willingness to fight to maintain their ownership of property ? Tinbergen has described the reactions of the Herring Gull:

> (Having paired and) once established on the territory the male becomes entirely intolerant of trespassers. Each intruding male is attacked. Usually no genuine attack is made, threat alone is often sufficient to drive a stranger off. There are three types of threat. The mildest form is the 'upright threat posture': the male stretches its neck, points its bill down, and sometimes lifts its wings. In this attitude it walks towards the stranger in a remarkably stiff way, all its muscles tense. A stronger expression of the same intention is 'grass pulling'. When male and female face a neighbouring pair together, they show a third type of threat: 'choking'.

And, in regard to the Stickleback:

> ...Again, fighting is rarer than threat. The threat behaviour of Sticklebacks is peculiar. Not only do they dart towards the opponent with raised dorsal spines and opened mouth, ready to bite, but, when the opponent does not flee at once but resists, the owner of the territory does not actually bite but points its head down and, standing vertically in the water, makes some jerky movements as if it were going to bore its snout into the sand. (130)

The "grass-pulling" and "choking" of the Herring Gulls and the "digging" of the Stickleback are merely two examples of numerous recorded observations of behaviour called "displacement activities" (Übersprungbewegung. TINBERGEN 1940). Threat displays are best interpreted in terms of displacement activities(131)(132) although the latter are not invariably associated with aggressive behaviour.

Displacement activities occur when an animal is under the influence of a powerful urge it is is unable to express in the normal way; they are an overt manifestation of inhibitory factors at work in moments of tension, and they signify the channelling of nervous energy into an harmless outlet. Animals exhibit a variety of displacement activities which include "irrelevant" feeding, preening, or even sleep, when behaviour of higher priority is blocked either by external causes outside the control of the animal or by its own internal conflict arising from the simultaneous experience of two incompatible types of motivation. Sexual inversion, infantile regression, and immobility responses can also appear in such a situation. Animals, particularly birds, frequently have species-specific patterns of displacement activities. It has been postulated by ethologists (e.g.Lorenz) that displacement activities are often transformed through "ritualisation" into stereotyped displays divorced from the originating causal factors. It has been suggested that the courtship display of birds developed in this way.

2.4 THE BEHAVIOUR OF TERRITORIAL DEFENCE

2.4.4 The similarities of animal and human behaviour.

Animals and men often act in the same way and this is not very surprising for Man retains many of his ancestral characteristics. Yet it should be remembered that the underlying mechanisms which actuate particular responses in animals may differ greatly from those which prompt Man. His capacity for abstract thought and his highly evolved vocalisation, his capacity for long-term planning on which much of his behaviour is based, and the symbolic importance of some of his behaviour, allows a more remote connection between action and its conceptual origin. Situations in which Man's actions parallel those of animals in the same circumstances are described below.

Threat signals. MORRIS (1967) detailed the human repertoire of threat and appeasement signals. He noted how aggressive arousal in Man produces the same physiological changes and muscular tensions to be seen in aggressive animals, and he described the resemblance between human and other higher primate intention movements. Among the visual signals of intended aggression he noted the familiar raising and shaking of the clenched fist:

> It is performed at some distance from the opponent, at a point where it is too far away to be carried through into a blow. Thus its function ....becomes a visual signal......... It has become further ritualised by the addition of back-and-forth striking movements of the fore-arm..... We perform rhythmically repeated 'blows' with the fist, but still at a safe distance. (133)

In regard to aggressive facial expressions, Morris distinguished human reactions which are culture-specific (learned), e.g. putting out the tongue, from those which are probably a species characteristic, e.g. jutting of the chin, and he concluded that "most cultures have also added a variety of threatening gestures employing the rest of the body."(134)

2.4(2.4.4) THE BEHAVIOUR OF TERRITORIAL DEFENCE

Lorenz has said how the chimpanzee confronts its adversary by sticking out its chin, by stiffening its body, and by raising its elbows and by rotating the arms inwards so that the longest-haired side is outwards the general effect is that of making it appear larger and more dangerous than it really is.[135] The wrestler's stance and the "cowboy" swagger indicate that Man strives for the same effect.[136]

Aggressive movements of animals include strutting, e.g. the barnyard rooster; and the military "goose-step" is too familiar. Morris made the point that the stare has a powerful intimidating effect it is difficult to ignore (zebras first stare their rivals), and that men subconsciously increase or diminish the aggressiveness of their gaze by their choice of spectacle frames.[137] He reminded us that moths frequently have large eyespots marking their wings to deter predators, and drew attention to the compulsive attraction of the eye configuration as an advertising device of such products as OMO,OXO,etc., SOMMER (1969) reported experiments in progress where an attempt was made to dislodge the occupant of a chair by staring at him.[138]

Appeasement signals. The appeasement posture corresponding to strutting is to stand still; and parents admonishing children can be heard to say: Stand still while I'm talking to you; when what they probably mean is : Show me that you are penitent.

Besides immobility[139], human submissive behaviour demands that the body is made to appear smaller; mammals often do this by crouching as the dog will at the sound of his master's angry voice, whereas our own abasement is determined more by the level of deference it is polite or expedient to show. The human levels of deference have no classificatory names - at least in Western society[140], but initially they entail the averted gaze and the head-bob, or the removal of the hat with its conventionalised substitutions of forelock-touching and the military (open-palmed) salute. Some societies may remove their shoes to reduce height. A more expressive indication of deference is the bow or curtsy. The kneeling posture and pronation are reserved to show complete subservience. Most of these signals are incorporated in religious and courtly protocols.

The word "appeasement" carries the notion of making concessions to someone and human friendship is hard to maintain unless this is done. Thus friendship gestures can evolve from submissive ones. The human hand-shake, for instance, is thought to derive from the begging gesture Man and chimpanzee share, and whereas in Western societies the offer to shake hands could once have meant 'I bear no weapons against you' or perhaps 'Take what is mine', it is interesting to note that some Eastern forms of greeting are still close to the act of supplication.

It is well-known that aggression can be deflected. The old advice that " a soft answer turns away wrath" is but one of several ways in which this can be achieved. Animal submissive gestures include those derived from infantile behaviour patters. The young dog when threatened will lie on its back as once wounded soldiers exposed their defencelessness on the battlefield. The adult dog may lick another's chops as it did when begging for food as a pup. Another submissive gesture is the adoption of the soliciting posture of the female; male and female baboons, for instance, will both do so to inhibit aggressors. As appeasement gestures, Lorenz was of the opinion(141) these actions have nothing to do with infantility or sexuality, but that they stemmed from the special inhibitions which prevail in a species preventing attacks on the young or females (Immobility, infantile regression and sexual inversion are also displacement activities). Women have long used tears to disable their menfolk, for whilst tears are not always "unmanly" they are commonly regarded so in response to aggression .

Grooming is yet another form of appeasement. A subservient monkey will offer to groom a dominant animal to placate it, and what we term "making amends" often follows a similar process involving the actual stroking of the upset person.[142] Lorenz has suggested that appeasement gestures and practices are the basis of bond-formation between animals enabling them to recognise their mates as well as other individuals in the group to which they belong.[143] A human parallel is the ritual exchange of tobacco and alcohol between men and perhaps the shared joke. Special "joking-relationships" are a feature of tribal organisation in West Africa in the control of inter and intra-tribal aggression. Paired individuals from mutually hostile groups are given the license of court-jesters in their dealings with each other.

Displacement activities. Displacement activities are often part of the ceremonial attached to fighting between conspecifics and as such they have survival value to a species. Man's displacement activities (redirected activities) need not have such importance although they may help preserve his mental and physical health. Displacement activities can occur outside their association with fighting and threat, but their origin in animal and Man is essentially the same. They arise as a result of motivation by conflicting drives, e.g. to fight or run; or as a result of the interruption of an episode of behaviour before its completion which frustrates achievement of some goal, e.g. in the absence of response to sexual overtures.

Human displacement activity in relation to aggression has familiar patterns. It includes the boxer's nose-dab as well as the real and figurative whipping-boy. It may take physical form as in the violent slamming of a door after human argument, or it can be a purely vocal attack on a third and innocent party to a quarrel. Displacement activities appear whenever Man is in an agitated state of inner tension. Youngsters being interviewed by an authoritarian figure can often be seen to jog from one foot to another in a bobbing and weaving motion; adults may rattle their coins and keys, drum their fingers, chain-smoke, chew sweets or fingernails, and indulge in a whole range of exploratory or tidying activities involving their person or the articles around them. They mey experience the frequent desire to relieve themselves. The truly dominant person in the gathering of an interacting group, Morris suggested, is the one who fidgets least. If the ostensible leader of a group is seen to perform a large number of small displacement activities it could mean that he believes his position is being challenged by others present.(144)

2.5 ANIMAL DEFENCE OF SUBJECTIVE SPACE

Animals fight or threaten other members of their species to gain dominance as well as territorial space, because the possession of one usually confers the benefits of the other. Conflict between conspecifics may therefore also occur outside the territorial context described so far, for the defence of territory, as CROOK (1968) made clear, is only "a special case of spatial defence not easily separable from the maintenance of personal space".[145] The occasions for animal aggression outside quarrels for the possession of a specific parcel of property are described below.

2.5.1 The struggle for status.

Animal hierarchies and peck-order. The basis of group organisation in social animals is sex-pairing, territory, and dominance status. Social rank among cattle has long been familiar to farmers, and the term "pecking-order" has passed into common usage since Schelderup-Ebbe's investigation of hierarchy among domestic fowl.[146] The "alpha" bird "rules the roost" and can peck all others with impunity; the lowest ranking "omega" bird dare peck no other. Each sex has its own peck-order; females defer to males. High social position is obtained by success in fighting or threat. Among hens, the highest ranking is entitled to the best roosting-place and the best food: the remainder take what is left. Dominance ranking as a general phenomenon may be linear or in pecking triangles where subordinate creatures share equal status. LORENZ (1952) has described how this ranking order among jackdaws protects its weaker members in that tension is greatest between birds of adjacent rank, and because high-ranking jackdaws intervene in favour of the weaker of quarrelling inferiors.[147] WASHBURN & DeVORE (1961) have said the same of baboons:

> The usual effect of the hierarchy, once relations among the males are settled, is to decrease disruptions in the troop. The dominant animals, the males in particular, will not let others fight. When bickering breaks out, they usually run to the scene to stop it. Dominant males thus protect the weaker animals against harm from inside as well as outside. (148)

Precedency in peck-order holds privileges for both animal and men in the choice of a constellation of activities including that of sharing out space, and as such it is inseparable from social organisation as Orwell's animals found to their cost. With an established peck-order every creature in a ranking-scale knows where it stands socially in relation to its fellows,(149) and what access this status gives to the available resources. It knows from whom it can expect deference and to whom it must defer. The observance of peck-order can therefore reduce the occasions an animal is called on to fight although the maintenance of peck-order may create problems for the community in the shape of tensions arising within the group. Even so, as Lorenz has remarked: "...a society may derive a beneficial firmness from the state of tension arising inside the community ....(150). A view which GLUCKMAN (1956) has propounded in regard to human societies.(151)

2.5.2 The consequences of crowding.

Social effects. The tensions within a community may, however, lead to its collapse. This can happen in conditions of gross over-crowding when high population densities produce a shift from the holding of individual territories to the exaggerated exercise of individual dominance. This, in turn, may precipitate increased fighting between conspecifics leading to the death of an animal by injury or stress. The consequences of overcrowding among Norwegian rats have been reported by CALHOUN (1962) who told how the social behaviour of a population of laboratory animals was completely disrupted by permitting them to increase their numbers to twice what experience had taught him could peaceably occupy an available space. Females aborted, failed to survive pregnancy, or abdicated their maternal responsibilities. Males became pan-sexual, cannibalistic, frenetically over-active or pathologically withdrawn.[152]

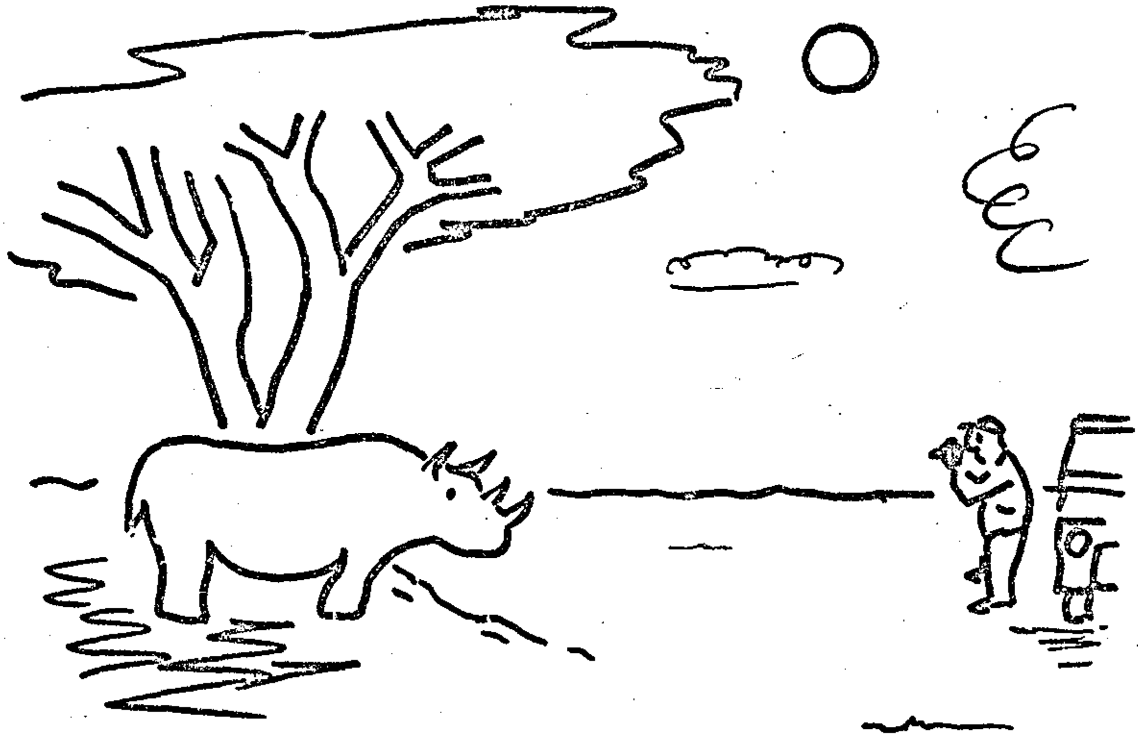
Physiological effects. Autopsy of deceased rats revealed that many had developed internal complaints consistent with hormonal imbalance. Other studies have also shown that spatial tolerance is affected by an animal's hormonal state.[153] The difficulty of defining aggression in terms of endocrine reactions[154], noted CLOUDSLEY-THOMPSON (1965), lies in separating cause and effect. The components of aggression include the emotional states associated with fear, stress, and anxiety, as well as those associated with aggressive sexual behaviour; but how far hormones operate independently of the central nervous system (CNS) and to what extent they are stimulated by its excitation is not known. He pointed out that most of the endocrine reactions which have been associated with aggressive behaviour are mediated by the adrenal glands (situate at the kidneys), and that the presence of adrenergic activity has been demonstrated in both animals and men exposed to aggressive situations. Thus, the adrenal-vein blood of cats excited by the barking of dogs has been found to contain more adrenergic activity than that of unstimulated animals. Among ice-hockey players, the excretion of the anxious goal-keeper was found to show a significant difference in adrenaline output than that from more active players.[155]

2.5.3 Encounters between different species.

Flight distance and critical distance. Wild creatures commonly take flight if approached too closely by Man or any other potential enemy, but should even a timid animal feel trapped in an encounter it will attack and may go beserk. A small mammal, for example, may develop an "audiogenic" seizure marked by violent and undirected movements followed either by catelepsy in which it becomes entirely motionless, or by "bouncing aggression" when it will attack any other creature however large.[156]

Most wild creatures also exhibit what Hediger has termed FLIGHT DISTANCE and CRITICAL DISTANCE. These operate when an animal confronts a member of another species. Flight distance is the spatial boundary an animal maintains between itself and a potential enemy; critical distance is the zone contained within an animal's flight distance. Closure of an animal's critical distance (FIG.) causes it to withdraw in order to maintain its flight distance, but if it cannot withdraw the animal will attack (HEDIGER 1950). The performance of the circus animal-trainer is based on this knowledge, and his whip and chair serve largely as stage props although they may be used to extend the dimensions of his body-image as perceived by the "performing" animal.[157] Conspecifics have probably about the same flight distances; and appropriate to their size and mobility, large slow-moving animals generally need a greater flight distance than smaller and nimbler species. The constancy of an animal's flight distance is quite precise. Animals tested by Hediger have shown flight distances maintained within a few centimetres.

Biological rank. There are dominance rankings between different species just as between the members of a species. Outside the predator-prey relationship, for example, leop-



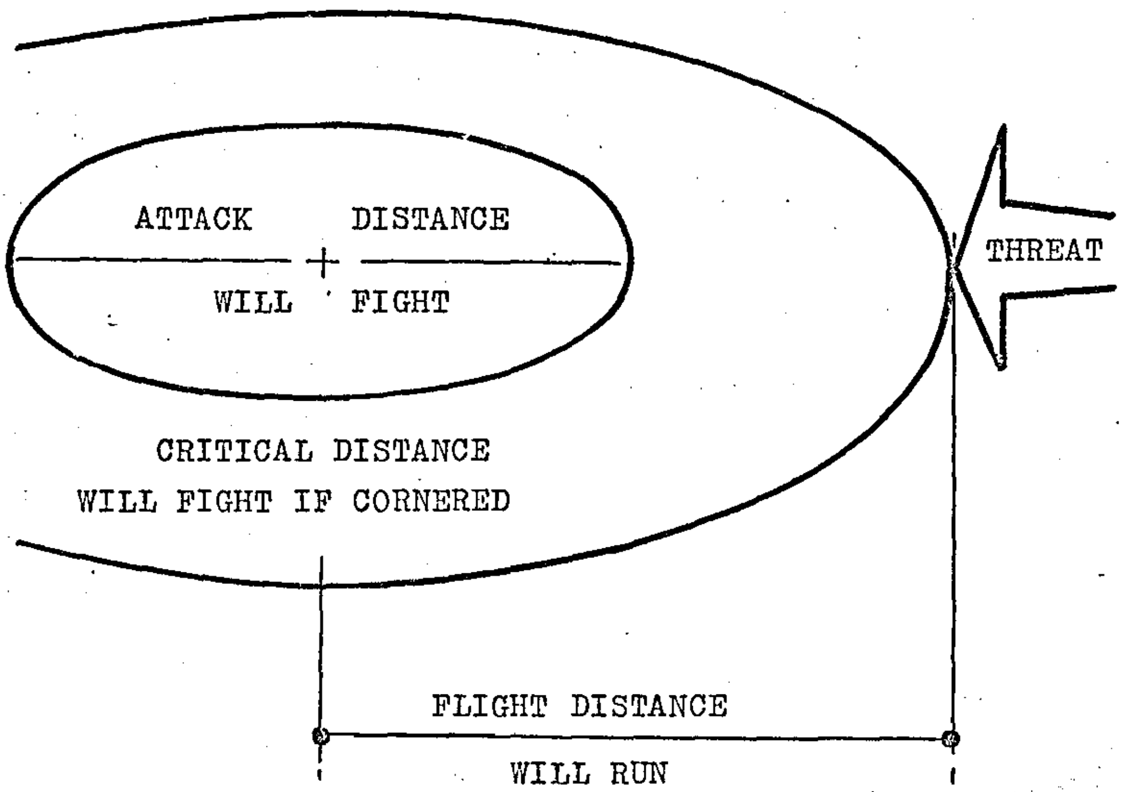


FIG.(11). MEETING OF DIFFERENT SPECIES pards outrank cheetahs, the walrus outranks other seals, elephants dominate hippos and buffaloes. Biological rank is seen demonstrated in the sharing of a kill when scavengers defer to the predators.

2.5 ANIMAL DEFENCE OF SUBJECTIVE SPACE

2.5.4 Encounters between conspecifics.

CONTACT and DISTANCE types.

There are marked variations in the sociability of animals, and members of a species may respond to the sight of conspecifics by associating with them or they may show the opposite tendency by repelling too close an approach. Hediger has dichotomised vertebrates into CONTACT and DISTANCE types. Contact animals are those which tolerate and even seek close physical contact with conspecifics; distance types do not tolerate physical contact - apart from reproduction and weaning. The index of sociability for a species under this classification is not however based on whether animals exhibit gregarious or solitary habits, but it describes the active response of individual animals to the proximity of neighbours. Gregarious species may be either contact types (e.g. seals) or distance types (e.g. starlings). Their classification is determined by whether they maintain what Hediger has termed Individual Distance.

INDIVIDUAL DISTANCE.

Individual distance is the space around their bodies which distance species maintain against the approach of conspecifics by avoidance or attack.

It has been likened to a mobile territory which an animal carries around with it, and it can be compared with the "personal space" of Man (TABLE I). Contact species do not observe individual distance; although both contact and distance types have Flight Distances. Individual distance is therefore a further spacing mechanism maintained by (distance) animals to protect their person rather than to protect their property.

Among species which organise ranking-orders (pecking orders), high-ranking animals often have greater individual distance than subordinate animals, whilst large species' members usually have greater individual distances than members of smaller species.

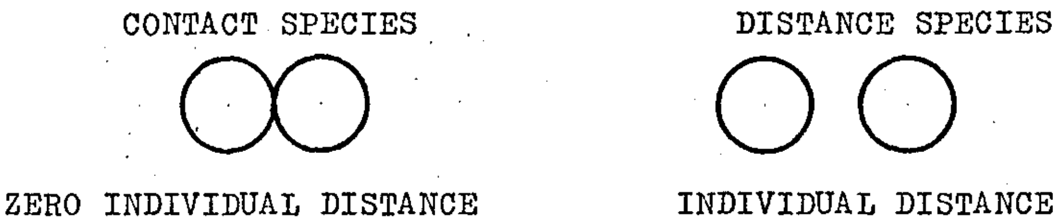
2.5(2.5.4) ANIMAL DEFENCE OF SUBJECTIVE SPACE

Occasions for the operation of individual distance are illustrated below (FIGS. 13 & 14); these figures are relational and not scalar.

Social tendency. If individual distance operates to repel distance-type conspecifics from touch contact with each other, why do gregarious distance-types congregate in large societies, i.e. what counter-vailing force opposes the divisive effect of individual distance ?

A likely explanation is the evolutionary proven better survival value of gregarious behaviour for group life facilitates both the imitation of behaviour and the transference of mood. This is useful not only in risk situations where mimicry is seen in the synchronous flight reaction of startled birds(158), but it serves also to phase other activity cycles such as migration and breeding. A further component of this evolutionary development is the operation of a social tendency which is implied by gregariousness and which is experienced as the "pull of the crowd", i.e. one can suppose that members of gregarious species are fond of the company of conspecifics and would feel exposed to fears when alone. As with Man, an animal separated from the group probably has to balance the strength of these feelings against the desire to follow personal inclinations.(159) Spatial proximity to the group arising from a social tendency is therefore a self-imposed restraint on movement and a form of spatial defence that does not require the active intervention of a conspecific or a member of another species.

The operation of Individual Distance. It has been noticed that the Individual Distance of the members of a feeding group of distance birds has increased when food was scattered thinly, and that it was reduced only when the attention of a bird was sufficiently diverted from the encroachment of an intruder or when in panic reaction birds will



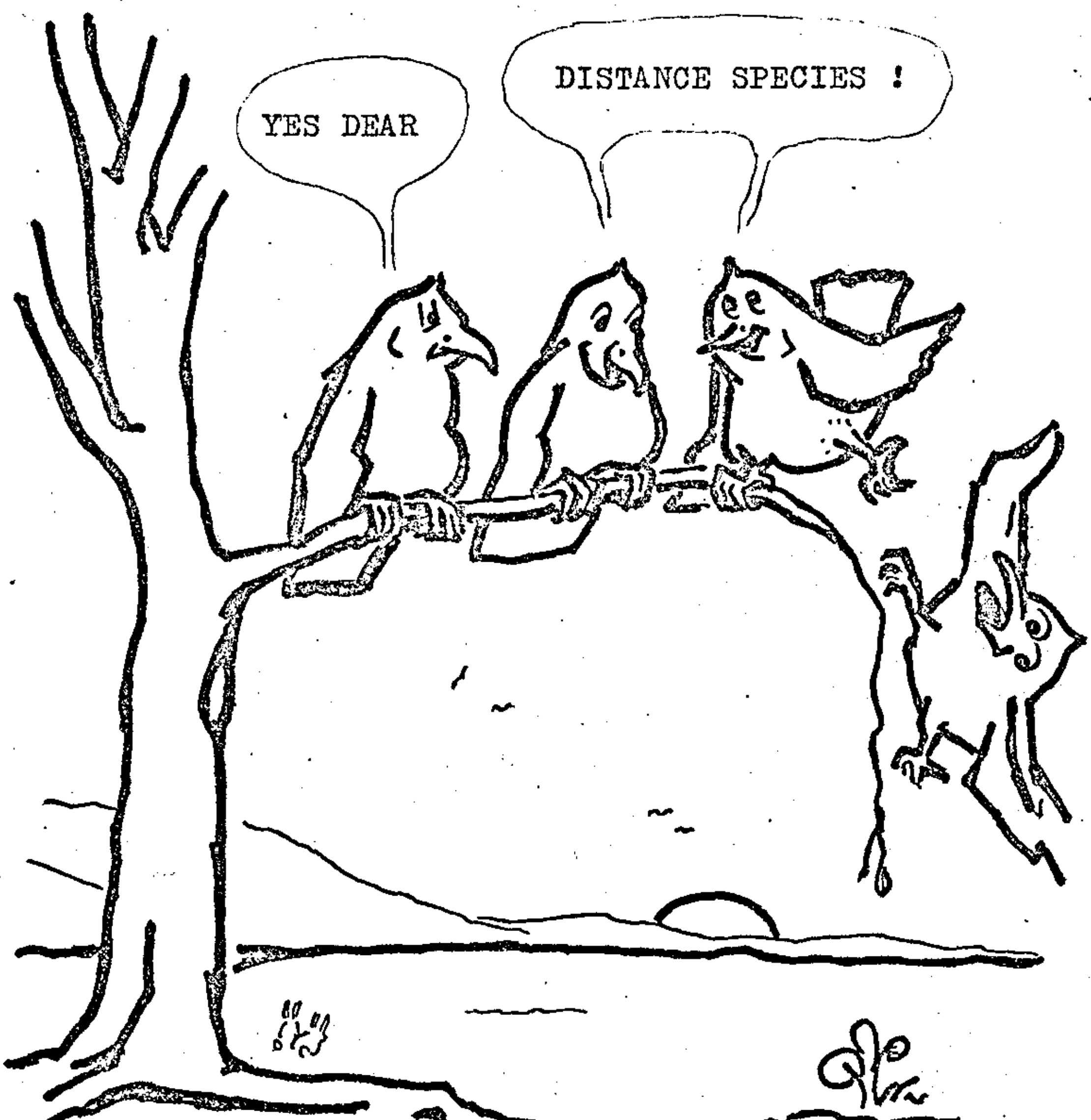


FIG.(12). MEETING OF THE SAME SPECIES

huddle together in fear (in an attempt to enlarge their body-image ?). The spatial distribution of distance bird flocks, CROOK (1961) inferred, is therefore not only mediated by the interaction of a social tendency and individual distance aggression, but also by the amount of attention an animal pays to the movements of other members of its group.(160)

Crook compared the spatial distribution of distance bird flocks (West African Weavers) with that of related contact bird species. Among distance birds he identified three spacings maintained by conspecifics in their use of an occupied aviary perch which he named as "arrival distance", "settled distance", and "distance after departure". The transferability of this nomenclature to human affairs and the sociometric application of its ideas to the analysis of human seating preferences make it worthwhile to recount his conclusions.

"Arrival distance" signified the distance between a bird with an established position on the perch and the alighting position of an adjacent newcomer. When the perch was well-occupied the newcomer had to land in a gap or at the end of the row, and its arrival at either place usually led to a shunting along the row as the occupants adjusted to the new available space. After these spatial adjustments were completed the mean incremental positioning between the birds was calculated as their "settled distance". Finally, the departure of a bird naturally left a gap on the perch; but the ensuing "distance after departure" between remaining birds was not measured because of sporadic variation. An alert bird which had been left isolated tended to move closer to the main group but some were often asleep or too drowsy to move.

Figure (13) is derived from Crook's explanation of these activities. It shows the social tendency of a new arrival (B) which undershoots the individual distance of an established bird (A) and closes upon it; and how a new arrival (C) overshoots into the individual distance of bird (A) and thereby provokes an aggressive response from it. Crook explained that the settled distance between (A) and (B) and between (A) and (C) was probably

A - 1 ARRIVAL DISTANCE

(13.a) A - 2 SETTLED DISTANCE (13.b)

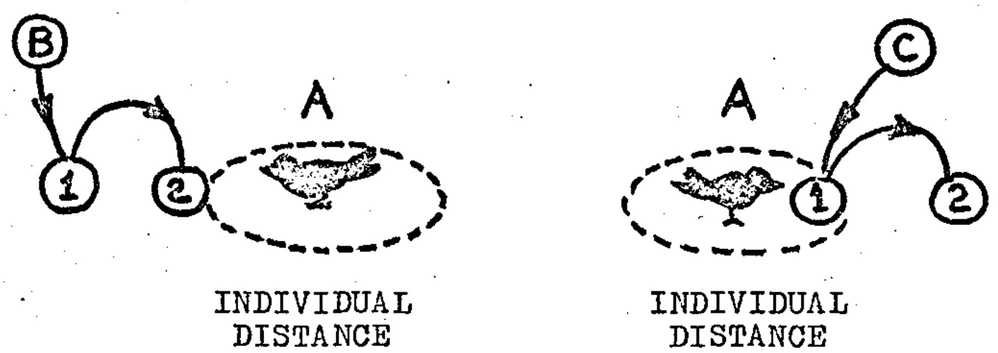


FIG.(13) THE OPERATION OF INDIVIDUAL DISTANCE BETWEEN DISTANCE-TYPE CONSPECIFICS

determined by the dominance relationship (peck-order) existing between them, for sometimes an approached bird would shift from the encounter instead of the new arrival. It could also be noted that whilst settled distance was never less than the individual distance of the dominant bird (cf.FIG.13.a) it could exceed that distance (cf.FIG. 13.b). Another way of stating this is that individual distances can but need not overlap. In FIG.(14.a) the

(14.a) (14.b)

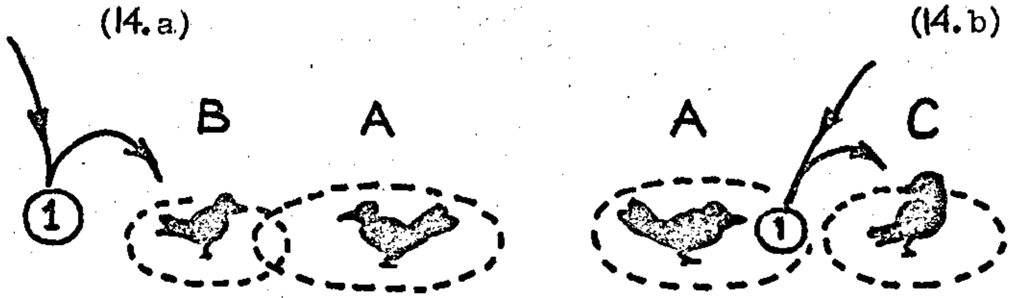


FIG.(14) THE OVERLAP OF INDIVIDUAL DISTANCES confrontation of birds (A) and (B) shows how far individual distances can overlap with (A)'s boundary as the determining factor. Individual distance do not overlap in FIG.(14.b), but they could do so depending on how far (C) hopped out of (A)'s way or vice-versa.

Individual Distance, Personal Space, and the Safe Distance.

Contact species are recognised by their predilection for huddling together when at rest since distance species normally maintain individual distance except in the circumstances previously described. However, because individual distance is more readily seen to operate when one or both partners to an encounter is resting, the dynamic properties of individual distance tend to be overlooked.

The question posed is whether a solitary animal can have individual distance or whether this is only possible as a relationship between two or more animals; for whilst it may be recalled that individual distance has been referred to as a "mobile territory" which an animal carries around with it, the analogy does not elucidate whether an animal merely carries the "stakes" of its mobile territory to erect on encountering a conspecific, or whether it transports its mobile territory "en bloc" regardless of the presence or absence of conspecifics. In different terms, the question is whether individual distance is a latent capability requiring external stimulation for its activation, or whether it is a continuous autonomous process. The solution to the question has pertinence to human territoriality.[161]

Again, to regard individual distance as "an internalised version of territory" directs attention to its quality of private experience. But a solitary animal cannot experience individual distance , so Crook has argued, since the accepted definition of "territory" requires a defensive display (as evidence of site attachment) to be shown against a neighbour[162]; and as SOMMER (1969) has pointed out, a solitary animal might then be said to possess "infinite individual distance"[163]. If individual distance is a property which can only exist between two or more members of a species, then a terminological solution might be to adopt the term "personal space" to denote a solitary animal's (putative) sensation of ownership of contiguous space. Whereupon if individual distance operates between conspecifics, and flight distance operates between non-conspecifics, could it be said that personal space is observed by an animal in relation to the avoidance of inanimate objects? Sommer has claimed that in regard to human affairs the avoidance of objects (and servants) does not involve personal space.

The term the "Safe Distance" has been introduced into this thesis partly because there is clear need to distinguish behavioural circumstances not covered by the existing pertinent terminology. In this discussion, the term "Safe Distance" (i.e. the projected measure) will connote the existence of an area of space around Man which has physical dimension and which is defended against non-human objects. It also connotes psychological dimensions which will be discussed later. Use of the expression "individual distance" will be restricted here to an ethological context where it refers to animal avoidance of conspecifics. Role and status may give us closer access to certain objects than others are allowed, but we gain that access from our role and status and not from our possession of individual distance. Our transaction with the object is still governed by our Safe Distance judgement. Reference to an animal's spatial tolerance of obstacles does not extend beyond this Section (See: TABLE I).

Measurement of individual distance.

Individual distance varies according to the activity of the animal, and experiments

NEED	MAN	ANIMAL
Minimum space for life support for any living organism	—	CRITICAL SPACE (Schäfer)
Minimum space for any dynamic activity	LOCOMOTION ENVELOPE	—
Proximity with conspecifics	—	SOCIAL TENDENCY (Social distance: Hediger)
Privacy from conspecifics	—	ANIMAL XENOPHOBIA (Ardrey)
Interval maintained from conspecifics: as affected by considerations of role and status	INDIVIDUAL DISTANCE	INDIVIDUAL DISTANCE (Hediger)
as determined by cultural setting and through fear of conspecifics	PERSONAL SPACE (Sommer & others)	—
Interval maintained from non-conspecifics through fear & anxiety	SAFE DISTANCE	FLIGHT DISTANCE (Hediger)
Interval maintained from environmental objects through fear & anxiety		—

Suggested term.

TABLE (1). NOMENCLATURE OF MAIN TERMS RELATING TO THE SPATIAL TOLERANCES OF ANIMALS AND MEN.

have been held to quantify those distances. MARLER (1956), for example, arranged the feeding hoppers of chaffinches progressively closer together until the feeding birds invariably fought. (The example is given partly to show the method of boundary exploration). His experiments revealed that male birds when feeding had about three times the individual distance of females (i.e. 21-26cm.:7cm.), and that an animal's individual distance was a tolerance zone rather than a specific fixed distance.[164]

The present writer found no references in the literature to studies which compare the individual distance of an active animal with its individual distance when at rest, nor to studies which entailed measurement of an animal's spatial tolerance of obstacles.

2.6 THE CONTROL MECHANISMS OF TERRITORIAL BEHAVIOUR

It has been explained earlier that territorial behaviour is marked by fixed action chains "which are distinct from chains of reflexes", and that all territorial species typically exhibit these fixed action patterns in their relationship with conspecifics and in their relationship to territorial sites.[165] It has also been mentioned that territorial behaviour does not invariably entail the defence of a site (2.4.0 & 2.5.0), but that it can be seen in the willingness to fight to maintain ownership of space and in the avoidance behaviour of those who encounter this willingness. The main psychological and physiological areas of interest pertinent to the mechanisms which mediate this behaviour in animals are indicated below. The discussion is elaborated in Section (3.0) as appropriate.

2.6.1 Psychological mechanisms.

Motivation. An action is said to be controlled by a drive when it is unplanned and not consciously directed. The social tendency of gregarious species mentioned earlier is drive-controlled, as are the feeling states associated with hunger, fear, anger, pugnacity, sex urge, and parental concern. A drive is the unconscious impulse towards some course of action on which is superimposed those needs and wishes of which we are aware. For example, in Man the drive to quench a thirst may lead us to choose to drink beer rather than tea. Many accept that most animal behaviour and much of human behaviour is drive-controlled and that the emotions associated with our drives influence our perception of the external world.

According to the classical formulation of motivation theory as applied to animal behaviour, complex fixed action patterns such as reproduction and feeding consist of a hierarchy of simpler behavioural units released at different levels of excitation. Energy specific to these activities (action-specific energy) accumulates within an animal as a result of unsatisfied physiological needs, or alternately through hormone secretion, and it is released when the appropriate "sign stimuli" occur. These sign stimuli activate "innate releasing mechanisms" in the nervous system. If the drive of an animal is fully satisfied the corresponding behaviour cannot be elicited by any stimulus; on the other hand, when a drive is unsatisfied the pent-up energy may trigger the corresponding action pattern spontaneously or in response to inappropriate stimulus. It is maintained that fixed action patterns frequently begin with "appetitive behaviour" in which an animal appears to search for some outlet for its accumulated energy. The eruption of this energy in the "consumatory act" of the fixed action pattern dissipates the drive within the animal.

The opposite to appetitive behaviour is when animals display "aversions". Aversive behaviour occurs when an animal is unpleasantly stimulated, and it persists until the stimulation is removed or the animal removes itself from the source of stimulation. Unlike appetitive behaviour, aversions are said to spring up spontaneously. The orthodox view[166] is that animal aggression in defence of territory is aversive behaviour, i.e. spontaneous, which accords with the observed situation that animals do not usually seek fights. Yet the fact that they will do so in the aroused state following a skirmish or when there is no other way to satisfy some over-riding physiological need weakens the claim that aggressive behaviour is completely spontaneous.

Avoidance behaviour by an aggressor in face of territorial defence could also be spontaneous. But this discounts the role that learning might play in fighting and other aggressive behaviour. The level of prior success in fighting or threat conditions the response of an animal to another's territorial defence; neither would an an animal normally attack those with whom it had formed bonds.[167] Avoidance learning in animals or men is not satisfactorily explained by "drive-reduction" theory[168], i.e. the explanation that learning results from the reduction of drive strength produced by satisfaction of certain physiological needs. Drive-reduction and other psychological considerations pertinent to the safe distance are discussed in Section (3.0). At this stage it is merely noted that "field theory" wherein "behaviour is considered goal-directed and concerned with avoiding or approaching something in the environment"[169] would appear to offer a more realistic framework wherein to explore human observance of the safe distance. Whether field theory can be applied to animal behaviour is not our concern: nor is it proposed to comment on how animals might perceive their environment.

2.6 THE CONTROL MECHANISMS OF TERRITORIAL BEHAVIOUR

2.6.2 Physiological mechanisms.

Aggressive behaviour in animals is mediated by two sets of factors. These are the chemical or hormonal factors referred to earlier (2.5.2) which are relatively slow-acting and which sustain the intensity of drives, and neural factors which control expression of the motor patterns of behaviour. All these factors act in concert although their individual responsibility for specific actions is often difficult to isolate. It is not intended to discuss endocrine reactions further other than to say that many accounts of experimental investigations into the causes of animal aggression are characterised by attempts to induce sexual inversion by the administration of hormonal preparations or by castration and spaying.

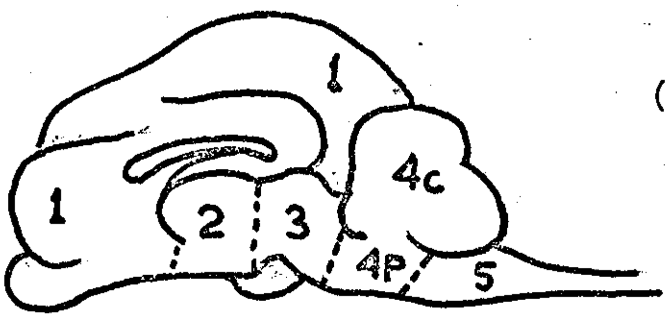
Neural factors. There are three ways of examining the neurological control of motor behaviour. "Ablation" involves the removal or destruction of some part of the CNS to discover the alterations in functions that this produces. More often a part of the nervous system is stimulated electrically and the responses are examined to the "false" nerve impulse. Another method is to study the functional changes brought about by injury to the nervous system or by some structural abnormality which renders part of it inoperative. Each of these methods has its particular problems.[170]

Attempts have been made to map the areas of the brain responsible for specific activities. But success in the localisation of particular functional areas alone does not explain how or why these areas function. Follow-Hess who implanted electrodes in the brain stem of cats, von HOLST and von SAINT PAUL (1962) treated fowl in the same way for the purpose of examining the nature of drive mechanisms. They recorded the animal reactions to different depths of the electrode and at different current intensities, and were later able to programme specific activities in fowl by energising the electrodes.(171) They noted that in the momentary situation the organism is subject to the interplay of a "bundle of drives" which may support or oppose each other, and that "spontaneous" activity is the result of the shifting interplay of these forces within the CNS.

It has been found by surgical operation (ablation) that lesions of the forebrain in certain fish, in pigeons, and in cats has produced a loss of inhibition in attacking other individuals. Cats which have had their cerebral cortex removed have become hyper-sensitive to provocation; similar reactions have been produced in them by electrical stimulation of the hypothalamus. It has been concluded from these and other studies that the hypothalamus (FIG.15) is the brain centre which amplifies and sustains the effects of external stimuli which produce aggressive behaviour, and that the cortex represses anger so that slight stimulation does not upset an animal unduly.

Support for the inhibitory role of the cortex which is considered to be the most sensitive part of the brain to oxygen lack has been drawn from the effects on human behaviour of acute anoxia. Human subjects exposed to induced anoxia in decompression chambers have shown marked lack of emotional control puntuated by periods of laughter, anger, and pugnacity.. Part of the cortex is therefore also considered to be the centre which actually excites aggression.(172) (173)

FOREBRAIN		MID-BRAIN	HIND-BRAIN	
TEL- ENCEPHALON	DI- ENCEPHALON	MES- ENCEPHALON	MET- ENCEPHALON	MYEL- ENCEPHALON
NEOCORTEX (new brain)	ALLOCORTEX (other brain)	i.e.	SUB-CORTICAL BRAIN (old brain)	
Cerebrum & its outer 'skin', i.e. cortex. 1	Thalamus Hypothalamus 2	Tectum Tegmentum 3	Pons Cerebellum 4	Medulla 5



THE CAT BRAIN

(Drawn after McCleary and Moore, 1965)

Note: The diagram of the human brain is for positional comparison only.

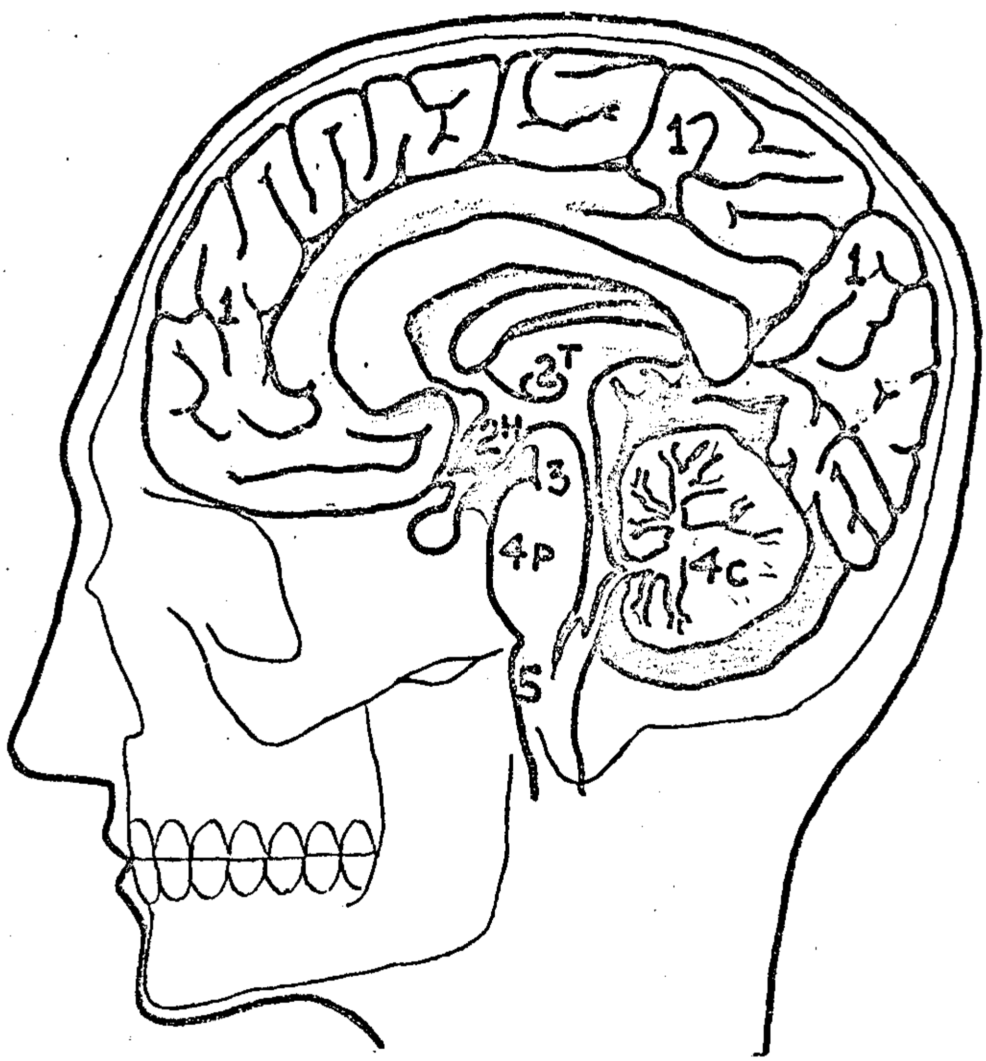


FIG. (15) MEDIAL SECTION OF THE CORTEX AND SUB-CORTICAL AREAS OF THE BRAIN

2.7 THE VALIDITY OF HUMAN AND ANIMAL BEHAVIOURAL ANALOGIES

Some regard any attempt to find an explanation for the nature of Man in the behaviour of animals as scientifically ill-founded (e.g. ASHLEY MONTAGU 1968)[(174)]. Others argue that it is morally wrong to claim that Man's conduct is influenced by ancient traits because this belief devalues his freedom of action and may lead him to reject his social responsibilities (e.g. LEWIS & TOWERS 1969)[(175)]. Opposed to these views are those who hold that it is profitable to study animals if this can help us to understand the functional significance of certain human behaviour (e.g. LORENZ 1966; MORRIS 1967; STORR 1968)[(176)].

Criticism of this latter view bears on two main issues. Firstly, it is maintained that the evolution of Man (Hominidae) has no parallel with that of the ape family (Pongidae) nor with that of any other species; and secondly, although there is some concensus as to how human behaviour is shaped excepting those who altogether reject the principle of behavioural inheritance, it is claimed that Man-animal analogies discount the importance of cultural influences on human behaviour. Concern is also expressed that theories which propose ancestral origins for Man's behaviour entirely on the basis of its ostensible similarity with animal behaviour (e.g. ARDREY 1967)[(177)] are not only unscientific - which would often seem to mean that they contain speculations different from those espoused by critics who refute them, but that the picture they present of Nature is drawn from highly selective evidence.

In his history of scientific ideas, SINGER (1959) described how the process of reasoning by analogy came to medieval Europe through Neoplatonism and the revival of Arabist learning. Thus schoolmen linked the supposed four ages and humours of Man to the seasons, the compass points, and so on.[(178)] The modern accusation is that analogies are pressed not entirely for enlightenment.

It has been necessary to describe the characteristics of animal territoriality in some detail since a substantive account of human territoriality has yet to be written.(179) Such an account for completeness could not overlook the existence of territoriality in the animal kingdom and the outward resemblance between many human and animal behaviour patterns. Yet scientists can rightly criticise those "analogists" who attempt to pursue the resemblance further either by anthropomorphism or by the extrapolation of unwarranted conclusions as to the origins of any resemblance. Speculation has a place in theoretical science but not when it is presented as dogma, nor when it is derived by tailoring facts to fit assertions. Analogists are not alone in this regard.

Lorenz, and Morris, and Ardrey derivative of Lorenz, have each drawn inferences from animal behaviour which were then projected into the human condition to explain Man's inhumanity. The development of their theme began with Lorenz who saw the cause of human conflict as due to an ineradicable aggressive instinct which has a valuable evolutionary purpose. Ardrey claimed the origin of this instinct was the "Territorial Imperative" or the propensity of Man and animal to annexe and defend territorial space. Morris used the argument of "innate" aggressiveness as a wheel to his vehicle that Man is "innately animal". Some find these views unwelcome because they describe human experience at the expense of human aspiration; but there are more important charges brought against the "analogists" whose assumptions are examined below.

It would seem less likely today that the public would accept that Man is descended from the apes, for it has been widely advertised that fossil evidence points to a common ancestor in remote time. Any blood relationship between Man and ape is thought to have ended some 15-35 million years ago, and since that time Man and ape have gone their separate ways. Moreover, contemporaneous development is not necessarily parallel development within the evolutionary scale, and the gulf which separates Man and ape lies not so much between their anatomical differences but between their encephalic differences. Changes which occur as a result of natural selection and mutation normally take place along an evolutionary time-scale of stellar magnitudes whereas the "supernoveal" event which created Man's private world results entirely from the sudden acceleration in the growth of his brain. From the time that Man became able to teach and learn he possessed a new form of heredity denied to other creatures. He became able to shape his own evolution. In doing so he was no longer bound by a primitive need to foster ancient modes of activity for he had the means to alter the environment which threatened his survival. As the need for old behaviour then disappeared it could be expected that old patterns of life would become transformed and finally erased, or in behaviourist terms the occasions to "re-learn" old behaviour would not arise. Furthermore, it has been pointed out that any comparison of Man and ape is twice removed. A direct comparison requires the assumption that ape behaviour has remained unchanged since early man but the behaviour of apes may have changed as much as our own.[180] Even further removed are comparisons between Man and non-primate species in some of whom biological development ceased in the dawn of time and in all we assume that cultural development is absent.

The contrary view is that the old patterns of human behaviour were never erased but only submerged beneath increasing veneers of cultural sophistication. It is claimed that the cultural evolution of Man is so recent in evolutionary time that its accrued benefits merely allow Man to master his environment without assisting him to solve his emotional relationships with his own kind.

2.7 THE VALIDITY OF HUMAN AND ANIMAL BEHAVIOURAL ANALOGIES

The "Papez-Maclean" theory of emotions stresses the structural and functional differences between the ancient part of Man's brain evolved from reptilian and mammalian ancestors and the neo-cortex evolved in the last half-million years.[181] It has been postulated that the faulty integration of the total brain structure from these components is responsible for schizoid state in the human nervous system which accounts for the differences in our emotional and intellectual behaviour.

> Whilst our intellectual functions are carried out in the newest and most highly developed part of the brain, our affective behaviour continues to be dominated by a relatively crude and primitive system, by archaic structures in the brain whose fundamental pattern has undergone but little change in the whole course of evolution, form mouse to man. (182)

Lewis and Towers, who question the equation of men with animals, lay store in the fact that "...most animal behaviour patterns are inherited and instinctual and are virtually complete at birth, and are only slightly modified by conditioning and perceptual learning....", whereas the behaviour of Man, they state, does not have this limitation "...most of his behaviour is based on simple, non-specific needs and propensities, which develop as learned behaviour based on conceptual thinking...".[183]

But in shifting the emphasis contained in man/animal analogies from their similarities to their differences the authors do not thereby eliminate the possibility that some human behaviour could have primitive origin. The underlying questions are whether Man is responsive to specific sign stimuli and whether these initiate hereditarily established fixed action patterns. Here it is known that there are certain innate movements of the face and body accompanying intense emotional states such as anger, fear, and joy, which are intuitively meaningful to everyone[184], but even casual observation gives proof that these conditions do not trigger stereotyped reactions in those who witness them although their exhibition may be infectious when they strike a chord of fellow feeling. It may be that we retain some vestige of primitive sensitivity (olfactory?) to the physiological changes in others attendant to their experience of intense emotional states, but should we have such awareness the manner of our response depends on many factors not least our personal relationship to the person affected. More generally, we find life easier if we control our impulses although there is nevertheless a human and animal capacity for the "emergency reactions" of avoidance and fight. <u>This thesis is concerned with the avoidance behaviour of human territoriality both impulsive and planned</u> which although sometimes expressed assertively would seem to arise from fear and anxiety; we are not concerned with the fighting response of territorial Man in which anger plays so frequent a part, nor with the controversy as to the origins of aggressive behaviour. Avoidance behaviour can be reflexive or centrally controlled and is therefore both innate and learned; it is discussed in the next Section.

In their rebuttal of the analogists in "Naked Ape or Homo Sapiens?", Lewis and Towers also endorse the view of Teilhard de Chardin (idem p.124) that Man's culture exists independently of the individual:

> <u>There are</u> technical discoveries (Fire, Nuclear Physics, etc.) and <u>there are</u> intellectual revelations (the rights of the individual, the reality of cosmogenesis, etc.), which once made or received are man's for ever (....).... a living force impregnating and completing, in its most essential humanity, each new fraction of human material as it newly appears.
> No, it is certainly untrue that, as is still said, the human being in us starts from zero with each new generation.
>
> (Teilhard: with Lewis and Towers' emphasis and ommisions).

2.7 THE VALIDITY OF HUMAN AND ANIMAL BEHAVIOURAL ANALOGIES

But this claim that human behaviour is shaped via the "cultural instinct"(185) does not preclude Man from other forms of inheritance, nor does it establish the priority or predominance of cultural influences on human behaviour. SCOTT (1968) is more cautious in his consideration of Ardrey's claim that Man has a territorial instinct:

> In short, there is no evidence that territoriality is or is not a biologically determined universal condition in modern man, but a great deal of evidence of important cultural differences. There may be some biological basis for territorial behaviour in people, but it is equally possible that it is a human cultural invention.(186)

Culture has displaced Reason as the distinguishing feature of Man. Animals cannot reason so it is believed; nor have they language, art, science, or ethical systems. It is therefore logical, argued KOESTLER (1969), that "explanations for behaviour which is exclusively human should be sought from those characteristics of Man which are also exclusively human". Koestler concluded that:

> ...It seems to me of doubtful value to attempt a diagnosis of man entirely based on analogies with animal behaviour - Pavlov's dogs, Skinner's rats, Lorenz's greylag geese, Morris's naked apes. Such analogies are valid and useful as far as they go. But......they stop short of those exclusively human characteristics - such as language - which are of necessity excluded from the analogy, although they are of decisive importance in determining the behaviour of our species. (187)

Cultural influences and hereditary habits (instincts) are not the sole factors which govern human behaviour. How we behave is governed by how we perceive the world, and this is affected by the use to which we put our sensory mechanisms as well as by our experience of how Life has treated us.

HUMAN APPROACH AND AVOIDANCE BEHAVIOUR 3.0

3.0 HUMAN APROACH AND AVOIDANCE BEHAVIOUR

The previous section indicated the possibility of biological roots to Man's claim for subjective space. Section (3.0) examines factors which are known to play an important part in his spatial defence system. These factors can be seen to operate in human approach and avoidance behaviour. Our approach behaviour is governed mostly by internal, i.e. motivational factors; whereas our avoidance behaviour arising from fear or dislike is triggered mostly by external, i.e. environmental factors.

How we steer our behaviour in the psychological climates and physical circumstances which lead us to consider our Safe Distance with regard to objects is regarded here as being subject to three main processes.

Firstly, human behaviour has energy and direction. Sub-section (3.1) describes how we plan our behaviour according to the priorities of our emotional and physiological needs, and how our actions are moderated by our past experiences and by their importance to us of events both immediate and in prospect.

Secondly, human behaviour is related to the external world. Our awareness of our surroundings is gained entirely through our sense organs and it is therefore limited to those events which possess the kind and range of energy capable of stimulating them. Sub-section (3.2) is concerned with how we make use of our sensory modalities in our evaluation of external events.

Thirdly, the concept of self is central to any scientific theory of human behaviour. The sense of our own body size and how we view its vulnerability is a prime source of our subjective space needs. Sub-section (3.3) describes how the imaginal self may interpose a boundary between the physical self and environmental objects which can be unwarranted in terms of our physical safety but which may be necessary to us in terms of our psychological safety.

3.1 THE ENERGY AND COURSE OF BEHAVIOUR

This section is concerned with involuntary as well as cognitive behaviour. Terms relating to the summoning and release of human energy are defined so that the meaning of their later use will be understood in discussion of the fear response to perceived threat and the techniques which might be used to measure that response. The broad issues of approach and avoidance behaviour are then related to the motivational factors which underlie the dynamics of goal-directed activity, and reference is made to established theories and behavioural models. The contribution of innate components to withdrawal and avoidance behaviour is mentioned in discussion of emergency reactions and reflex actions. Avoidance learning is not overlooked. Some factors which constitute choice criteria in approach and avoidance decisions are then reviewed. The section concludes with discussion of human preferences in space usage and note is made of learned attitudes to spatial observances.

3.1.1 Preliminary concepts.

Activation and arousal.

The level of human activity from sleep to extreme effort and its related cortical excitement is known by the term "activation". Capacity for activation depends primarily on the physiological metabolism of the body and the amount of energy it can supply which, in turn, is dependent on the body getting adequate nourishment. Evidence has suggested that energy is mobilised and directed by the reticular formation of the brain stem (FIG. 16), for it is here that consciousness has been found to be alerted and the appropriate motor responses regulated. The reticular formation interacts with the cortex which registers and interprets the sensory stimulation occurring within and outside the body; and with the limbic area and hypothalamus which are thought to be the centres of the emotional and motivational processes. It has been found that direct stimulation of the reticular formation sharpens attention, whereas injury to this region of the

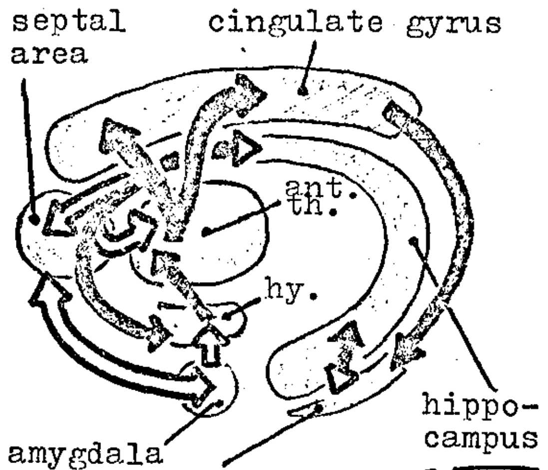
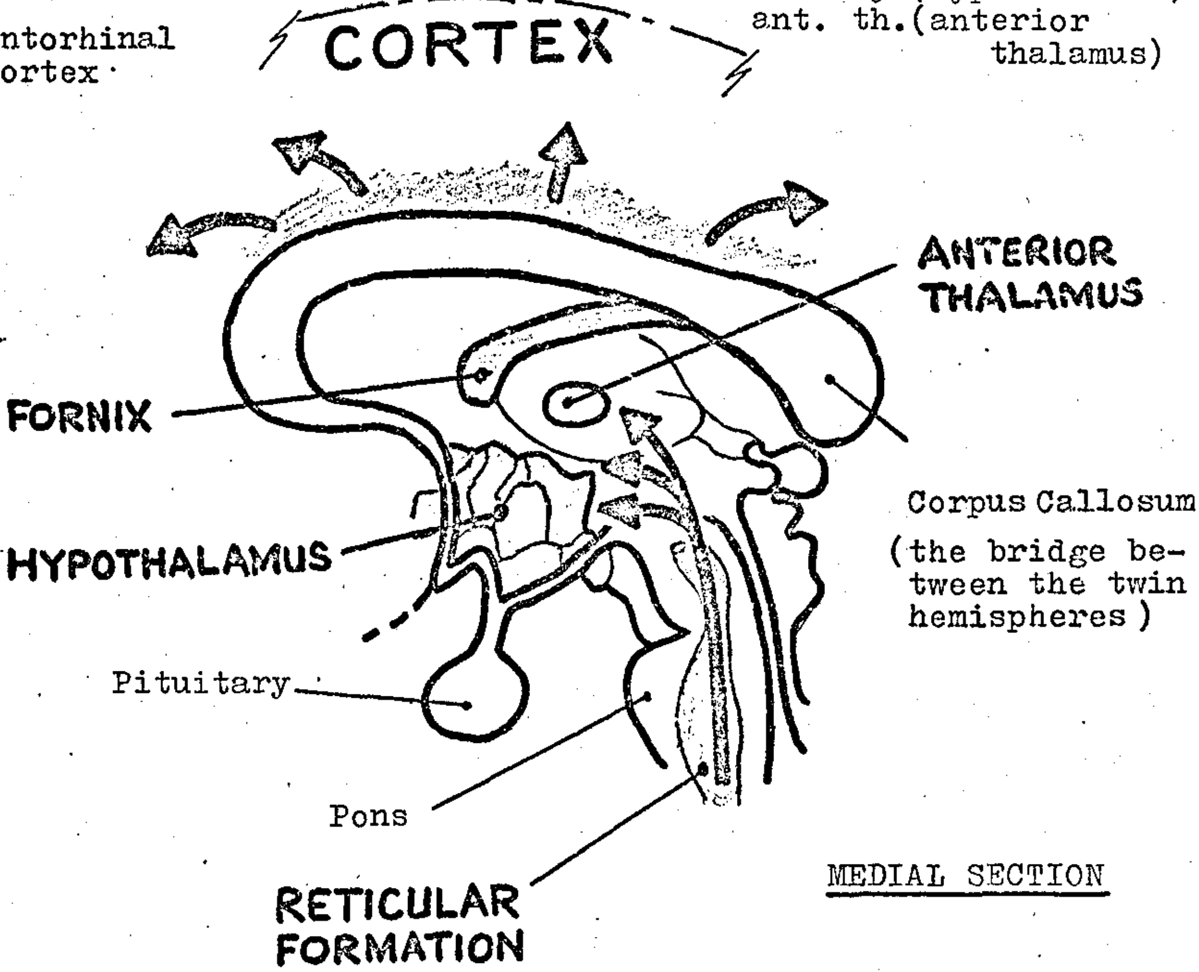


Diagram of the neural structure included in the limbic system.

Arrows show circuit pathways. Double-ended arrows indicate a two-way path. Black arrows represent the Papez circuit. The outflow from the hippocampus is the fornix bundle (see below). Structures not repeated below are deeper inside the cerebrum.

(After McCleary & Moore:1965)

hy.(hypothalamus)
ant. th.(anterior thalamus)



(Drawn and modified from Keele,C.A.and E.Neil (1966) Samson Wright's Applied Physiology (11th edition)

The Limbic System are structures which form a border (limbus) around the junction between the diencephalon and forebrain.

FIG.(16) THE RETICULAR FORMATION AND LIMBIC AREA brain and the action of barbiturate drugs have dulled consciousness[188].

The alerting of consciousness preceding activation, i.e. the arrest of attention, is known as "arousal". There are individual differences in the level of arousal produced by specific situations for the latter may not have the same meaningfulness for individuals. Moreover, individual response to an arousal stimulus is influenced by our private evaluation of the satisfaction to be obtained from action - action must be worthwhile. A repeated stimulus can therefore evoke the law of diminishing returns in terms of ensuing action. Response to stimulus is also affected by our effort of will, for those who possess a high level of achievement motivation may react more positively to a given stimulus than others less determined.

Techniques of measurement.

There are various ways in which the energy of arousal and activation have been assessed, and studies have been made to relate the level of arousal to body-image boundary definiteness as well as to approach and avoidance behaviour.

EEG. The level of arousal in the cortex has been determined by recording its electrical activity via an electroencephalogram (EEG), and by differentiating the traces which accompany bursts of nervous energy from the rhythmical "alpha waves" which are the normal manifestation of neural activity in the awakened state when the brain is "off-load".

Electro-encephalography reveals a high amplitude rhythm of about 10 cycles per second in a subject at rest with his eyes closed. This changes to a low amplitude high-frequency activity when the subject attends or tries to perceive a visual stimulus[189]. The alpha rhythm is therefore blocked or reduced by stimuli which alert the individual, and one might suppose that a measure of this alpha component - or rather of its absence - would indicate a subject's consideration of his safe distance. Yet whilst BARRATT (1956) found that suppression of the alpha was not a reliable index to the mental process of visualising, FISHER & CLEVELAND (1968) discuss evidence that individuals with firm body-image boundaries have exhibited low percent time alpha characteristic of high level activation in the brain stem reticular formation (BSRF). They note that proprioceptive impulses (sect.3.2.2) rank second to pain in their ability to alert the BSRF, and conjecture that the relatively higher level of proprioceptive arousal (striate muscular excitation) to be found in those with firm boundaries accords with this low alpha(190).

GSR. Changes in the level of activation have been measured by recording galvanic skin response (GSR). The electrical resistance of the skin decreases in emotional states and during arousal due to the increased secretion of sweat. GSR techniques entail measurement of the resistance of the skin to an applied electrical current. If the current is kept constant the voltage across the subject will be an index of his resistance.

Among those who have used GSR for the express purpose of investigating the level of arousal associated with the proximity of neighbours - though not objects - are McBRIDE et al.,(1965). They found that subject GSR response was greatest when subjects were approached frontally, whilst side approach yielded a greater effect than rear approach(191). This study can be compared with that of KINZEL (1970) conducted in a U.S.Federal prison. Kinzel tested the spatial tolerance of prisoners with violent and non-violent records respectively by asking them to tell him when he had approached them too closely. The claim to space around non-violent prisoners was found to be nearly cylindrical, whereas violent prisoners made additional claims to the space behind them - an approach they regarded as very threatening(192). The Freudian's thoughts would probably turn to paederasty amongst long-term prisoners who are perhaps more likely to be violent men.

3.1 (3.1.1) THE ENERGY AND COURSE OF BEHAVIOUR

EMG. A measure of activation can be obtained by recording the fluctuations of muscle tensions in body parts. The electro-myogram (EMG) is referred to below in connection with stress and tension.

Appraisal of techniques. Changes in activation level are also accompanied by internal physiological changes in the heart rate and in the pressure and circulation of the blood. In fact almost any human activity produces some physiological reactivity in muscular tension, skin resistance, heart rate, and cortical excitement, correlate to the intensity of the external stimulus and the motivational factors governing the activity. But the value of the level of activation (or arousal) as a measure of the drive state of an individual is lessened by the fact that the correlation between the various indices of activation are not always high. There is evidence, for instance, that cardiac and conductance measures show independent variability according to the nature of the stimulus situation[193]. Furthermore, studies of (partial) sensory deprivation have shown that subjects sometimes respond to a decrease in sensory input by an increase in activation[194]. Animal studies also show that the various indices of activation - autonomic, electro-cortical, and behavioural - may operate independently[195]. Whereas the notion that the level of activation can be measured along a linear scale may be valid when there is high correlation between dependent variables (HINDE 1966), there are difficulties in selecting those variables since patterns of physiological response can be highly individualistic. Particular physiological functions may be highly disturbed or unresponsive in two individuals exposed to the same stimulus situation. Physiological measures of activation and arousal as an index to changes in a subjects assessment of a Safe Distance would have to be calibrated for each individual tested.

3.1 (3.1.1) THE ENERGY AND COURSE OF BEHAVIOUR

Stress and Tension.

People concerned for their personal safety often show signs of stress and tension. In vernacular speech "stress" and "tension" are often given much the same meaning, although it is widely recognised that stress produces tension and that tension is evidence of stress. Stress and tension can be differentiated more clearly if stress is regarded as a physiological condition in which internal preparation is made to meet some perceived threat, the evidence of this preparation being given by some homeostatic imbalance; whereas tension can be conceived as the manifestation of an emotional or physical load as evidenced by muscular contractions[196]. Such an opinion would find support from those who regard the best index of stress to be that derived from biochemical analysis[197]. The division is also appropriate to the hypothesis proposed by FISHER & CLEVELAND (1968), that people with firm body-image boundaries would show greater physiological sensitivity in their outer body layers (the skin, the striate musculature, and their vascular components), than those with weak boundaries who would show equivalent response in their internal viscera[198].

Stress. People respond to stress in different ways, for their reactions can not only include physiological changes perhaps accompanied by nervousness and fatigue, but impaired motor responses and perceptual inaccuracies as well. On the other hand, simple motor acts, reaction times, and movement times, have been found to quicken under stress[199]. The involuntary self-protective defence mechanisms suggested by Freudian theory also come into operation as a result of stress.

Measurement of stress. Various physical reactions are regarded as indices of stress. Stress induces increased palmar sweat which can be measured by GSR techniques. Other physiological measures used have included eye blink rate, pupil dilation, skin temperature, and salivary secretion. Blood and urine analysis, excretion analysis, muscular tremor, and muscular action potentials have also been used as stress indicators. Subjective evaluation methods could require a subject to indicate the level of his concern during a stressful situation. Some of these measures have been used to detect evidence of human spatial tolerance.[200]

<u>Tension.</u> Evidence of tension is muscular contraction. Self-initiated skeletal body movements cannot be made without muscular contraction, and muscular tension is well known to influence body movements. Muscle cramp is a familiar although extreme occurrence of this relationship.

It would seem that we are aware of some general level of muscular tension which is desirable for alertness to our surroundings. Thus people who startle easily or who make rapid awkward movements are thought to be "over-tense" whereas the lethargic are thought not to be tense enough. This general level of tenseness is somewhat arbitrary and is perhaps influenced by the metabolism of the individual.

Overt tension is often taken as a mark of general activation, but tension can also be specific in its point of origin such that the magnitude of "effort" tension would seem to be greatest in the performing limb closest to the source of stress. Effort tension can often facilitate motor performance, whereas "emotional" tension can have a contrary effect. Moreover, emotional tensions can be unrelated to the task in hand.

The relationship between muscular tension and effective response is unclear. It has been postulated that muscular tension lowers the threshold of cortical excitability so disturbing the ability for fine discriminatory movements, and it has been supposed that this excitability takes place in the brain stem reticular formation[201]. On this basis, it might be assumed that consideration of the Safe Distance would lead to the emergence of grosser movement patterns.

<u>Measurement of tension.</u> More primitive means of measuring muscular tension seem now to be superseded by electromyographic techniques. Muscle action produces weak electrical impulses in nerve pathways which can be measured by the electromyograph (EMG). The magnitude of these currents is

assumed to indicate the prevailing tension. In so far as stress and tension are related, certain techniques which can be used to measure stress, e.g. GSR and variations in blood pressure, can also be predictive of tension.

3.1 (3.1.1) THE ENERGY AND COURSE OF BEHAVIOUR

Anxiety and fear.

Anxiety and fear are brain events which accompany consideration for our safety, and they are related emotions which frequently influence approach and avoidance behaviour. Anxiety and fear are not easy to differentiate with precision, but it has been suggested that anxiety is a long-term state of foreboding during which the individual feels threatened by some danger or pain he wishes to avoid; whereas fear arises suddenly in response to the immediately threatening situation. It has also been suggested that it would be better to regard fear as the response to actual threat, and to associate anxiety with failure and frustration in attempts to reach some goal and with motivational conflict[202].

In some people over-anxiety is a personality trait which they characteristically evidence in their excessive timidity, by their lack of venturesomeness, or perhaps by their tendency to take precipitate action. All such factors could bear on their Safe Distance judgements. Other people may have morbid fears of the particular (phobias), or of more general contact with the external world (as in some forms of schizophrenia). The latter group are ill and their Safe Distance judgements are likely to be wildly erratic according to circumstance.

The experience of fear and anxiety is accompanied by changes in such autonomous processes as heart rate, circulation, respiration, and sweating; but changes in particular systems do not invariably accompany experience of a specific emotion.

Both anxiety and fear are intimately related to movement behaviour. Either state can lead to aggressive action by those experiencing those emotions, or, alternatively, either state may precipitate withdrawal or avoidance behaviour. Furthermore, experimental results which have reported an increase in muscular tension in people who are highly anxious seem pertinent also to those who are fearful[203]. Yet although anxiety and fear may both produce tensions, anxiety states tend to inhibit action because of their intrinsic conflict nature whereas fear is often the spring of action. Moreover, anxiety would seem to foster stereotyped behaviour as when those who are anxious fall back on the familiar in situations which give them disquiet. In the same fashion, we commonly feel uneasy when breaking habit patterns governing the route of our daily journeys. By contrast, the behavioural response to fear can be highly adaptive.

Fear and anxiety both influence Safe Distance judgements, and although we have suggested that we can differentiate when the one experience shades off into experience of the other on the basis of whether they are long-term or short-term experiences, we can also regard the in-between area of decision situations involving uncertainty some of which evoke anxiety and others fear in another way.

Thus JORDAN (1968) has postulated a minimum level of psychological certainty which is a prerequisite for any action. For example, in our illustration (Fig.4 :sect.1.0), the skater would never venture onto the ice unless he was sure it would support him. Then should he be seen to go on the ice hesitantly, his situation would be that of psychological uncertainty even though the conditions for the fulfilment of the minimum level of psychological certainty had been met. But should he go on the ice blithely, it follows, argues Jordan, that action taken in a confident, assured manner, is that which functions under conditions of absolute psychological certainty. That is to say, our skater would feel that the environment would not present any situation with which he would be unable to cope. As we have noted before, events might prove him mistaken.

Now the behaviour that occurs between the level of minimum psychological certainty and absolute psychological certainty is characterised by feelings of doubt, indecision, and insecurity. Gradually these conditions change in a positive way as their associated situations seem more within our control. Jordan therefore suggested that it might be possible to illustrate what takes place in diagrammatic form. His illustration below shows five discriminable levels of fear and of anxiety (Lickert semantic differential scale) obtaining between minimum and absolute levels of psychological certainty and operating in conjunction with four subsets of possible events. Events occasioning fear and anxiety are ordered, those below the minimum level or at the absolute level of psychological certainty are not. The diagram is interpreted such that "the level of psychological certainty for each alternative facing a decision-maker is determined (by the point on the X-axis where he) is psychologically certain that none of the events to be found to the left of that point will occur if he chooses (that point)"(204). His explanation seems transferable to the manner in which we form Safe Distance judgements.

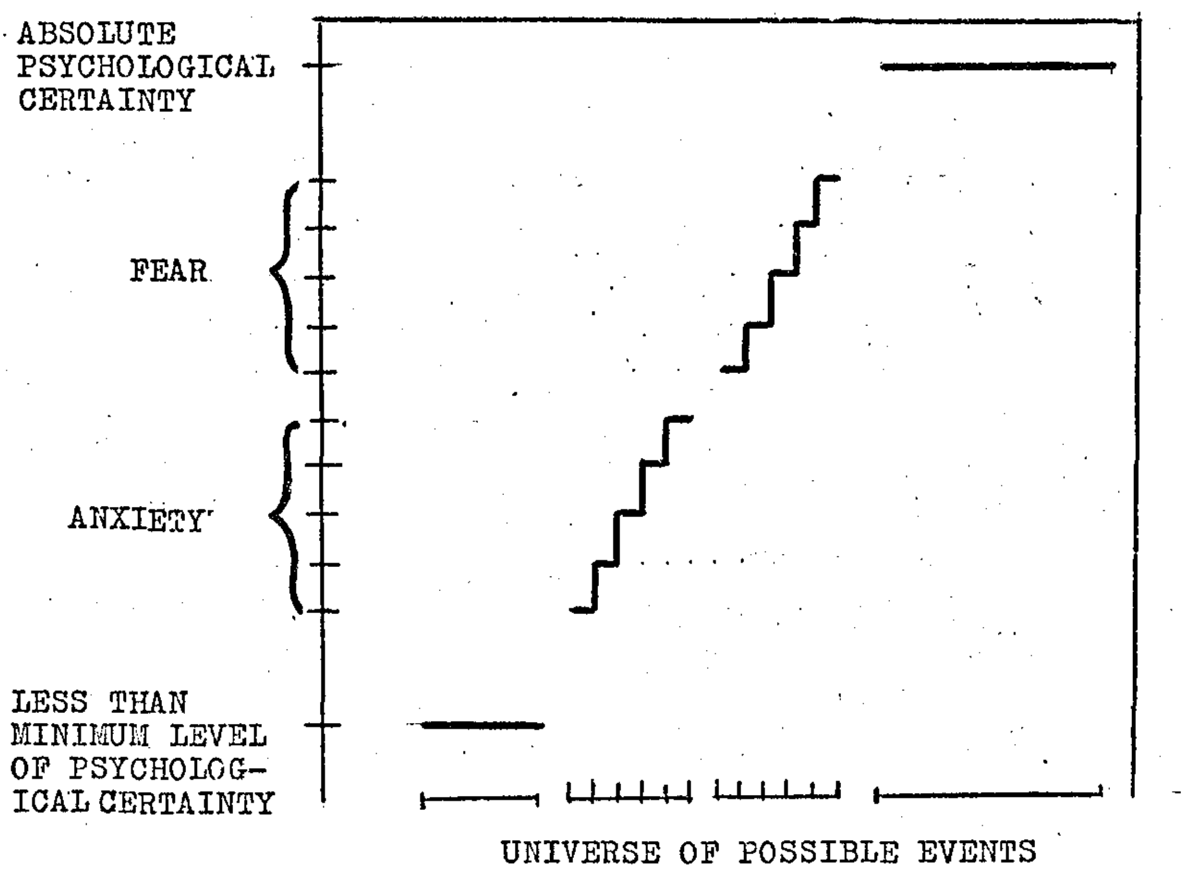


FIG.(17) STATES OF PSYCHOLOGICAL CERTAINTY AND UNCERTAINTY IN CONDITIONS OF FEAR AND ANXIETY.(After JORDAN (1968).

3.1 THE ENERGY AND COURSE OF BEHAVIOUR

3.1.2 Motivation and drive-reduction.

Human behaviour is purposive in that we select certain behaviour and activities in which to engage. Selection is initiated by an impetus to action, i.e. a drive, which is directed consciously or unconsciously towards the attainment of some specific life condition (see Sect.2.6.1). The direction taken by our actions depends on how we are motivated; in what we see as desirable ends and the values we attach to their achievement, and in what we regard as preferred means to obtain those ends.

Animal behaviour is said to be characterised by its "stimulus boundedness", in that by and large they respond only to the intrinsic physical properties of objects important to their physiological life.[205] The mark of intelligence in sentient creatures is the absence of this trait. Intelligence implies not just a capacity for thought which animals may often display, it implies amongst other things a capacity to reason. Animals are not known to possess anything like our own ability for reasoning although they can draw on past experience to solve novel problems without trial and error.[206] The consequence for them is that the maintenance of physiological life becomes the end to which practically all their behaviour is directed, whereas civilised Man more often regards the satisfaction of physiological needs as simply expedient to the fulfilment of wider satisfactions or "goals". He is aware that Life can offer more than just survival.

It is a fair premise that all sentient creatures are motivated to maintain their life.[207] To do so requires the maintenance of an internal physiological stability of the body chemistry which is partly achieved by autonomic processes such as the circulatory, respiratory, and digestive systems, and partly through the voluntary processes entailed in seeking the satisfaction of physiological deficiencies associated with hunger, thirst, and elimination.

These processes are considered innate. Sexual behaviour is a further type of innate motivated behaviour companion to this category in the sense that it it essential to the survival of the species although not to the individual. At one time it was suggested that all human behaviour could be traced to activities which satisfied physiological deficiencies, and from this thinking arose "drive-reduction" or "need-primacy" theory[208]. However, as VERNON (1969) has pointed out:

> The avoidance of pain, injury and danger by withdrawal or flight would seem also to be innate; and it is essential for the preservation of life. But no physiological deficit is involved. The same is true of defence by fighting. (209)

Action taken to satisfy the basic desire for survival reduces the strength of the accompanying drive, i.e. there is drive reduction. But human behaviour is clearly not entirely motivated by the dictates of visceral needs since some forms of human motivated behaviour offer no need reduction although they may give satisfaction. This is shown when men seek stimulus or self-realisation by the deliberate undertaking of hazardous pursuits; or when they engage in intellectual or physical tasks simply to enjoy their mastery or to satisfy their curiosity. Success in these forms of activity can breed further appetite which is not abated by a consumatory act as occurs with eating or drinking which reduce and terminate activity. Moreover, although human motivated behaviour includes innate tendencies which often lead to the satisfaction of physiological needs, this state is not normally achieved by fixed action patterns but is highly modified by learning, i.e. we choose to act as we do.

3.1 THE ENERGY AND COURSE OF BEHAVIOUR

3.1.3 Goal-directed behaviour: subjective properties.

A goal is the aim or purpose to which some sequence of behaviour is directed. It is the terminal point of short or long-term activities consciously directed by our interests, sentiments, or personal philosophy. Goal-directed behaviour is characterised by the experience of inner motivational forces which cause us to strive towards some end-state which may be clear in our minds or just vaguely envisaged. Goal achievement can admit alternative end-states all of which are experienced as a successful conclusion to the expenditure of effort.

It is outside the scope of this study to consider the various personality theories which have advanced explanations of goal-directed behaviour. We shall merely describe a few salient features of the method of analysis promoted by Kurt Lewin and his successors which seem pertinent to examination of the Safe Distance.

Constructs from Lewinian "field theory".

Field theory is a procedure in which behaviour is viewed as occurring in a field or organised system. The main divisions in the field consist of the person and his environment, with environment further divided into psychological and non-psychological parts. The person and his psychological environment are termed his "life space", and how he perceives his situation (his psychological environment) and the kind of man he is will jointly determine his response. $B = f(P,E)$.

An individual's life space contains "regions" which correspond with the dynamic aspects of the situation. But there is no necessary dispositional correspondence between regions in the life space and the events they represent in the physical world with the exception of the "quasi-physical" circumstances described earlier (sect.1.1.9). Events which loom large to the individual could be psychologically closer and of greater magnitude than those of less concern to him.

Behaviour occurs in the person's life space following arousal of a need. Need is the energy construct, the motivator, in Lewin's theory; it can arise from physiological arousal, e.g. hunger, or from desire and intention. Out of the needs at a given time particular regions acquire significance. The "valence" or significance of those regions can be positive or negative. Because of needs the person is influenced to move toward regions of positive valence or away from regions of negative valence by internal forces called "vectors". If movement takes place "locomotion" is said to have occurred. Locomotion may refer to a change in mental state only sometimes accompanied by external evidence, but it may also occur in a physical sense.

Lewin would not define his terms closely on the basis that it would hamper future research. But by linking need to valence instead of directly to behaviour, his system allows other determinants of behaviour to be linked to need to produce valence. A multi-determined valence itself does not translate directly into behaviour; it has to compete with the valence of other regions to determine the resultant vector path (GEIWITZ 1969)[210].

Need-reducing goals, tensions, and activation level.

Lewinian theory attributes human striving to an inner drive which is precipitated by a condition of tension arising within the individual. Attainment of the goal-state reduces or may terminate tension. Lewin conceived tensions as set up by internal needs which may be transient or longer lasting, and he did distinguish between the general need states of "undersatiated, satiated, and oversatiated". The degree of satiation partly determines the strength of the valence associated with the need.

The person himself was conceived as being composed of several sub-regions, and tensions could arise in particular sub-regions or in the person as a whole. Attainment of the goal either neutralised or equalised tensions within the sub-regions which themselves could interact or remain segregated. Tension systems discharge in action whenever possible, but this depends on the total energy possessed by a needs-tension system and the activation level of the person.

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Non-need reducing goals.

Short-term goals, i.e. immediate need-reducing goals such as finding a seat on a crowded train or finding somewhere to buy a meal, enable a consummatory act by their achievement which discharges the tension system. But as well as drive-reduction, Lewinian theory also encompasses situations where the achievement of goals has little or no need-reducing properties. JORDAN (1968), for example, has explained the form of these latter goals. First, there are many alternate goals which are within the potential reach of the individual and many which are not, and much human striving is directed towards extending our grasp over a wider range of potentialities. Often it must happen that surmounting the obstacle to our desire becomes the goal itself and not the state made attainable by achievement of the goal. Hence the common experience that possession diminishes the value of the spoils. Second, goal-directed activity can be directed towards unknown goals as when we set aside resources to meet future contingencies. Third, are "ought" goals; these are the standards of personal behaviour we respect and aspire to. They are ethical codes we feel we "ought" to observe (211).

Valence and vectors.

In Lewinian theory, valences are the measure of the attractiveness of goals and things related to them. For example, we might pleasurably anticipate the prospect of the journey to our holiday destination as well as our arrival. All external circumstances which are perceived as being related to needs possess valences which are positive or negative according to whether they are expected to allow or prevent goal achievement. Needs organise behaviour. An increase in the intensity of need (e.g. for rest) leads to an increase in the positive valence of certain activities (e.g. going to bed) and to an increase in the negative valence of other activities (e.g. digging the garden). Thus statements regarding change of needs carry implications for associated valences.

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Lewin gave the name "vector" to the psychological force which directly determined thought and behaviour. As is used elsewhere, a vector has direction, intensity, and point of application. In the life-space the point of application is the person.

The properties of a vector are usually determined by valences. Its direction is either towards positive valence or away from negative valence. Its intensity is a function of the strength of the valence (directly), and of the psychological distance between the person and the valence (inversely).

Regions.

"It is very difficult, if not impossible, to define a region conceptually or operationally" wrote JORDAN (1968). Regions within the psychological environment do not necessarily share the characteristics of regions within the person. As far as the Safe Distance is concerned, a region could represent either what we see of the world, or what we think we can do about it, or how the consequences might affect us.

Regions can be mutually influencing, and those perceived as psychologically close tend to affect each other more readily than those further apart. But this depends on the "permeability" of a region, i.e.its susceptibility to influence.

Valence and utility.

It can be recalled from section (1.1.9), that a distinction was made between the utility of an activity (or a goal) and the valence of an activity (or a goal); where it was claimed by this writer that utility denotes a capacity to supply satisfaction whereas valence has to do with the direction and compulsiveness of the drive (meaning vector force) to gain that satisfaction.

Lewin himself noted that valence and satisfaction should be clearly distinguished. He saw that the valence of an activity was closely related to its utility, but that:

...not all activities...which have positive val-

"ence also have satisfaction value in (the) case of consumption; on the other hand, activities with no or even negative valence may have satisfaction value. (212)

In the first instance, consumption in the biological sense can be associated with the fact that hungry people must often make do with poorer food than they would prefer; in its economic sense, consumption in the form of acquiring a car can result in disatisfaction with its performance on the road. In the second instance, a regimen of diet may be unattractive to us although we might be pleased with its effects on our waistline.

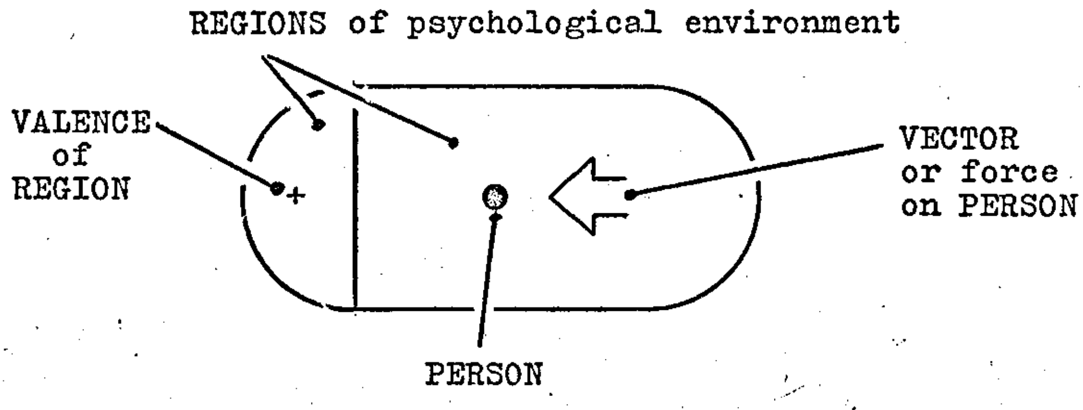
The representation of competing valences.

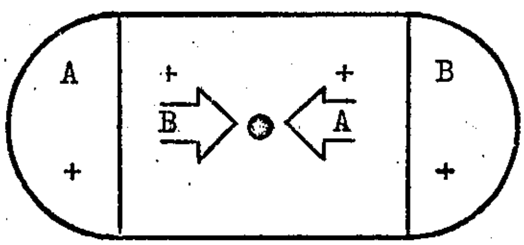
One area of human behaviour which has lent itself to analysis in Lewinian terms is that of intrapersonal conflict. Goal-directed behaviour may not always achieve its object because of the intervention of social or physical obstacles. As a result, the person may experience anxiety and frustration. Frustration may also occur from an incapacity to pursue competing interests simultaneously. Activity may then become redirected.

Lewin saw intrapersonal conflict as a state which occurs when two or more opposing forces (vectors) are approximately equal. The principal forms of conflict between competing valences arise in three basic situations: approach-approach conflict, approach-avoidance conflict, and avoidance-avoidance conflict (FIG. 18).

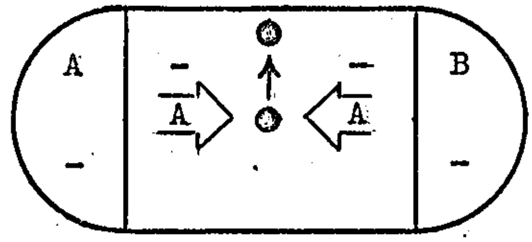
Conflicts between two positive valences of about the same strength are of the kind where choice must be made between equally attractive courses of action (FIG.18 a). Since force is an inverse function of psychological distance, any locomotion towards (say) A, increases the force towards A and lessens the force towards B thus resolving the conflict.

Conflicts between two negative valences of about the same strength are of the kind when we are placed on the horns of a dilemma (FIG.18 b). If a person moves towards

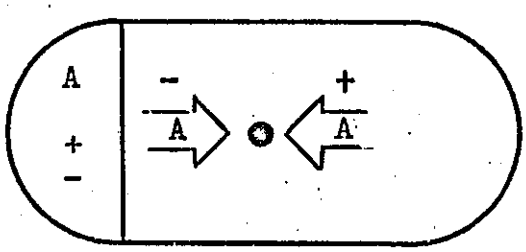




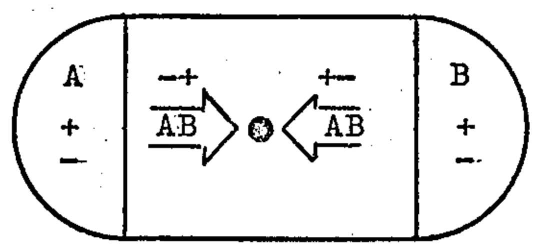
(a). APPROACH-APPROACH



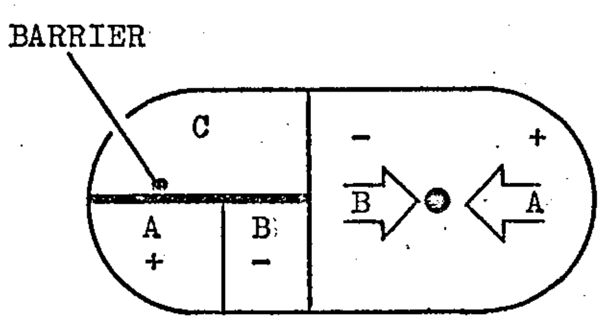
(b). AVOIDANCE-AVOIDANCE



(c). APPROACH-AVOIDANCE



DOUBLE APPROACH-AVOIDANCE



APPROACH-AVOIDANCE with impermeable barrier

(Drawn and modified from GEIWITZ 1969)

FIG.(18) THE REPRESENTATION OF COMPETING VALENCES (say) A, the force from A will increase and tend to move him back to the initial position. Movement towards B has the same effect; with the result that the person may attempt to leave the situation either physically or by restructuring his psychological field.

Approach-avoidance conflicts can be represented in two ways (FIG.18c). First, there are conflicts which involve a single region where there are forces both towards and away from that region. Conditions of this kind occur when we weigh up the advantages and disadvantages of a course of action. For example, we might fear sanctions for pursuit of some pleasurable but proscribed behaviour. Double approach-avoidance conflicts occur when we weight the pros and cons of alternate courses of action. Approach -avoidance conflicts of the kind which resemble the condition of the experimental situation in Section (4.0) can be shown another way. Thus A can only be approached by negotiating the negative valence of B; the impermeable barrier enclosing the regions A and B cannot be broached and the person cannot go outside the field to reach A.

Decision in the Life Space: time, information, and basis of judgement.

Lewin conceived all thought and behaviour as occurring within a field during a given time period of duration depending upon the scope of the situation. In dealing with the individual, the field concerned is the life space of the individual. This comprises the state in which he finds himself, the goals available to him, and his state of means some of which may lead to the goals. At a given time span, the life space contains not the whole of the individual's total knowledge of the world, but merely the part that has updated relevance to a given behavioural event. There is resemblance to the "schema" drawn from the total number of schemata which constitute the frames of reference of ourselves to non-self (HEAD 1920); (BARTLETT 1932); (LEE 1968)[(213)]. Lewin maintained that behaviour is a function of the life space (B=f(P,E), with the consequence that what is not perceived or cannot be perceived as relevant to the given behavioural event cannot be included in the life space. For example, if we do not perceive ourselves as subject to threat there can be no Safe Distance judgement although we may be in hazard.

> The essence of explaining or predicting any change in a certain area is the linkage of that change with the conditions of the field at that time. This basic principle makes the subjective probability (i.e. psychological probability) of an event a part of the life space of that individual. But it excludes the objective probability of alien factors that cannot be derived from the life space. (Lewin 1943) (214). (Interpolation added).

Pitfalls of analogy.

Lewin was mathematically adept which substantially explains why field theory employs some terms which in physical sciences imply tangible dimension. The temptation to equate psychological dimension with physical dimension is self-evident. Sometimes this might be possible in controlled circumstances, i.e. in the "quasi-physical" situation recognised by Lewin; but in the general case it should be remembered that regions in the life space may be operating in different conceptual dimensions. The significance of this is that the definition of the boundaries of psychological space may require "n"-dimensions for their statement. (A problem endemic to interaction matrices: see JONES 1970)[215]. Pictorial representation of the causal nexi of subjective space therefore tends to be a gross and misleading simplification, although it is possible to portray the ostensive demand for subjective space in the ordinary way.

3.1.4 Goal-directed behaviour: system properties.

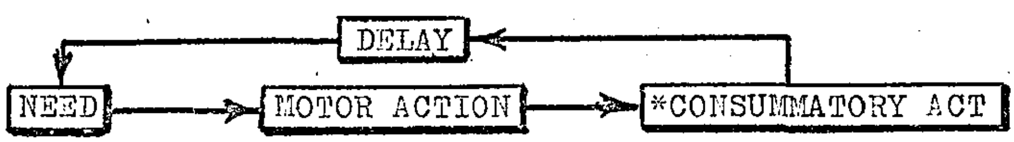
In objective analysis, the exhibition of goal-directed behaviour in the experimental situation is often described as "goal-seeking" to emphasise that behaviour is adapted to meet changes in the situation whether actual or foreseen. Goal-directed behaviour is therefore behaviour not only aimed towards the actual goal event, but determined such that were the circumstances to alter the ensuing action would show the requisite modification. Moreover, implicit in goal-seeking is the notion that action is chosen on the basis that it reduces the distance either temporal or physical between the experienced situation and the goal event, and that where alternative courses are possible that the most economical course will be chosen. Examined together or separately, these notions have directed theoreticians to enquire into the nature of the corrective mechanisms which determine behavioural changes, and they have sought ways of identifying and characterising observed relationships between action variables and environmental variables as processes within some organised dynamic system.

The expression of these relationships is naturally affected by the complexity of the situation to which they refer. Thus HINDE (1966) described how goal-directedness has been used to refer to behavioural mechanisms of greatly differing complexity, and that it is necessary to differentiate between cases in reference to the concept. He said the simplest were goal situations which were merely consummatory and which terminated behaviour, and that in such as these the effectiveness of further stimulation might be merely a matter of chance rather than the consequence of any (internal) comparison process between the input of the moment and a Sollwert (a reference value). More complicated, he remarked, were situations where the difference between an experienced situation and a goal situation influenced the intensity of behaviour, its direction, and its nature. Such cases implied a process of comparison, the existence of a Sollwert and a "goal-seeking" mechanism.

At a further level of complexity were cases where goal-seeking behaviour involved successive sub-goals[216].

Mechanical-biological analogies.

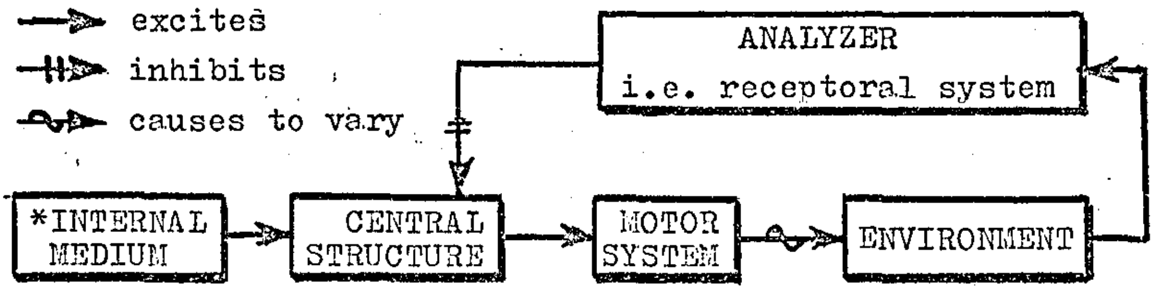
Hinde's specification of the activities which have been described as "goal-directed" is illustrative of the way various concepts relating to biological activities have acquired such uncertain definition as to hamper the discussion of events assumed to take place in the human mind between the appreciation of a situation and what we do about it. Words to describe human experience are unfortunately susceptible to ambiguity; the Safe Distance is a good example: but to some extent the risks of misunderstanding can be overcome by expressing biological concepts in the terms used by engineers to describe the operation of servo mechanisms. For example, the reciprocal interaction between the individual and his surroundings which takes place in goal-directed activity and which initiates, sustains, and modifies his behaviour can be referred to in the terminology of servo theory as a "behavioural loop" which signifies that in particular circumstances we act as self-correcting mechanisms constantly adjusting to changes in our internal and external conditions. A motivational model of drive reduction can be expressed as a behavioural loop. Figure (19) is a simple example.



*Or consummatory stimulus which inhibits further appetitive behaviour.

FIG.(19) DRIVE-REDUCTION BEHAVIOURAL LOOP

Thus NEED arises from an internal state, e.g. hunger, leading to MOTOR ACTION, e,g. food seeking, culminating in a CONSUMMATORY ACT, e.g. eating. The satisfaction of physiological needs is cyclic with a DELAY factor, e.g. the diurnal rhythm. A more complicated and informative example has been given by DEUTSCH (1960) who has also developed a model for goal-directed behaviour involving sub-goals[217].



*i.e. the chemical state of organism's physiology

FIG.(20) DEUTSCH'S FEEDBACK MODEL OF MOTIVATION UNDERLYING DRIVE-REDUCTION (after Deutsch)

Since we refer to the principle below, we may note that Deutsch's diagram incorporates a (negative) feedback loop whereby the system is stabilised (inhibited). Stabilisation is achieved in circuits of this kind via response to error signals derived from comparison with a reference signal.

Apart from providing an agreed vocabulary of terms, an attraction of servo theory is that it allows system properties to be expressed in a form amenable to abstract mathematical analysis which in turn may enable predictions to be made regarding such as the speed of recovery of a disturbed system or the conditions which promote its imbalance. It has been an inviting step to apply this kind of analysis to human affairs, for there are circumstances easily envisaged when the similarities between a man's possible actions and an equilibrium-seeking servo mechanism are clear enough. For instance, Broadbent has provided the example of a man holding a flag in a gusty breeze. But though it may be possible to measure in Man those qualities of response which can be measured for mechanical servos, a servo simulation of human response still fails to capture the essential nature of Man who, as the same author remarked, "changes in a bewildering fashion from being one kind of servo to another, according to the situation in which he finds himself"(218). Moreover, the alternative course taken by some who treat the human nervous system as a "black box" is equally inadequate, Broadbent noted, for without some assumption as to its internal organisation "no regularity can be obtained in the observed behaviour" (loc.cit.,).

Much the same objections have been voiced by SOMMERHOFF (1969), who remarked that although concepts from servo-theory such as error signals and feedback loops can often illuminate parallel forms of goal-directed behaviour in living systems, their usefulness is strictly limited. Goal-seeking, he emphasised, is not the same as equilibrium seeking nor is it co-extensive with feedback control:

> ...these concepts fail us when, as in so many biological cases, the commands (setting the goal) are merely transient ones which themselves form part of a goal directed activity of higher order. In other words....when we face typically integrated forms of biological order. (219)

Nonetheless, in the default of a better exposition of the human mental processes involved in goal motivated behaviour, it is worth mention that Deutsch has conceived a scheme based on servo analogies which although applicable to rats would seem to have wide application elsewhere (220) (HINDE 1966). And which, in Broadbent's (1964) view, would appear to explain:

> ...the curious variability of the actions which an animal or man may take on different occasions to attain the same end. This variability is difficult to account for if we think in terms of the learning of particular responses.(221)

In effect Deutsch has postulated networks formed in the brain in which the relationships between parts of the network model those of the outer world. The location of significant external events are copied in the model as is their hierarchy of importance. Thus if a hierarchy of parts A,B, and C has been established, and C is activated by a drive, e.g. C could be food and hunger the need-state originating the drive, then activation spreads throughout the network from C. At the furthest point in the network from C, a servo system is then brought into action which varies the actions of the animal until the senses are stimulated by the event corresponding to that part of the net. That is to say the system hunts to seek A, and having found it that servo switches off to be superseded by the next in line.

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The description above is indebted to Broadbent's account of what is a highly sophisticated mechanism Deutsch himself explains in the esoteric of servo terminology.

For his own part, Sommerhoff has examined goal-directed-ness as an objective system property which could be expressed in terms of mathematical relations between physical vaiables. He has described what he has termed "directive correlation" and has suggested how this concept could encapsulate many aspects of goal-directed behaviour including adaptation, learning, instinct and drive. His definition of directive correlation is embedded in an algebraic argument to which the present writer can only refer the mathematical adept. Sommerhoff pointed out that the appropriate mathematical equations and proofs required to apply his form of analysis would need to be evolved to suit particular problems. Perhaps human approach and avoidance behaviour will contribute problems in this category.

3.1 THE ENERGY AND COURSE OF BEHAVIOUR

3.1.5 Withdrawal and avoidance behaviour.

This sub-section considers human behaviour in face of threat we meet singly or jointly from human or other sources.

The emergency reactions.

Only a flagellant (or Jesuit) possibly enjoys getting hurt[(222)], and from infancy we show withdrawal from painful stimulation and a fear of sudden unexpected events such as loss of support or loud noises. Such circumstances give rise to motivated behaviour known as the "emergency reaction" which appears to be innate. Emergency reactions include the avoidance, flight and fighting responses to immediate danger and threatened injury, and they are often accompanied by the emotions of fear and anger with their corresponding physiological changes. Fear is reinforced by experience of pain and distress, and expectation of hurt associated with fear leads to withdrawal and avoidance behaviour. Fear therefore has survival value as indeed has mere respect for the potentially dangerous situation. (Our aggressive response to threat has been illustrated in Section 2.0).

Withdrawal and avoidance behaviour can be triggered by various circumstances we confront ranging from those we find merely strange or novel to others we recognise as threatening our survival, although what is perceived as danger or threat will differ for different people and cultures and the nature of individual response will also vary. Avoidance is not invariably stimulated by expectation of hurt to us, but with regard to the more potentially harmful events it is commonly so. Human behaviour in response to the emergency situation has been summarised by VERNON (1969):

> ...(it) includes withdrawal, which may be a spontaneous reflex action; avoidance by means of complex patterns of activity under cognitive direction and control; disruptive and uncontrolled behaviour and aimless movement, culminating in panic flight and escape; and a state of

> of general inhibition and rigidity, as in animals 'shamming dead', when escape is impossible. The uncontrolled behaviour may be accompanied by .... rapid heart beat, sweating, muscular tension and tremor, even involuntary urination and defecation.... there may even be loss of consciousness (fainting).... (The) more severe the threat, the more violent, uncontrolled and disrupted the behaviour; but it is also affected by differences in age, intelligence, personality and previous experience. Quiescent states tend to supervene when active escape is impossible; fear may be more severe in so far as no definite course of action is available. (223)

Whilst individual reactions in fear-inducing situations may be highly individualistic, there are some general observations broadly applicable to those in a state of fear. Firstly, where there is expectation of pain, fear is a function of that expectation, and those who expect to suffer badly perhaps in childbirth or at the dentist seem often to confirm their own predictions. Fear anticipates pain and aggravates it (Vernon. loc.cit.,) It is also an emotion easily communicated, since fearful people often display impelling visual cues and may give warning noises which in the animal context tend to precipitate synchronous reactions from conspecifics. Perhaps there is an atmosphere, a sweat of fear, which Man can still detect? On the other hand, fear that is shared is often thereby reduced when reassurance is obtained by the absence or weakness of fear cues from others present. Lastly, in conditions of fear our attention is focussed on the specific (the orientation reflex) to the exclusion of the general and this may adversely influence the appropriateness of our ensuing actions.

Phobias. Phobias are morbid states of fear and anxiety the origins of which often lie in repressed memories of unpleasant experiences. Phobias are often expressed in exaggerated and irrational avoidance of some object or situation which triggers those memories. Examination of the Safe Distance as manifested by those subject to claustrophobia and agoraphobia is beyond the scope of this discussion. The therapy of these neuroses and their resemblance to avoidance reactions in origin, manifestation, and resistance to extinction has been discussed by METZNER (1961)[224]. Schizophrenia and avoidance behaviour is referred to in discussion of the body-image.

Effects of habituation. If avoidance behaviour is elicited by some situational stimulus which persists, repeated encounters or prolonged exposure to the stimulus may lead to an "habituation" whereby response wanes as the situation loses its fear-inducing qualities. We learn to live with situations that are intrinsically dangerous and through over-familiarity we expose ourselves to a greater chance of accident.

3.1.6 Reflex actions.

Involuntary responses to nervous stimulation are called reflexes if they operate through the central nervous system, are inborn or emerge soon after birth, and are present in all members of the species. Examples of innate reflexes are: blinking and pupil contraction, sneezing, shivering and sweating, knee jerk, and flexion of a limb to noxious stimulation of an extremity. Reflexes are aroused almost immediately by simple sensory stimuli. Anyone who has ever pricked his finger can probably recall how quickly the hand is withdrawn even before any sensation of pain has been experienced. Reflex action is unidirectional with response graded according to the intensity of the stimulus. The nervous connections involved in the classical description of reflex action follow a pathway called the "reflex arc": stimulus → receptor → afferent nerve → connective fibres in CNS → efferent nerve → effector → response. An argument that reflexes are based on comparator feedback loops and not afferent - efferent arcs has been made by MILLER et.al.,(1960)[225].

The conditioned reflex.

PAVLOV (1927) distinguished two kinds of reflex: the innate reflex noted above and the acquired or conditioned reflex. The conditioned reflex (or response) is formed from the innate reflex by creating new functional links in the CNS between a conditioning stimulus and the innate reflex. The conditioned reflex is a primitive form of learning. The term "conditioned" implies that certain conditions must be present before this learning can take place[226].

In a well-known experiment launched to fame by Watson in 1916, Pavlov conditioned a dog to salivate to the sound of a bell. This was done in the following way. The presentation of food (unconditioned stimulus) to a hungry dog sets up an unconditioned reflex salivation in the animal. If a neutral stimulus such a ringing bell accompanies the presentation of food and it continues to ring whilst the animal eats, and if the procedure is repeated often enough, the initial stimulus (the sound of the bell) will of itself elicit salivation. The salivary response to the bell is the conditioned reflex; the bell itself becomes for the dog a conditioned stimulus, i.e. one which elicits a conditioned reflex. However, if the bell is sounded on successive occasions and the food is not presented, the conditioned reflex will be "extinguished" through lack of "reinforcement", i.e. the signal becomes misleading and it will be ignored. Such are the facts of Pavlov's experiment, but their interpretation has proven more complicated than he or Watson supposed. For instance, it was originally believed that the motor action of a reflex could be transferred simply by its contiguity in time with the conditioning stimulus. But this is not so; nor is that response finally learnt necessarily the one which occurred most often in the conditioning situation (227). Furthermore, a conditioned reflex can be aroused by a stimulus which resembles the original conditioning stimulus.

In so far as reflex actions enter human avoidance behaviour, the lesson to be drawn is that we may wrongly ascribe the cause and magnitude of an individual's detour solely to the environmental object present. What may be an example of a conditioned reflex affecting human spatial tolerance is the head bob of very tall persons passing under a door lintel. Such an action may be noticed when the available clearance is grossly adequate in a purely physical sense.

<u>The orientation reflex.</u>

Fear-inducing stimuli usually produce in animals and ourselves a "startle reflex" and an "orientation reflex" whereby selective attention is given to the stimulus source and readiness for action is increased. The sense organs are attuned to gain maximum information about the stimulus and there are changes in such autonomous functions as respiration rate, heart rate, and GSR coincident with the level of activation. Changes in the electro-encephalogram have also been noted[228].

What happens then depends on the significance or perceived harm potential of the stimulus and its novelty. If the stimulus is without significance, man or beast "calm down", i.e. the physiological components of their response return to their customary state. This is followed by a lessening of the general alarm response to that of one specific to the sensory modalities of the stimulus. For example, a fire alarm might arouse a whole battery of responses in us which eventually would fade into a waning watchfulness for smoke, temperature changes, or other cues normally associated with accidental fires. This "localised" response may in turn become replaced by an "adaptive" response such that in smoke-filled air we might possibly close our eyelids partially and breathe less deeply. Our response to stimuli we regard as significant again depends on their nature. For instance, the stimulation might take the form of a conditioned stimulus which evokes a conditioned response. An illustration was observed by the present writer in a plate-glass processing factory where the unexpected sound of plate shattering invariably produced momentary rigidity in the process workers. At such times, the rigidity of the defensive response preceded the orientation reflex.

An important property of the orientation reflex not shared by the defensive or adaptive response is the way it wanes with the repetition of a non-significant stimulus. It would seem that this is not just a consequence of reduced sensitivity, but that it results from an inhibitory process in cortical response. Should the nature or intensity of the stimulus be slightly changed the orientation response can be reinvoked.[229]

3.1.7 Avoidance learning.

Behavioural scientists interested in learning theory have studied how animals respond to noxious stimulation administered in the experimental situation. The term "avoidance learning" is used to describe the animal's physical reactions and assumed mental processes when so stimulated. Briefly, an animal learns how to stop an unpleasant stimulus or how to avoid it happening:

> ...the animal learns an instrumental response (i.e. a manipulative action such as pressing a bar: writer's note) which, if performed during application of a shock, terminates the shock (escape training); and if performed before the shock and after a warning signal - the conditioned stimulus - prevents shock (avoidance training). (230)

The nature of avoidance learning is not completely known. A widely held view is that avoidance learning has two components: a fear response with autonomic association, and an instrumental response which can be reinforced either by pain-reduction (escape learning) or by fear-reduction (avoidance learning).

Of the two kinds of learning, BROADBENT (1964) noted that avoidance training was in some ways the more effective, for though it is not so otherwise, an animal trained to avoid shock will continue to respond for long periods when no shock is given. He pointed out that we ourselves in performing something which is regularly rewarded (and reward may be simply the reduction of anxiety or fear) soon notice any break in the connection between action and reward, whereas if we regularly do something to escape punishment we can fail to notice when the hazard is gone unless we put such a doubt to the test. The persistence of behaviour established by punishment, he explained, allows us to reconcile with biological principles many apparently futile and maladapted human actions which have no apparent reward or biological advantage. Examples of these he saw as the small rituals many people undertake before going to bed such as might include certain body movements or the distribution of their clothes in a particular way[231]. He might have added who better demonstrates adherence to rituals of tidiness than the time-served career soldier with his experience of comparatively harsh punishment for its trivial infringement. Old habits die hard.

Even in the army punishment must be readily identifiable as the consequence of some specific action, for to deny this is a technique of "brainwashing", i.e. the preparation of a human mind as a tabula rasa in readiness for indoctrination. Thus if we cannot discern which actions lead to punishment and which to reward in the sense of no punishment or its more usual meaning, and we cannot leave the situation, then we can only endure or accept the guidance of our persecutors. On the other hand, reward in the sense of good fortune is usually welcomed from whatever direction it arrives. Moreover, there are many adages about not enquiring too closely as to its source and more importantly as to its value. All the same the earned reward should not be too meagre or else the actions which obtained it will be discontinued.

Punishment as a learning aid therefore has the weakness that when its connection with action is not clear, it can turn us against taking any action. In the case of the Safe Distance this might be exemplified by the learner motorist who gives up his attempt to acquire a license as just not worth the effort to acquire the requisite skill. Alternatively, if the consequences of action are punishing, we can avoid the ensuing anxiety by repressing the thought which attaches anxiety to those actions. The danger is that by doing so we may become irresponsible. It hardly needs to be added that actions followed by reward are likely to be repeated. But the flaw in controlling behaviour by reward is that failure to be rewarded weakens action, whereas action to avoid punishment tends to continue unnecessarily.

3.1.8 The criteria of avoidance behaviour.

The involuntary actions of avoidance behaviour were described in the preceding sub-sections (3.1.5 and 3.1.6). Here we are concerned with cognitive avoidance behaviour and some of the factors which influence the way we evaluate avoidance options.

It was remarked in the Survey (1.1.9 ; The Unsafe Distance) that when the prospects of a decision enter our considerations as to what we do (and we mentioned when they do not) then it is conceptually difficult to separate the assumed probability of a foreseen outcome from its desirability. This relationship between psychological probability and utility is mutually sustaining, for what is assumed likely to occur on that account may be more (or less) desirable to us and what is seen as desirable on that account may appear more (or less) likely to occur. Whilst the factors discussed below are those which attend our uncertainty about the outcome of our decisions and actions, i.e. their psychological probability, most if not all could influence decisions where we disregard or are not conscious of the utility of our actions.

The measure of risk.

It is common to speak of the ideas people hold of their chances of success or failure in a venture as the expression of their level of confidence that a particular outcome will occur if they pursue some envisaged action. And if they are asked to rate their chances they may reply that they are "good" or "fair" or "Fifty-fifty" as the case may be. Pressed further, they might be prepared to estimate more accurately the proportion of times they would expect to gain success (or failure) in some given number of performances. Risk is measured in terms of subjective uncertainty; it is the subjectively estimated frequency of expected failure, i.e. the psychological probability of failure. Curiously, as COHEN (1968) noted, a man takes no risk when he is certain that he will always (or never) succeed, for it is not belief in failure that constitutes the risk but the uncertainty attending that belief[232].

3.1 (3.1.8) THE ENERGY AND COURSE OF BEHAVIOUR

The certainty of hazard.

We meet hazard if we undertake a task in which we sometimes fail irrespective of the level of confidence we bring to that task. Hazard is measured by the actual proportion of failures we incur in some given number of performances. It is the mathematical probability of failure. If we therefore incur no failures in a set of trials we incur no hazard although of course according to our level of confidence we may take risk.

The quality of information.

Politicians deciding issues are often charged with not wanting to be confused with the facts. For it is the belief that we possess the requisite knowledge which often governs our decision on a course of action and not the reality of that belief. Choice situations entail comparing comparing alternative courses of action with our estimate of their likely consequences. The actual quality of our information concerning a state of hazard depends on the closeness of our estimate of the probability of an unwelcome outcome occurring as compared with the mathematical probability of its occurrence. Arising from this comparison are misjudgements as to the gravity of hazard which may be greater or less severe than imagined.

The profit of experience.

In an experiment held by COHEN (1957), it was found that experienced bus-drivers rarely failed to judge accurately whether or not they could drive a bus through a given gap. Instructor drivers never failed in their judgement of this task, whereas learner drivers frequently tried to drive through impossible gaps[233]. Remembered success or failure in similar ventures contributes towards a realistic appraisal of self-estimated performance levels for envisaged tasks.

The bearing of skill.

It is perhaps the most common human conceit that we are capable of making realistic judgements in situations of subjective uncertainty however much left-wing pragmatists often boast their imagined monopoly. Few men are not sometimes guilty of wishful thinking with regard to their abilities, and the older we become the more culpable our guilt for the alternative is to admit defeat by Time. But many are modest in assessing their own skills, and so our judgements involving their use are subject to both under and over-estimation. The penalties of under-estimation are often those of the cat in the adage who would but dared not, whereas those of over-estimation may lead us into situations of disaster. Should we truly possess exceptional skill our knowledge of this may lead us to undertake tasks of exceptional difficulty with pitfalls of corresponding magnitude.

The assessment of difficulty.

Football supporters often taunt their rivals following some success by the team they support with the cry "easy". And the excitements of the fairground boxing booth have possibly led many to challenge the resident pug unwisely. The essential issue concerns the relationship between risk and the subjective difficulty of a task. There are tasks we might face where we would be wholly confident of success and those where we would be wholly confident of failure. Of interest to experimenters is the point at which the degree of subjective difficulty is realistically judged. That is to say, when our forecast of expected success is confirmed. Work by COHEN & HANSEL (1955) indicated that judgements are most realistic when the estimated level of difficulty is such that an individual would expect three successes in ten attempts. In one experiment noted, subjects had to jump over a beam the height of which could be varied; in another, spatial judgements were called for that did not involve personal danger. But in both it was found that the easier the task measured by the number of successes achieved the lower the estimate of expected success, whereas the more difficult the task the higher the wrong estimate of expected success[234].

COHEN (1968) made the point that we may wonder whether the seeming propensity of Man to over-estimate his success in difficult tasks is not a biologically-established factor with evolutionary value: (235)

> ...(for had) our ancestors ... recognised difficulties for what they really were they might have shirked them..... They were possibly led to confront true dangers and hence incur hazards because they experienced relatively little risk, in the sense of feeling sure of success without injury.

The belief in luck.

Many people seem to regard the experience of luck as a form of bonus for good behaviour and of unluck as a measure of punishment for real or imagined misbehaviour. The disappointment of such beliefs are generally regarded as undeserved. Luck is the chance confirmation of expectations greater than those which could be realistically hoped for, whereas unluck is the chance disappointment of the latter. Commonly the desire for luck is greater according to the duration and magnitude of past ill fortune. The optimist is one ever hopeful of luck, the pessimist is ever expectant of unluck. COHEN & CHRISTENSEN (1970) have noted how some regard luck as a store which is depleted when we are lucky and replenished when we are unlucky. They observe that such a view explains the actions of the compulsive gambler who doubles his stake on losing, whereas should he win, his winnings in a sense change their sign.(236) Our belief in luck when making spatial judgements is understandably less when we have confidence in our skill, although as we have explained such confidence may be misplaced.

The timing of decision.

Some situations require the need to act more promptly than others when danger arising from spatial judgements is to be averted. For there is no advantage to be gained from taking the right action at the wrong time over taking the wrong action at the right time when both incur the same penalty.

3.1 THE ENERGY AND COURSE OF BEHAVIOUR

3.1.9 Preferred Speed and Spatial Preference.

It is not unusual for us to recognise people long before we can discern their features or clothes, for besides learning someone's physical appearance and details of their wardrobe we often learn their customary body movements. The idiosyncratic characteristics of personal sensory-motor patterns are strikingly demonstrated in the way we walk (consider Groucho Marx and Chaplin). Another witness is our handwriting.

We can often identify people whose gait is familiar merely from the sound of their footsteps. Such sounds form a rhythmic pattern of noises which can be equated with what has been termed their owner's "preferred speed" of movement. Most people seem to have distinct preferences with regard to the tempos at which they best perform many physical activities besides walking, and evidence has suggested that preferred tempos are consciously maintained[237].

Preferred speeds can be found by timing repetitive actions. The term might also be applied to more general activities such as our desired speed of conveyance under particular traffic conditions. What determines our preferred speed of locomotion? Ignoring the mechanical aspects of vehicular motion an obvious influence is the urgency of our errand. Other influences are noted below. It seems likely that given preferred speeds are moderated by their associated Safe Distance judgements, for quite clearly we normally adjust our pace to road conditions if we are driving a vehicle just as we adjust our step to pedestrian conditions. Some self-assessed factor of safety comes into play. One component of this factor is undoubtedly our measure of confidence in our ability to take effective avoidance action should it become necessary. Another component might be our conscious avoidance of physical conditions we find physiologically distressing compounded with our instinctive self-regulation of movement[238]. Hurry reduces the factor of safety afforded by preferred speeds; to compensate we rest or observe wider spatial margins in our Safe Distance judgements.

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Our familiarity with the sound and timing of someone's movements also extends to the way they move. We learn their bearing and how they displace their limbs in movement as well as whether they are given to gesticulation. The space they habitually utilise in the movement of their limbs has been termed the "spatial preference" of the person observed.

The spatial preference of individuals in the performance of an activity such as walking can reflect their mood, their life-style, and sometimes their occupation, and so preferred speeds and spatial preferences would seem to be influenced by personality factors.

Research into the relationship between expressive movement and personality started early (ALLPORT 1933), although CRATTY (1967) has remarked how the ensuing speculation about space utilisation in movement has promoted little objective research. He noted that among the tests employed to investigate the asssociation of spatial preferences with personality have been modifications of the Draw-A-Person Test (also used to investigate the boundaries of the body-image), but that the results of such tests were disappointing. More useful to the understanding of spatial preferences, he thought, was the work of his pupil AHRENS (1966) who remotely televised the unstructured dance movements of girls, and who found a high correlation in regard to spatial utilisation between successive trials with individual dancers[239].

One could infer from the foregoing that preferred speeds and spatial preferences are possibly related to the physique of the individual observed in that long-limbed people might have different preferred speeds and spatial preferences from short-limbed people. And one might suppose that such differences as were found would be repeated in their respective Safe Distance judgements. But preferred speeds and spatial preferences might equally well be set by the basic metabolism of the individual, and we should not overlook such effects of upbringing and accustomed time-scale as cause rural Hodge to differ from his city cousin. Attempts to relate personality factors to physique meet the difficulty that we tend to conform to the imagined or known expectations of others with regard to the manner of our behaviour. Sexual differences may emphasise this tendency for if we face danger in mixed company it is the socially-expected role of the adult male to be less circumspect than females. Again, behaviour which is rewarding may become habit-forming such that if assertiveness has gained someone advantage in the past then regardless of their stature they may become unduly assertive.

3.1 THE ENERGY AND COURSE OF BEHAVIOUR

3.1.10 Exploratory behaviour and respect for property.

Many of us in childhood are enjoined to curb our natural exploratory activities for we are given to understand that it is not polite to touch the property of others uninvited. We are told to take care what we do for various reasons. But mainly it is through concern that we shall not encounter danger before we have learnt to recognise it, and it is that we should also learn the difference between "meum" and "teum". Most of us soon come to realise the close connection between property and personage and find out that unless we show consideration for the property rights of others at best we earn their disapproval and at worst we receive punishment from them.

There is in effect a similarity between the "no-touching rules" and their exemptions which the members of a society develop to govern the acceptable propinquity of physical contact between themselves and no-touching rules which apply to property. It arises from the inevitable identification of an object as the physical extension of its owner and which as such must be treated accordingly. If we respect the owner we should also respect what is his. But such a code is weakened by the anonymity of the owner of property, and as a result communally-owned property becomes susceptible to abuse. Until now we have discussed the Safe Distance in terms of an object's perceived capacity to harm us. Yet equally well it can be conceived in terms of the distance we set between ourselves and an object for fear of damaging the object and thereby giving other people displeasure by our action. Of course we might fear to damage our own possessions.

3.2 THE MODERATORS OF THE SAFE DISTANCE

The process by which we keep in contact with events both within and outside ourselves is called "perception". By this process we select, register, compare, and give meaning to our sensory impressions. The actual process of perception involves the reception and transmission of information along nerve pathways unto the stage where the nerve impulses are transformed into a brain event and acquire meaning.

The greater concern of the study of perception is linked to examination of the influences of learning and motivational states upon the veracity of the percept, and of the range and determinants of individual differences in behaviour. Avoidance learning, the forces which arouse motivational states, and route choice criteria have already been described. <u>In this section we are concerned with the acquisition of information</u>. The directional quality of Safe Distance judgements requires the consideration of visual factors. It is also necessary to describe how individual differences arising from various causes can affect the content and amount of information upon which we act. And, arising from the measurement of individual differences via the sensory threshold, attention is given to the possibility that our recognition of the need for action is susceptible to influence by factors beyond the margin of conscious awareness. These main lines of discussion are supported by descriptions of the perceptual process, the sensory receptors, and the threshold.

The study of perception.

Although there are various explanations for certain postulated aspects of the perceptual process, matters of interpretation can often wait on the importance that new information has been acquired.

In studies of the perceptual process, Gestaltists have stressed the importance of visual phenomena as modifiers of meaning in such areas as human ability to discriminate the boundaries of forms in the visual scene[240]. Experiments have been held to to discover which shapes are easiest to perceive as well as to find out what features of shape permit us to tell one shape from another. The first line of investigation has had in view the practical applications of discerning the shapes which best convey information, direction, warning and so on. The purpose of the second line of investigation has been to discover how the brain organises the electrical impulses it receives. Gestaltists have contended that the eye always tends to see the simplest structure by the principle that we organise our percepts in whatever way keeps change and differences to a minimum. But it is far from certain that their laboratory discoveries have much relevance to the manner in which we perceive events in the busy world.

Other theorists have emphasised that receptivity to stimulus in the visual field is equally dependent on the individual's internal state or tonus, i.e. the tension within him as evidenced by his visceral and muscular reactivity, from findings that induced changes in tonus factors are associated with alterations in perception by certain sense modalities. It has been suggested that this "sensory-tonic" theory "...integrates well with those (theories) emphasising the importance of the body-image, perception of the self or of the ego in the perceptual process"[241].

Another school of thought maintains that more account should be taken of the significance which an event holds for an observer in the assessment of the quality of his perceptual response. Events, it is held, are constituted from the perceptual awareness of things which assume importance to the observer, and since this relationship ("transaction") is interdependent, the accuracy of an observer's judgement of spatial-temporal relationships can only be gauged through knowledge of the assumptions upon which he founds those judgements[242].

Cultural factors exert an important influence on the meanings we ascribe to events. Bartlett recounted how visiting Swazi chiefs in London were struck by the friendliness of the London policeman regulating road traffic since his signal for traffic to stop was the same gesture used as their tribal form of greeting(243). In strange surroundings does the eye take comfort in the familiar? Anthropologists have provided evidence of how the perception of members of particular societies is modified by their way of life in that there are recorded instances that certain peoples are less susceptible to some kinds of visual illusion(244). Perception is also bounded by language. Thus EVANS-PRITCHARD (1940) described the obsessive interest in cattle among the Nuer (Sudan) and how this had built a linguistic profusion of "several thousand expressions" of cattle nomenclature which "...whatever be the subject of speech continually focusses attention on them..."(245). One can imagine the exasperation of strangers in their community. The perniciousness of Orwell's "Newspeak" in suppressing the perception and communication of meaning except within the vocabulary of an approved ideology does not require emphasis.

3.2 THE MODERATORS OF THE SAFE DISTANCE

3.2.1 The perceptual process.

The stages in the process of perception have been given various labels. CRATTY (1967) has used the following: Preparatory set - Object or event - Sensory stimulation - Selection and interpretation - Decision (formation); the operation of each stage being affected by our immediate experience, what we have learnt, and our expectations[246]. A simple account of the way we arrive at a Safe Distance judgement is given below. The whole process is iterative, that is to say it contains stages or parts of stages that are repeated in the formulation of the eventual decision.

Examination of the process begins by consideration of the observer prior to the presence of an object/event or, as it is termed, a distal stimulus. What he happens to be doing and his preparatory set, i.e. his state of mental preparedness predisposing him to act in a characteristic way, is then a function of his immediate needs, expectations, and mood, as influenced by his past experiences and current physiological condition.

The second condition is naturally something for him to perceive for plainly without this perception cannot normally take place[247]. (See difference between percept and image: 3.3.1). Perception therefore requires the physical transmission of energy patterns from the distal stimulus to the observer.

The next requirement is that the energy patterns transmitted by the distal stimulus must be capable of evoking a change in the energy state (sensation) of one or more of the observer's sensory end-organs before there can be a burgeoning of awareness, although actual perception may not occur until stimulation ascends the recognition threshold (see: 3.2.5). The energy patterns which reach and affect the sensory end-organs are termed the "proximal stimulus".

The key stage is that of selection and interpretation. Incoming stimuli transformed to nerve impulses proceed via the nerves of the sensory receptor to their own special "projection area" in the brain and from there to surrounding "association areas". From the total sensory experience in the brain impulses are selected and arranged into some "quasi-stationary neural state" (the phenomenal object) to be given meaning by reference to the context in which they occur, and by comparison with pooled past experiences of a like kind (the notional basis for concepts of cognitive maps, neuronal models, and schema). The phenomenal object is merely a selection compiled from the entire energy process mediated by the retina (of the eye) and other receptors; it will differ according to the way the observer segregates a given proximal stimulus manifold. Put another way, it will depend on what the observer selects to be the figure in the figure-ground organisation of the total stimulus impinging upon him. Thus two people viewing the same scene may perceive different events as is often testified by evidence in law courts.

Decision is reached at the fifth stage on whether the stimulus demands action from the observer and as to the form his motor response should take if events are regarded as threatening. Decision may either precede or be the consequence of problem solving.

In the final stage, the process is completed by the observer's review of his implemented decision. Its effectiveness is evaluated sometimes unconsciously, and the measure of success employed to reinforce or to restructure the formation of future preparatory sets (maps, models, and schema).

3.2 THE MODERATORS OF THE SAFE DISTANCE

3.2.2 The receptors.

There are various classifications of the sensory end-organs or receptors depending on the purpose of the classification, but they are generally placed in three main groups: interoceptors, exteroceptors, and proprioceptors (WYBURN et al.,1964)[248].

Interoceptors are concerned with transmitting information about the operational state of autonomic functions, e.g. they transmit the feeling state of a full bladder. Exteroceptors are concerned with sensations arising from a stimulus source outside the body; they are the peripheral analysers of the organism responding to energy changes in the environment such as light, sound, heat, cold, pressure, pain, and the chemistry of the environment. Proprioceptors are concerned with motor function and involve two sorts of receptors, the kinaesthetic and the vestibular.

The receptors of specialised structure will only respond to the appropriate stimuli, other kinds of stimuli are ignored ; thus the eye (retina) responds to light[249] but not the ear (basilar membrane) and so on. All the receptors respond by generating nerve impulses through the nervous system to the brain when they are appropriately stimulated. This transmitted information can be measured. But what cannot be measured objectively is the neural picture the brain synthesises from its sensory input. We still have to ask an observer what he perceives, whilst we can only infer from the temporal juxtaposition of sensory stimulation and cortical excitement that the former is the cause of that excitement.

The truth of a percept can be modified by the observer's needs, expectations, or previous experience. So although sometimes it may be possible to measure the Safe Distance in terms of sensory response, we could expect that response to be highly individualistic.

3.2 (3.2.2) THE MODERATORS OF THE SAFE DISTANCE

Which receptor or combination of receptors provides the best source of information in forming a perceptual judgement of a Safe Distance depends on the nature of the "warning" stimulus and the operative range of the receptor. Disturbing events in our immediate vicinity can arouse an entire battery of receptors including the interoceptors as when we have "butterflies" in the stomach; whilst at greater distances, the nature of events that stimulate only vision or hearing are often inferred rather than truly perceived.

Hearing. We learn to associate certain sounds with danger. The bilateral pairing of our ears enables us to detect the direction of the sound source since the time of arrival, phase, and intensity of a sound wave differs for each ear if the source is oblique to the transverse plane of the body.

Vision. At most times, however, vision has a predominant role in locating things which might harm us. The eyes (foveas) are particularly well equipped to pinpoint the location of events and they are better endowed with neural pathways to the cortex than the other receptors.

But seeing an object involves more information than that meeting the eyes when we look at it. Usually it involves previous knowledge of the object gained from experience which could have involved other senses. Without this knowledge we may be in the position as arises when we offer to help someone and have to say: Tell me what to look for. Our request denoting that we cannot perceive the object until its characteristics assume significance for us.

How we perceive an event is also affected by the orientation of our body. The world seen backwards through the legs by Peter Pan or the world of the flier is a different place from where most of us spend our time.

WITKIN et al.,(1954), in particular, have shown how individual differences in our ability to orientate ourselves to the horizontal and vertical directions of space in poorly defined perceptual situations is linked to disparities in capacity to discriminate events from the background against which they occur.(250) Furthermore, there is an interdependence of movement and vision (parallax) which is at the foundation of our ability to structure events within their spatial context. But discussion of this is temporarily deferred to consider other receptors (see Sect.3.2.4).

Proprioceptors. Important among these are the proprioceptors, a term coined by Sherrington to describe the sensory systems which respond to stimuli in the "deep field" of the body as distinct from the "surface field". They include the vestibular afferent systems of the inner ear and the muscular and joint (arthroidal) afferent systems.

Vestibular receptors. The vestibular apparatus has nothing to do with hearing. It consists of two cavities (otolith organs), the utricle and the saccule, and three semi-circular canals forming loops arranged approximately along the axes of a three-dimensional co-ordinate system. Both groups of organs contain fluid and are equipped with hair-cells which transmit nerve impulses to the brain. The hair-cells in the vestibular sacs are sensitive to gravity and their prime function is to sense body posture in relation to the vertical; without them it would be impossible for us to sense whether we were standing upright or lopsided.

The semi-circular canals are sensitive to a change in rate of motion. Each tube is filled with liquid (endolymph) which slops about the canals with acceleration or deceleration of the body to flex a tiny organ (cista) bearing the hair-cells which are thereby stimulated. The function of the semi-circular canals is to provide us with information enabling the adjustment of body movements to conditions of disequilibrium; without this sense we would fall over every time we tried to walk unassisted.

Kinaesthetic receptors. Whereas certain information about the movement of the body as a whole is supplied through the vestibular apparatus, knowledge of the movement and position of individual body members is obtained from nerve signals emanating in sense organs situated at the muscles, tendons, and joints. Movement sensation (termed "kinaesthesis") enables us to make movements without dependence on vision; and in regard to learned movements, e.g. walking, and except for their initiation and termination, without dependence on perceptual formation. This is because the neural pathways from the proprioceptors to the cortex also have connections to the more primitive cerebellum as well as to the grey matter in the spinal cord. Nonetheless, the brain is so redundantly interlocked that it usually a convenient fiction to suppose that particular behavioural functions are under the sole control of any particular level of the brain.[251]

There are three main types of kinaesthetic receptors which collect movement sensations of force, speed, and displacement of body parts, namely: the muscle spindles, the tendon end-organs, and the joint end-organs.

Muscle spindles have nerve endings either spirally wound round the muscle itself or with spray-like endings distributed over the muscle fibre. They work only when the muscle is stretched. The contraction of muscle which thereby applies leverage causing a body member to move in the appropriate direction is controlled by motor nerves from the neural centres.

Tendon end-organs signal this contraction. They are located at the junction of muscle fibres and tendons and are spiral fibres around the tendon.

3.2 (3.2.2) THE MODERATORS OF THE SAFE DISTANCE

Joint end-organs are situated in the tendons and muscle sheaths located at the joints. They are sensitive to deep pressure and deformation of the tissue in which they are found. Their exact function is uncertain and a subject of controversy (MERTON 1964)[252].

It was said (1.1.5) that it was Critchley's belief that the body-image stimuli were chiefly visual, kinaesthetic, and tactile. And whilst this order of description has been followed, the particular sensations we receive will naturally depend on the setting of our experience.

Touch.

Touch has an important role in relation to movement behaviour since tactile impressions play a large part in the developmental process of structuring space and body awareness. Touch is also a form of communication which can affect our body positioning in relation to others (cf. contact and non-contact species).

Other exteroceptors.

Thermal and olfactory factors play some part in our spatial positioning in interpersonal relationships. They also provide advance warning of an object's properties harmfull to Man. We learn to recognise the dangerous effects of heat both upon objects and ourselves, and we learn when smell denotes the presence of danger as from putrefaction or burning.

3.2 THE MODERATORS OF THE SAFE DISTANCE

3.2.3 Individual differences.

Physical and mental. The perceptual process allows each of us to form a private opinion as to what is a Safe Distance in particular circumstances. This is partly because there are variations in our endowment of sensory receptors which place the handicapped such as the blind and deaf hostage to fears and dangers often unsuspected by the more fortunate[253]; and which bring attendant risks to those with even the minor disabilities of colour blindness and poor night vision[254].

It is also because there is a gradual deterioration in some sensory capability as a consequence of ageing which may culminate in an impaired ability to integrate information and to act upon it, although as we age we may become more careful[255].

Few of us get through life without damage to ourselves. A Safe Distance for an agile person may not be so for the lame; whilst the mentally ill, particularly schizophrenics, can be distressed by the proximity of events which do not perturb the more balanced[256]. But all of us have to sensible to what is a Safe Distance if we wish to avoid unnecessary exposure to harm, although the quality of our response to the threatening situation may depend on our intelligence.

Besides the more stable characteristics of individual differences mentioned above, perception is also affected by transient emotional and physiological states. For instance, anxiety, fatigue, and inattention through preoccupation with other matters might cause us to misread visual cues and jump to wrong conclusions about our personal safety. In fact any circumstances which weaken our contact with reality whether caused by drugs, alcohol, or conditions of social and physical privation may have a similar effect.

There is also considerable evidence that perception is affected by our personal needs and expectancies, by our goals and intentions, by our interests and values, as well as by our individual attitudes, sets, and habit systems. Some of these influences may be more enduring than others, perhaps becoming subsumed within a private philosophy (e.g. Panglossian) which in turn can structure our views, actions, and interpretation of events. Our percepts can also acquire symbolic importance for us such that their meaningfulness to us may not be guessed by others. Thus to the tramp, sixpence might be a cup of tea; but to Gulbenkian, it was, he claimed, an unfamiliar object on which he understood his private taxi could turn.

Personality traits.

Personality factors often have great importance on the manner in which we perceive objects (ALLPORT 1961); and perceptual ability is related to personality structure in various ways[257]. We might therefore invest (project) objects and other people with qualities which are not real. Illustratively, mothers have been known to say of their daughter's choice in boy-friends: I'll never know what she sees in him. Others might see something nasty in the woodshed. Again, there are variations in personal susceptibility to suggestion which are tested by a readiness to believe an interpretation placed on events by others; with youngsters this is often tragically proven in the dare. Moreover, in making judgements about the features of objects we often take into account the way others evaluate them such that if we like a person we may tend to share his value-judgements.

One way of regarding individual differences has been to categorise people into types according to how they usually structure their percepts. Individuals are sorted on the basis of their measured ability to make certain kinds of perceptual judgements including those of space and object perception. The idea is that people exhibit consistent modes of perception - at least in laboratory experiments; but whether they do so in everyday life is doubtful. Most likely it would seem that we adjust our perceptual mode to the nature of the task in hand.

However, among the classificatory systems used to describe individual tendencies in perceptual formation (in laboratory experiments) are those which express human tendencies either to generalise or to analyse from percepts as "lumpers and splitters"; to accentuate or to minimise differences within a set of circumstances as "sharpeners and levellers"; to perceive more easily from visual stimuli than from contact or kinaesthetic senses as "visualisers and haptics"; to think in terms of pictures rather than in words as "visualisers and verbalisers"; there are those who are relatively sensitive to disruptive stimuli and others who are relatively insensitive " the augmenters and reducers"; some people depend less than others on visual cues in forming perceptual judgements of the true vertical "the field-dependent and the field-independent": each classification although expressed as a dichotomy is regarded as a continuum of experience within the range of which individual response may vary according to the nature of the event.

VERNON (1970) cited attempts to relate the well-known "introvert-extrovert" dichotomy to mode of customary perception. The indications are that introverts more readily adopt an analytic approach to perceptual resolution than extroverts who tend to "synthesise" meaning by taking a broader,less critical view of the circumstances[258]. BROWN (1961) related introversion and extroversion to "perceptual defence" (3.2.6), finding that extroverted female observers were quicker to lower their recognition thresholds ("sensitization") to emotionally-charged stimuli than introverts although the relationship did not hold with male observers[259].

There seems little point in detailing the minutiae of differences in mode of perception discerned by various experimenters, for their experiments refer invariably to very restricted perceptual conditions which eliminate the immense redundancies of information normally available to an observer in natural settings. Moreover, where there are individual differences in the cognitive organisation of our percepts they must be very slight and not fundamental, since in the development of Man as a species he is equipped by genetic endowment with an adequate perceptual mode adapted to deal with a constantly varying environment. What use he makes of his facility would seem to depend more importantly on the significance he attaches to particular events. Where human safety is concerned one might even suppose that except in those with some form of mental illness we all possess an equally effective "hot-line" to acquaint us with danger.

3.2.4 The visual experience of objects.

Reference was made to the redundancies of information normally available to us which enable the formation of veridical judgements concerning events in natural settings. By far and away most Safe Distance judgements are made on the basis of visually acquired information which may be accompanied by confirmatory cues - sounds, smells, movement sensations, or thermal assurances - which could also operate to orientate us to danger. But the greater channel capacity of visual experience would suggest that it provides a more compelling call to action than other modes of experience. Furthermore, since visual judgements of the location of perceived danger carry explicit judgements as to to the location of perceived safety, they have a steering quality absent from judgements which derive entirely from cues dependent on hearing, touch, smell or movement. Discussion is therefore restricted to the manner in which we derive information about objects by visual inspection. Such a course should reveal some gateways to error in Safe Distance judgements [260].

The discrimination of form. The perception of objects is an active process which requires a procedure of selection and the organisation of sensory impressions. Completely homogenous surroundings cannot be perceived except as something vaguely outside us. For perception to occur some part of our visual field must gain ascendancy over the remainder so that we can separate the object experience from the context in which it occurs. This has been described by Gestaltists as the "figure-ground" experience. Objects therefore have boundaries, and among factors governing their ease of discrimination is their sharpness of contour as embodied in a change in textural density, brightness, colour. According to Gestalt theory we are predisposed to organise our percepts in accordance with certain "rules" of assembly in such a way that they gain simplicity either by acquiring symmetry and regularity, or through the conjunction of independent parts into greater wholes. Illustratively of the latter are conditions of "proximity" and "similarity". Thus the closer two objects are together the greater the tendency to perceive them as an integrated figure, whilst objects of similar colour, size, shape, and luminosity are more likely to be combined into a single percept than objects having disparate visual characteristics.

A good deal of attention has been paid to discovering the principles which facilitate object perception. Thus it is well-known that the background against which an object appears can enhance or camouflage its figural properties. Sequential context effects are also important in that the recency and frequency of previous encounters with an object may influence later perception in various ways. In judging a Safe Distance our expectancies based on preceding encounters may be unrealised so that we are unprepared for a worsened situation or, alternatively, we may be in less danger than we imagine. There are also times when we are inclined to watch for certain classes of objects to which others might not attend either because it is our business to do so or through differences in motivation, interests and values.

Attention has been given to the factor of redundancy in resolving uncertainty in object identification, since uncertainty is reduced when different aspects of an object percept all endorse the same choice from equal possibilities. For example there is high redundancy when figures (and patterns) are symmetrical about an axis, or when the surfaces of figures have unbroken direction, unchanging brightness and texture. By the same token, asymmetry in a figure is non-redundant information. "Good" Gestalten of which the circle is the paradigm are figures with visual properties which allow them to be readily perceived. They have high informational redundancy so allowing identification with greater conviction.

3.2 (3.2.4) THE MODERATORS OF THE SAFE DISTANCE

The estimate of distance.

We are concerned with the redundancies of information obtaining in object perception that allow us to cross-check our estimates of a Safe Distance. What sources of information enable us to do this? Previous knowledge of and familiarity with the spatial arrangements of the visual field can be helpful in securing accurate distance judgements, but apart from this we can estimate distance by comparing various visual as well as non-visual depth cues.

Non-visual depth cues.

In order to see an object clearly we have to focus the lens of the eye. Most of the light entering the eye is bent by the cornea to form an image on the retina. The function of the lens is to sharpen this image by altering its own radius of curvature and the action of doing so is known as the accommodation of the eye. As we move closer or further from an object quite near to us the action of keeping the object in focus requires the eyes to alter their angle of convergence. The accommodation-convergence process produces kinaesthetic sensations of eye-muscle tensions which provide range-finding information for distances up to about one to two metres. Objects beyond about six to seven metres from us are at optical infinity and require no accommodation and neglible convergence. Also as a crude measure of what is near and what is far we look up to objects near the horizon and down to those in the foreground.

Visual depth cues.

There are several ways of classifying visual depth cues. Traditionally, it has been the custom to distinguish what are known today as monocular depth cues from the remainder since the former are associated with the conventions of perspective representation evolved by Western medieval artists. Thus we can tell which object is closer when our view of one partially blocks our view of another (Overlay). We also learn that larger objects are closer than smaller objects of the same kind (Size perspective) and that parallel lines of sight converge with distance (Linear perspective). Again, our familiarity with the usual sizes of particular objects (man, tree, length of a car or horse) enables us to construct a scale of known standards we can apply to objects seen distantly in propinquity with a standard object (Familiar size).

Arising from the fact that our eyes are about 2.5 inches apart between their centres, each eye receives a slightly different projection of the object under observation. The separate images in the focal place are synthesised by the brain, but those objects before and behind the focal plane are perceived as blurred. The difference between the two images is known as retinal disparity. It provides depth perception by stereoscopic vision but for relatively near distances only, i.e. in proximal space; at greater distances the differences are neglible.

In a third category, we discern what is near or far according to the regular and gradual changes in the features of the landscape as it recedes from us. With increase in distance there is a corresponding increase in compactness or texture density in the features of the landscape. Expressed another way, there is loss of detail with distance.

Depth cues of another kind occur from visual sensation of parallactic movement. This is the apparent movement of stationary objects in relation to the observer and to one another as the observer himself moves. For example, objects which are close appear to approach us more quickly than those more distant; again, when we move laterally, the closer of two objects we have aligned visually appears to move more quickly and further.

Related to texture density (gradient) is the effect of aerial perspective. Not only do we lose detail with distance but the brightness of more distant objects diminishes, their colours become less saturated, and their outline blurred by the intervening effects of air pollution and by the refracted light rays occurring in thermal currents.

Finally, there are shadows in the visual scene deriving from the direction of light falling on an object. Shadows may give an object a sculptural quality which could assist ease of identification, but since their configuration changes with the direction of illumination their value as distance (and size) cues would seem limited to exceptional circumstances.

Beneath the surface of this brief statement of elementary and widely-known facts concerning the visual elements of experience has been the unstated assumption that errors in judgement of physical distance can have repercussions upon judgements of associated psychological distance. Perhaps psychological distance has texture gradients, shadows, and perspective cues; perhaps it even has Gestalten? For example, during the process of sustaining serious injury who has not had the leap of mind to its consequence to self?

3.2 THE MODERATORS OF THE SAFE DISTANCE

3.2.5 <u>The threshold.</u>

We monitor changes in particular energy states in the environment via our sensory receptors; thus sensory receptors in the eye respond to certain wavelengths of light, and there are receptors in the ear which respond to sound waves within a certain range of frequencies. The action of such receptors forms the afferent or incoming part of our total relationship with the environment. The inherent capacity of a sensory organ to respond to stimuli is known as the "sensitivity" of that receptor. Expermenters distinguish two kinds of sensitivity: an "absolute" sensitivity defining the limits of capacity to respond to stimulation, and a "differential" sensitivity defining the capacity to discriminate qualitative and quantitative differences between stimuli of the same kind. The branch of experimental psychology concerned with the determination of lawful relationships between the measureable characteristics of a stimulus and the reportable attributes of sensory experience is known as "Psychophysics".

In the determination of the absolute limits of sensitivity it is naturally found that stimuli well within the energy-range capacity of the tested sensory organ will normally produce a response, and that stimuli beyond this range will normally produce no response. There is , however, no abrupt change between affirmative and negative response to stimuli, but rather a transitional change relating to alterations in the response-promoting quality of the stimulus. Because of this, it is usual to consider the stimulus which yields a response 50 per cent of the time in a response-no response situation as the mark of the "absolute threshold" of sensitivity of the receptor. It is found in practice that the absolute threshold for a particular stimulus will vary on occasion according to the needs and expectancies and so on of the person tested, and for this reason the value of an absolute threshold is essentially a statistic rather than a parameter of response.

This is also true for estimates of differential sensitivity. The "differential threshold" is taken to be the stimulus difference, e.g. between two levels of illumination, which give rise to the judgement "different" for half the number of trials.

The detection of thresholds is essentially a matter involving the vigilance and arousal level of the individual. We shallsee that the absolute threshold must enter considerations of perceptual recognition (3.2.6) as an influence on efferent, i.e. outgoing, response.

<u>The measurement of recognition thresholds.</u>

Recognition thresholds are usually found only by "ascending" methods in which recognition of a stimulus by an observer is initially prevented and then increasingly facilitated. Procedures for estimating recognition thresholds have included the successive presentation of a stimulus for increasingly longer intervals of time, at increasingly closer distances to the observer, and at increasingly higher levels of illumination until recognition takes place.

Recognition is credited as soon as an observer can correctly identify the stimulus although presentations may continue beyond this point. The magnitude of the incremental stages of presentation, the criteria for correct recognition, and the units in which the recognition threshold is expressed are decided by the experimenter. The only non-verbal response widely used in recognition tests has been the GSR. An unusually large GSR is taken to indicate that the stimulus evoking it is disturbing to the observer.

3.2 THE MODERATORS OF THE SAFE DISTANCE

3.2.6 Perceptual defence.

Many of us probably find that we are quick to notice the things in which we are especially interested, and that we also tend not to notice what we find unpleasant. Our ease of recognition of external events might therefore be affected by the operation of value systems upon selection. It has been mentioned how perception can be affected by motivation in a number of ways, e.g. by our needs, expectancies, or the possibility of reward, and so on; here we are further concerned with the way in which judgements of safety could be facilitated or delayed by the emotional significance which an event has for us.

Among the terms which have been used to describe the process whereby recognition thresholds (3.2.5) have been found to vary according to the emotional value of the stimulus are "perceptual sensitization" and "perceptual defence". Pre-recognition and the lowering of thresholds are associated with "sensitization"; impairment of recognition and the raising of thresholds are associated with "defence". However, BROWN (1961) in explaining how ambiguity surrounds the use of many of the terms in the experimental literature himself adopted "perceptual defence" as a comprehensive label to describe: "...any systematic relationship found to hold between stimulus emotionality and the ease of recognition". His use of the term is adopted here. Papers on key experiments in the literature between 1947-62 have been brought together by VERNON (1966) and have been further discussed by VERNON (1970) (261).

Reported investigations of perceptual defence would seem to be concerned almost entirely with measures of the recognition threshold of words and pictures presented under controlled conditions of exposure time and illumination. Tests have shown that subject identification of emotionally-charged words (and pictures) is either slower or quicker depending on their nature than identification of correspondingly "neutral" words (or pictures). Again, in many tests when particular words (or nonsense syllables) have been coupled with electric shock, it has been found during later presentations that the non-shocked stimuli have been perceived more readily. A lot depends on the severity of the shock associated with particular stimuli; severe shock can disrupt perception totally, whereas mild shock can either inhibit perception or produce heightened awareness facilitating perception - especially if it provides the opportunity of avoiding further and more intense shock[262]. Furthermore, it has been found that stimuli previously associated with shock are responsible for an increase in GSR response which may occur even before the stimuli are fully perceived (LAZARUS & McCLEARY 1951). From this it has been conjectured that perceptual defence operates sublimimally in connection with GSR responses established through previous conditioning. In fact Lazarus and McCleary in describing what they termed the "subception" effect remarked that: "...in so far as autonomic activity can be regarded as a form of behavior, we believe that we may have here an experimental instance of such an unconscious process"[263]. One is reminded of the Russian claim to have identified an autonomic component affecting our spatial tolerance of external events (Section 1.1.5); and we can wonder whether the postulated sensory "bubble" some suggest we possess is built upon the subliminal recognition of danger arising from previous conditioning.

However, the question arises whether a subject actually perceives the fear-arousing characteristics of the shocked (or emotionally shocking) stimulus before he appears to identify it, or whether he perceives it and retards his reaction. The difference being that the former might occur below the recognition threshold but above the absolute threshold (else there would be no response - autonomic or otherwise) leading to action without awareness or without conviction; whereas the latter response suggests conscious suppression of action. Experimenters would seem to have concentrated upon the ego-defensive aspect of perceptual defence rather than upon its complementary property of pre-recognition. Perhaps this is because there are respectable explanations for the former behaviour but few for déja-vu except the postulate that one eye registers events marginally quicker than the other. There is some evidence for the influence of personality characteristics on the cognitive style of subject response. CHODORKOFF (1956), for instance, found that subjects indicated by Rorschach test to be well-adjusted showed sensitization, whereas less well-adjusted subjects showed defence[264]. But whilst evidence of this relationship does not itself disprove the existence of an autonomic process which inhibits or facilitates response to an emotionally-charged stimulus in the same person at different times, stronger evidence must still be sought in Vernon's (1970) opinion before the postulate of an autonomic process can be accepted[265].

What may have pertinence to the timing of our judgement of the Safe Distance and any consequent avoidance behaviour we undertake have been findings of a curvilinear relationship between perception time and emotionality as measured by reaction time (Brown 1961); perception time increasing with reaction time and then declining. To put it another way, the recognition threshold first rises with increases in stimulus emotionality but later declines with further increase in stimulus emotionality. Familiarity breeds tolerance as it were. Yet although our avoidance behaviour may be facilitated or delayed according to our recognition threshold to an emotionally-charged object, as well as by the effects of non-emotional influences such as the recency of the last prior exposure to the stimulus object and its previous frequency of occurrence, this would not seem to affect the dimensions of the Safe Distance we would be prompted to set though it might affect the speed of our manoeuvre.

3.3 THE SPATIAL IMAGE OF SELF

The matters reviewed in this section relate to the experience of the body-image, and included are accounts of its developmental progress, its plasticity and projectional qualities. Two characteristics of the body-image of particular interest to those whose job it is to assess space needs for various human activities are its locational properties and its defensive properties. These properties are also held by the Safe Distance. But the body-image boundary and the Safe Distance percept are not one and the same although they seem of a kind in their ego-defensive nature. Apart from the fact that images and percepts have different antecedent conditions, the Safe Distance is differentiated from the body-image boundary by its location. The view taken by this writer follows that expressed by Schilder (3.3.4): "...that the body-image is surrounded by a sphere of particular sensitiveness". The term "sphere" is merely a figurative expression indicating the omni-directional occurrence of some evaluative process. We have called this the Safe Distance.

<u>Difficulties of definition.</u>

In what category of self-experience to place the Safe Distance is hard to say. It would appear to be a function of the body-image. However, the term "body-image" has been attached to a forest of meanings. This is because the body-image experience involves conceptual activities such as imaging as well as impressions of actual bodily sensations which are <u>mainly</u> perceptual, i.e. some can be illusionary as with phantom limbs. CRITCHLEY (1968) has held that the "body-image" should refer to the mental idea we possess as to the physical and aesthetic attributes of our own body ("mental" presumably connoting associations of reality status), and has suggested that the term "corporeal awareness" would better express that idea[(266)]. But his substitute term swings the balance towards the human "clay" at the expense of the human psyche.

One term widely accepted as synonomous with the body-image is that of the "body schema". Both terms describe a brain activity, but the body schema concept expands the idea of the body-image in two ways. Firstly, the body schema refers to the postural model we construct as to the whereabouts of our body parts (HEAD 1920)[267]. Secondly, it is a name given to the process by which we actively organise new sensory data upon the structure of past experiences (BARTLETT 1932)[268]. In brief, the body schema stresses the dynamic property of the self-experience.

It has been mentioned (1.1.7) how there are close links between human territoriality, the body-image and the ego-identity. In describing the dimensions of self, ARGYLE (1967), for example, has shed light on this interconnexion. In using terms which he explained were only recently adopted and still tentative he distinguished the "self-image" as the "ego-identity" - meaning how a person see himself - from "self-esteem" which is the extent to which that person approves of what he sees[269]. The "self-image" or "ego-identity", explained Argyle, has a central core of perceptual awareness usually consisting of a man's name, his bodily feelings, body image, sex and age, and certain other qualities such as social class which might be of importance to him. Argyle held that the origins of the self-image derive from social experience - the reactions of other people to us, the comparison with peers, and role playing; yet experience of the body-image does not depend on those factors although it may be influenced by them, whereas the desire to maintain territory could well result from such influences. Nevertheless, when regarded in spatial terms, the body-image is necessarily the boundary of the self-image, and this aligns with the Freudian view that the ego concept is that part of the personality which interacts with actual events in the real world:

> ...the ego is ultimately derived from bodily sensations, chiefly from those springing from the surface of the body. It may thus be regarded as a mental projection of the surface of the body. (270)

By the circularity of these definitions the Safe Distance is revealed as a mental device which when operationally applied protects the ego-identity. This characteristic it shares with the body-image: how do they differ in their locational properties? Broadly speaking, the body-image is the ghostly embodiment of the ego-identity which mediates between the tangible body and the abstract self, whereas the Safe Distance is the distance we set between what we fear will harm us - or more precisely its perceived boundary capability for harm - and the tangible body or abstract self. Thus if A, B and C apply respectively to the self, to the body-image boundary, and to what we fear, then A-B is the dimension of the body-image and B-C is the dimension of the Safe Distance. FISHER & CLEVELAND (1968) have tested the permeability of the body-image boundary and have equated relative permeability with degree of threat to the ego-identity. What we have done (sect.4.0) is to assume the body-image to have stable permeability and to equate degree of threat with variations in the distance B-C. Incidentally, just as it is convenient to envisage the body-image as a Gestalt homunculus so it has been convenient to think of the Safe Distance as a sphere of protection. In practice, however, reference to our postural model or to the self in connection with our Safe Distance judgement is possibly particular and directional rather than general and overall. That is to say, except when we fear for our life itself threat is seen to have a point of application upon us - we fear to bump our head or knock our shins rather than to suffer unspecified injury.

Figure (21) illustrates the relationship between the Safe Distance and the body-image with regard to a perceived threat to self. It is important to notice that dynamic measurement of the Safe Distance has required the substitution of the locomotion envelope for the body-image boundary. What justification is there for this substitution other than its convenience (referred in sect.0.0.) in separating emotional space from functional space? Perhaps it can be pleaded that the locomotion envelope is the container of our postural model during some activity.

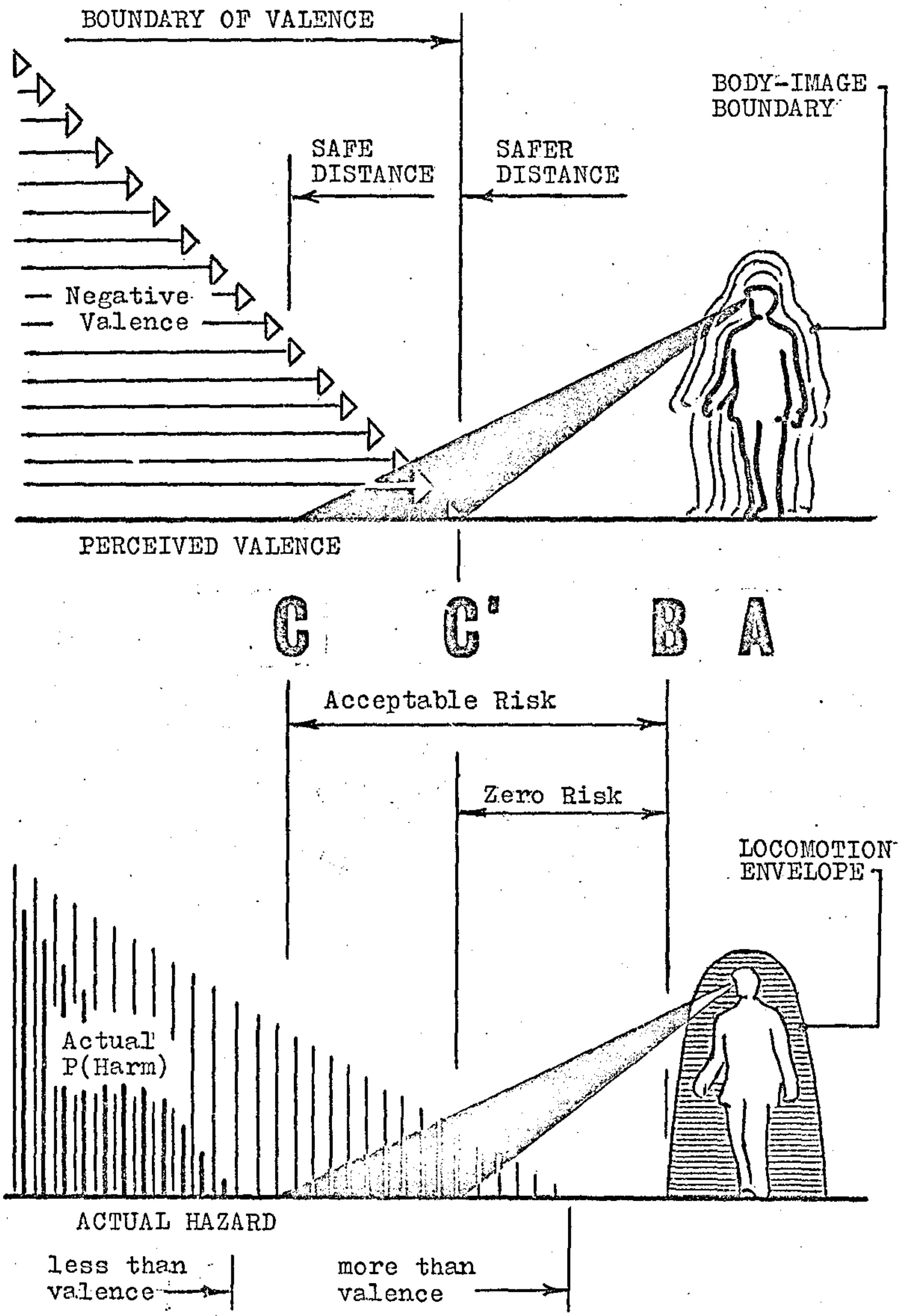

FIG.(21) VALENCE, BODY-IMAGE and the SAFE DISTANCE

3.3 THE SPATIAL IMAGE OF SELF

3.3.1 The percept and the image as cognitive processes.

Cognition. The percept and the image are both mental constructs which occur within the wider process of cognition. "Cognition" is a term embracing all the various ways of knowing - by perceiving, imagining, remembering, conceiving, reasoning, and judging. The function of cognition is broadly that of acquainting us with our internal and external environment and of assisting in the shaping of our attitude to this information. Cognitive processes are marked by a tendency to select from the total sensory experience (manifold) impinging on us at any moment that which is important to us so that we can achieve an economy of effort in dealing with that experience. Selection tends to be directed by our needs, interests, and habits of thought. Cognition also tends to gather and synthesise the selected impressions into unitary constructs in order to assess their significance by comparison with earlier related experiences. It effects a reduction process, which,because it is private, allows each individual to build an idiosyncratic "picture" of schema of events in which he has been involved.

The percept and the image.

Percepts occur in the presence of and in response to stimuli, whereas images are the experience of sensory data in the absence of peripheral stimulation. Perception provides the material from which images, beliefs, attitudes, and the like are cast, but perceiving itself is affected by the prevailing images etc., we have already formed of the world and of ourselves. In operation, imaging is the more sensitive to individual differences, for it seems the case that most people have a preferred sensory mode by which they form images. Images also have a plasticity not shared by percepts, and it possible for some people to exercise a greater measure of conscious control than others over the form taken by their imaging.

RICHARDSON (1969) in his account of mental imagery has mentioned various difficulties in assembling definitions which distinguish percepts from images(271). Important among these is the fallibility of the subjective criteria which have been proposed to enable this distinction. He noted that it had been early suggested (Hume 1748) that images were shadows of less intensity than the original sensations on which they were based, but that contrary evidence in the twentieth century had redirected attention to the variations in persistence between images and percepts as a means of differentiation. Accordingly it was postulated that an image tends to fade when fixated whereas a percept becomes more distinct, but though this largely applies to visual and aural experiences it does not hold entirely and in respect of our contact senses it may not do so at all. With regard to the latter the reason lies in human adaptation to stimulus which causes experience of physical sensation to cease fairly quickly. In the case of the former, it has been demonstrated that even visual perception is dependent upon changes in its pattern of excitation or else the eye adapts to a completely stable optical image and it can no longer be seen. Richardson noted that objective criteria can be used to distinguish the percept from the image firstly by evidence of their antecedent conditions, but he questioned whether it was always possible to guarantee that the experience of a subject in response to stimuli was unalloyed by an accompanying image. More concrete are tests of the reality status of the experience. These are facilitated by our accumulated experience. Even then there are circumstances as with olfactory sensations when it may become necessary for us to obtain the confirmation of others.

Of relevance to subjective criteria and of particular interest to any postulated threshold for the Safe Distance are the findings of SEGAL & NATHAN (1964) who replicated an experiment of PERKY (1910). Richardson avers that to most psychologists it is the definitive study illustrating that there are no absolute markers for the consistent differentiation of percepts and images. In both experiments the procedure was to ask a subject to imagine some specified object such as a lemon or banana and then ask him to project it onto a glass screen. Unknown to the subjects the experimenter back-projected a slide of the chosen object onto the screen at a level of illumination above the threshold for its detection but below the threshold at which a subject would become aware of the sensory basis of his "image". The acceptance by some subjects that the images were their own was cause for the later experimenters to suggest that "...there is a region of experience where the distinction between self-initiated imagery and the perception of an external event is uncertain"(272). If we do project sensory "bubbles" around us it is here that they are likely to reside.

3.3 THE SPATIAL IMAGE OF SELF

3.3.2 Locational and defensive properties of the body-image, body-schema.

The body-image (schema) has both locational and directional properties such that we know where to find particular body parts and we know their position relative to other body parts. At the same time we can use body "landmarks" as reference points in our spatial relationships with the non-self world. We register these landmarks upon what HEAD (1920) termed a sensory schema of the body's postural relationships. Head was concerned with the nature of the afferent co-ordinations which directly underlie voluntary adjustive activity (OLDFIELD & ZANGWILL 1942); he saw that we are not always consciously attending to the position of our body members but that awareness of altered position is immediate and measured as a change from what has gone before. Head believed that such a comparison process is made possible by the existence of a neural postural model of ourselves which continuously registers postural movements as they occur.

> By means of perpetual alterations in position we are always building up a postural model of ourselves which constantly changes. Every new posture of movement is recorded on this plastic schema, and the activity of the cortex brings every fresh group of sensations evoked by altered posture into relation with it. (273)

Head's theoretical position is criticised by OLDFIELD & ZANGWILL (1942); BARTLETT (1932) extended and refined the notion of the schema - criticism of Bartlett's theoretical position is made by NORTHWAY (1940)[274].

The postural model is formed from knowledge of our anatomy and its movement capacities; and in terms of body/external object relationships, the body schema provides a self-platform essential to the formation of an accurate perception of events and objects in space.

> It is to the existence of these "schemata" that we owe the power of projecting our recognition of posture, movement and locality beyond the limits of our own bodies to the end of some instrument held in the hand. Without them we could not

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> "use a spoon unless our eyes were fixed on the plate. Anything which participates in the conscious movement of our bodies is added to the model of ourselves and becomes part of these schemata; a woman's power of localisation may extend to the feather in her hat. (275)

What are the defensive properties of the body-image (schema) ? It is clear that we need to be aware of the disposition of our body parts in order to safeguard them from possible harm, and if our knowledge of this is insufficient we remedy our awareness by testing movements. The defensive nature of the body-image (schema) also derives from its projectional qualities. The latter have two forms. In the first place, it has already been noted (3.3) that the body-image can be regarded as a projected intervening structure between what is self and what is non-self. But we also introject ourselves into the object world; that is to say we absorb environmental objects into our body-image (schema), and we react accordingly when the integrity or completeness of this composite structure is perceived as subject to threat. To put it another way, we come regard certain external objects as part of self, and we come to regard certain claims to the space around us (territory, personal space, individual distance) as part of self, and we defend them as though they were part of self.

3.3 THE SPATIAL IMAGE OF SELF

3.3.3 How we build up the body-image.

We are not born with a body-image but acquire one. According to LHERMITTE cited (CRITCHLEY 1950), the body-image is very gradually built up during infancy by the interaction of several factors, among which are:

i) painful stimuli
ii) libidinous factors
iii) visual impressions
iv) play entailing the repetition of kinaesthetic activities. (276)

As regards painful stimuli and libidinous factors it has been found that points on the body with strong sensations are always those which are strongly featured in the postural model since this is partly a function of the density of the sensory receptors at those points. CRATTY (1967) has related how the infant also gains self-knowledge through visual-motor inspection. He noted how soon after birth the infant's fists become unclenched and whilst its head is habitually held on one side it is able to gain impressions about capacity for movement during the opening and closing of its hand. The child thereby integrates kinaesthetic sensations from the moving hand and from the visual musculature controlling eye movements with what it sees. The classic asymmetric position of the head assumed by infants is also supposed to assist the early differentiation of the two sides to the body. Later when the head returns to the mid-line of the body, the infant can watch the traversing of objects and perhaps initiate their movements across his (277) body centreline so forming ideas of direction and elevation. Development of the body-image procedes in a step-like rather than a uniform fashion with abrupt advancement between the seventh and eighth years. The plasticity of the body-image in early age is shown by the anatomical distortions in children's drawings which often show the arms of a person emerging from the head.

The same preoccupation with certain body parts can be seen in the pornographic graffiti of the young and immature, for it is some time before the body-image achieves its usual adult form. Possibly the development of the body-image is dependent on sensory motor development. The stumblings of teenagers reflects the incompleteness of this development at the physiological level; their bizarre dress and body adornment reflects a similar incompleteness at the emotional level. The body-image always lags behind in the ageing process. Thus whilst we may notice how others have aged since we have known them, we frequently fail to recognise how old we must now look to them.

What factors assist in building up our body-image at the physiological level? The most important are considered to be the impressions we gain from visual-manipulative interactions and associated labyrinthine components.

Visual factors.

The prime source of information about our appearance pertaining to its form and the location of its extremities is naturally that of self-inspection. Those parts which are normally unclothed according to custom, climate, or activity provide more opportunities for inspection. But due to the placement of the eyes veridical impressions of the face and the back are harder to obtain. Mostly we are satisfied with a laterally reversed mirrored reflection of these body sectors, though in regarding our own features we only gain a stylised impression of their characteristics since concentration on that action freezes their animation apparent to others when we are not posed.

Information about the self is also gained from inspection of others. We learn the usual anthropometric dimensions associated with age and sex, the various facial delineaments associated with race, the expressive gestures used within in own culture, the body postures necessary for walking, running, or other activities. The information may be indirectly obtained from photographs and similar media.

Tactile factors.

In the development of the postural model of the body those parts which have regular and close contact with the not-self seem most important. Perhaps this is because every spot that is touched promotes a mental picture of its point of application on the body. What is true for pressure would also seem to hold for the other surface indices of pain and temperature. But the body-image is not a hollow shell. Other sensory components from visceral sensations allow us to form impressions regarding its internal structure.

Formation of an accurate body-image is intimately related to sensations received from the various kinaesthetic receptors which register movement sensations in the muscles, tendons and joints. Kinaesthetic sensations facilitate judgements involving motor actions relatively independent of vision, e.g. in the operation of a throttle pedal. They assist in registering the position of body parts and their range of movement, although they come into operation on at least two levels of awareness. Kinaesthetic response can be reflexive as in the example cited above; possibly more often it is inextricably bound up with visual cues as when we mentally manipulate seen objects. Concepts of force and time are frequent components of space and distance estimates, e.g. we ask 'Is it far?' meaning 'too far to walk?'.

Labyrinthine factors.

Labyrinthine factors provide information regarding the total position of the body in space. The otilith organs are sensitive to gravity and their prime function is to sense body posture in relation to the vertical; the semi-circular canals are sensitive to changes in our rate of motion and to the turning of the body about one of its axes. SCHILDER (1935) gave importance to the pressure changes on the bony prominences of the body in the formation of our postural model in that the effect of gravity produced pressure sensations which varied with posture [278]. But the later experimental work of Witkin and others has indicated that the vestibular apparatus is subservient to the visual apparatus and kinaesthetic receptors in perceptual judgements of body verticality. Thus in a variety of tests creating a conflict between visual and postural elements in discerning the perceived upright, it was found with certain degrees of exception that the prevailing tendency in those tested was to base their judgements of verticality upon cues from their surroundings and not upon sensations of gravity[279].

<u>What factors assist in building up our postural model at the emotional level?</u>

The body-image is built up not only by our own interest in our body, but also by the interest others show in its parts and in their own. There is a high level of ego involvement conveyed for example in the significance we attach to body openings, to our experience of pain or irritation, to the erogenous areas, and to the actions of others towards our body. In general, emotional influences affect the relative importance we ascribe to different body parts and their clearness of discernment. At some time in their lives and particularly in youth many people possibly model their behaviour on that of someone they admire, and this modelling may extend to the adoption of the postural characteristics of another person. Parents and children often share the same gait. But imitative behaviour is not bound by blood ties nor restricted to unconscious intentionality. Role playing requires many to assume postural habits by an effort of will.

3.3 THE SPATIAL IMAGE OF SELF

3.3.4 The changing characteristics of the body-image.

Although the body-image operates in the same spatial dimensions as the physical self it is not bound by the body anthropometrics of the self. Ordinarily it spreads to incorporate nearby objects having intimate association. Illustratively, there is the famous reference by HEAD (1920) that the body-image of a woman extends to the tip of the feather on her hat. Whilst we take our clothing into our body-image so readily that the traditional song warning peril to those "who tread on the tail of m'coat" is immediately understood to refer to attacks upon the person. The body-image of the experienced car driver temporarily includes his mode of locomotion. COHEN (1968) noted that the motorist becomes a centaur, a bio-robot, an inseparable unity of man and machine; no doubt the centaurs of mythology were horsemen just as the American Indians believed that the first Spanish horsemen they ever saw were single human beings [280].

The body-image is extremely unstable (labile). It can shrink and expand; lose parts and gain parts. We donate faeces, hair and nail clippings to the non-self world (the disposal of them can have magical importance in primitive communities), and we can take objects such as a walking stick into the bony system of the body. We have an almost unlimited number of body-images at our disposal for it is human nature to improve, alter, distort, and transfer the experience of self in role playing and for relaxation. But not all changes in the body-image are consciously initiated.

Self-initiated changes.

Many attempts are made to change the body image by decoration and alteration of the actual surface of the body. The colour of the skin may be changed by sun-bathing or cosmetics, the contours of the body may be changed by use of girdles or by alteration of hair style. More permanent changes follow from tattooing, dentistry, and plastic surgery. In primitive societies there are various forms of self-mutilation such as gashing the face and body or pegging the nose and lips. More pathetically, the young may be mutilated by their elders for religious reasons or sexual reasons as in old China where infant girls were suffered to have their insteps broken.

That we enjoy the plasticity of our body-image is conveyed in many ways. For example, there are numerous tales in folklore where individuals could assume the form of beasts or monsters such as werewolves and vampires. Children's fairy tales are full of stories where princes are bewitched as frogs and the like, and there is the classic account of Alice in Wonderland. The present popularity of "drag" or transvestism, the enduring popularity of pantomime, indicates that transformation themes are not enjoyed solely by children. The fashion trade exists entirely to satisfy the human desire to change its body image.

We enjoy this plasticity through enhancement of tactile and proprioceptive factors. For example, the rapid gyratory movements which can occur in dancing disturb the vestibulary reactions to give an illusion of lightness or freedom from gravity. For the same reason gyratory movements are adopted by religious cults - the whirling Dervishes - or as a prelude to prognostication in some primitive communities. The contact sports of Rugby and wrestling give opportunities to participants and spectators to distort their body-image in reality or imagination. The gymnast and the contortionist are of the same ilk. Drugs and alcohol provide a ready access to those wishing to experience uncontrolled changes in their body-image.

Many people have experienced with pleasure the distortions available in a fairground 'hall of mirrors'. But there are more seriously intended self-induced body distortions which have obtained in the experimental situation. These have involved the displacement or inversion of the visual field by the use of lenses placed over the eyes. In one of the earliest studies of this kind, Stratton noticed that his initial visual impressions concerning the position of his body parts upon donning lenses was at variance with the sensations he had of where those parts actually were. But gradually he revised his concept of the relationship that should exist between his visual perception of his body parts and his kinaesthetic perception of their location. He had changed one dimension of his body-image. On removing the lenses, the experience of incongruity returned until it was eventually extinguished by rebuilding the relationships in their customary form (STRATTON 1896)[281].

External-initiated changes.

In this category are the experiential effects and after-effects of vehicular motion on the body-image. Schilder's introspective description of the perception of gravity on the body incurred during vertical movement in a lift has been cited earlier (Notes to 1.0). It would be interesting to know how astronauts experience their body-image during weightlessness. In the same vein one could speculate upon the effects of acceleration. For example, does the body-image trail behind the body surface in high "G" loadings and is this in any way due to time-lag? It was also mentioned earlier (1.0) how rapid horizontal travel suddenly halted can be accompanied by sensations that our body dimensions have shrunken. The magnitude of the effect seems to be related to the perceived speed of preceding travel as well as the physical characteristics of the surroundings in which we find ourselves having halted. Perhaps this is because projection of the body-image requires effort which may not be easy to maintain in conditions of intense sensory stimulation?

Emotional changes.

Mood influences the concept of our body size and again examples have been given earlier (1.0) as to when we "swell" or "contract" in response to passing feeling states that are self-induced or promoted otherwise. Added to those remarks we might consider the manner in which we alter the penetrability of our body-image. We seem to contract and harden its surface in defence and aggression, and to expand and soften its surface in benevolence and love.

3.3 (3.3.4) THE SPATIAL IMAGE OF SELF

Morbid changes.

The presence of pain on the body leads to local distortion of the body-image at that place. The effect can persist after experience of the pain has subsided. SCHILDER (1935) has described how following severe injury to his hand in a car accident he was sensitivised to the approach of motor vehicles: (282)

> ...in the early days after the accident every approaching car seemed to involve a particular danger element which encroached into the sphere of the body, even when it was a considerable distance away.
> In other words, around the body there was a zone closely interrelated with the body-image which was in some way the extension of the body. Later on this general zone diminished in size until finally there remained only a zone around the painful hand. These experiences induced in me the conviction that the body-image is surrounded by a sphere of particular sensitiveness.
>
> (emphasis added).

Mental illness.

Changes in the body-image experienced by people with certain kinds of brain damage or with certain types of psychiatric disorder make fascinating if somewhat morbid reading. For example, individuals have been known to hallucinate themselves into trees, lose their reflection in a mirror, or see their Doppelgänger come towards them. Others have complained of radios in their teeth, that they are being manipulated by a distant machine, that they have lost part of their body, or that they have changed their sex. Examples abound in the clinical literature (e.g. LAING 1965).

One type of psychosis (disturbance of thought or mood) particularly associated with reported distortions of the body-image is schizophrenia. Schizophrenia has various forms which may or may not include paranoid reactions (experience of delusions and hallucinations)(283). Schizophrenics often have disturbed ideas concerning their body attributes. These FISHER & CLEVELAND (1968) note as occurring in four broad categories of behavioural experience. Thus persons can be distinguished by their confusion over their gender. Another group experiences feelings of body disintegration. A third group find it difficult to establish reality status; whilst the fourth group includes those who have lost the sense of their body boundaries. Members of this latter group cannot differentiate where the self ends and the outer world begins; they experience external events as though they were occurring inside themselves, whilst injury to others is experienced as injury to self[284].

It is a familiar cliché that we recognise in the descriptions of illness those symptoms we have bravely or unsuspectingly borne. CRITCHLEY (1968) has however reassured us that the body-image experience is a perfectly natural and normal one.

Para-normal experiences.

With the exception of experiments into telepathic ability the investigation of cryptaesthesia has remained outside the fringe of scientific respectability. Yet many claim to be able to discern radiated emanations around the human body which are visible as bands of colour. The colours of the "aura" as it is termed are supposed to depend on the mood and health state of the individual. In medical terminology the "aura" is a premonitory symptom of epilepsy and hysterics which is experienced as a sensation of cold air rising from some body part to the head, and interestingly accounts can be found where primitive peoples select novitiate shamen or witchdoctors from youths with demonstrated tendencies towards epilepsy. European interest in the aura can be traced from Reichenbach's "Odic force" (1840) to recent interest in para-normal experience at Oxford University. A fascinating reference to an experimental investigation of the aura which combined opportunities for voyeurism has been provided by the work of Dr.Walter J.Kilner (1847-1920) onetime of St.Thomas's Hospital, London. According to N.Blusden's "Popular dictionary of spiritualism" (London: Arco Publications,1961), Kilner developed "dicyanin dye screens" incorporated in goggles which sensitivised the eyes to perception of the aura. On removing the goggles and in gazing at naked figures against a black backcloth in subdued light observers reported seeing the figures surrounded by distinct bands of radiation. The possibility of investigating subjective space needs by this method was reluctantly discarded.

4.0 EXPERIMENT

4.0 EXPERIMENT

AIM: <u>EXPLORATION OF HUMAN APPROACH AND AVOIDANCE BEHAVIOUR</u>

4.0.1 Hypothesis.

It was decided to examine the premise that a stationary obstruction in the immediate path of a walking person would induce detour behaviour in that person which could be directly related to the specific circumstances of the confrontation and to the specific characteristics of the obstacle. It was further decided that such an obstruction should resemble an obtruding structure of the kind often encountered in passageways.

If Ss. repeatedly maintained unvarying movement patterns in their negotiation of randomly presented obstacles, such constancy would indicate evidence of firm parameters to their concept of a safe distance.

4.0.2 Apparatus.

Apparatus was constructed to examine the movements of Ss. asked to walk along a straight passageway four feet six inches wide and twenty-three feet long. The dimensions of the passageway were governed by three considerations: the maximum length was limited by the size of the laboratory available for the experiment; the minimum length was determined by the decision to place obstacles in positions where any associated detour behaviour could be well differentiated; the width of the passageway was chosen as representative of non-public circulation spaces. The walls of the passageway were built by clamping hardboard-faced flush doors (72" x 27" x 1 1/2") edge-to-edge on a boxed framework of (1") square Dexion tube (See FIGS. 23 & 24).

The obstacles comprised upper and lower sets of L.H. and R.H. detachable panels of half and quarter-passageway width (TABLE 4) which could be fastened at right-angles to the walls by means of split-hinges and a locking stay. The panels were rectangular constructed from 3/16" hardboard on a 2" x 1" timber frame. They were hung on timber posts (72" x 2 1/2" x 3/4") attached to horizontal battens fixed to the walls. (FIGS. 22,25,26,27 and 28).

The positioning of the obstacle mounting posts was varied according to the stride length of each S. From observation of unobstructed trial walks (Unobstructed Trials 1-10) it was seen convenient to present obstacles at the third and seventh pace distant from the start of each S's. walk. Three paces were necessary for the S. to gain full momentum of normal walking speed; the seventh pace was chosen because it was the maximum distance from the start which allowed completion of detour behaviour. (Obstacle mounting post positions: TABLE 3).

The height of the obstacle panels was arranged according to the elbow height of the S. under test (TABLE 4). The lower set of panels were arranged with their upper horizontal edge at elbow height so as to simulate obstructions which impede leg and lower-arm movements. The lower horizontal edge of the upper set of panels were set to the same datum to obstruct movement above the S's. waist.

All obstacles and the walls of the passageway were painted matt white before trials began. The end wall facing Ss. traversing the passageway was hung with black cloth to preclude the use of sight lines.

4.0.3 Subjects.

Three male and three female Ss. employed within the Department were tested separately at times convenient to themselves. Five Ss. were under twenty-five; one male (M2) was in his late thirties. All Ss. had normal vision without spectacles. None had suffered any past injury to limbs or trunk which impaired their locomotion. Both sexes had tall and short representatives; all had average body-build characteristics for their height. Ss. were of U.K. origin. One female (F.3) was coloured.

4.0 EXPERIMENT

OBSTACLE PANEL	QUARTER-WIDTH. (less hinge)	HALF-WIDTH (less hinge)
Upper	*11.8 x 22.0 x 1.187	*25.3 x 22.0 x 1.187
Lower	11.8 x 35.0 x 1.187	25.3 x 35.0 x 1.187

Dimensions in Inches.
*Fitted widths of panels were 13.0 and 27.0.

TABLE (2). OBSTACLE PANEL SIZES

SUBJECT No.		MEAN DISTANCE FROM START Heelmark (3)	Heelmark (7)
MALE	M.1	72.6	180.0
	M.2	85.0	212.0
	M.3	81.1	213.8
FEMALE	F.1	68.3	170.5
	F.2	67.1	173.0
	F.3	74.4	188.0

Dimensions in Inches.
Mean distances derived from Unobstructed Trials (1-10) APPENDIX 1 (TABLES 39-44).
Posts were set with near edge at Heelmark.

TABLE (3). OBSTACLE MOUNTING POST POSITIONS

SUBJECT No.		STATURE	ELBOW HEIGHT
MALE	M.1	66.7	40.9
	M.2	72.8	44.9
	M.3	72.9	45.5
FEMALE	F.1	64.2	39.8
	F.2	64.9	40.1
	F.3	68.2	41.2

Dimensions in Inches.

TABLE (4). BODY DIMENSIONS OF SUBJECTS

4.0.4 Method.

The detection of change requires a process of comparison. Detour behaviour can be detected by a frame-by-frame examination of before-and-after filmed body movements, or by reference to an accurately recorded symbolic notation of such movements. The present study required a method of recording data that was cheaper than filming and less dependent than notation procedures upon the skill and perception of the observer.

In the event, it was decided simply to observe how Ss. responded to different obstacles without regard for the anatomy of their postural movements. This was achieved by recording the footprint impressions Ss. left in an even (1/4") layer of fine damp sand spread on the floor of the passageway, (FIGS. 29-31). SMITH & SMITH (1962) noted that:

> ...there are certain advantages in recording from the sole of the feet. All the actions and interactions of the body in walking, landing, stride, take-off, postural balance, and direction of gait - are reflected in the many articulations of the base of the foot in relation to the substrate. (285)

On completion of each trial walk, measurements were taken of the distance of the centre-line of each heel and toe impression from the left-hand wall of the passageway and from the start of the walk (FIGS. 29-30); the information was recorded on specially prepared data sheets to facilitate storage on punched cards (APPENDIX 2, FIG.129). (An eventual delay in processing the data onto cards and a requirement for an early account of the experiment made it necessary to reduce all data "manually").

The modal number of footprints per trial was ten; each footprint requiring four measurements. Approximately 16,000 separate measurements were taken during the course of the whole experiment accounting for over 650 footsteps per S. Each S. took three full working days to complete the tests. Trials were in daylight supplemented by the ordinary laboratory lighting. Photoflood facilities were not used during the trials.

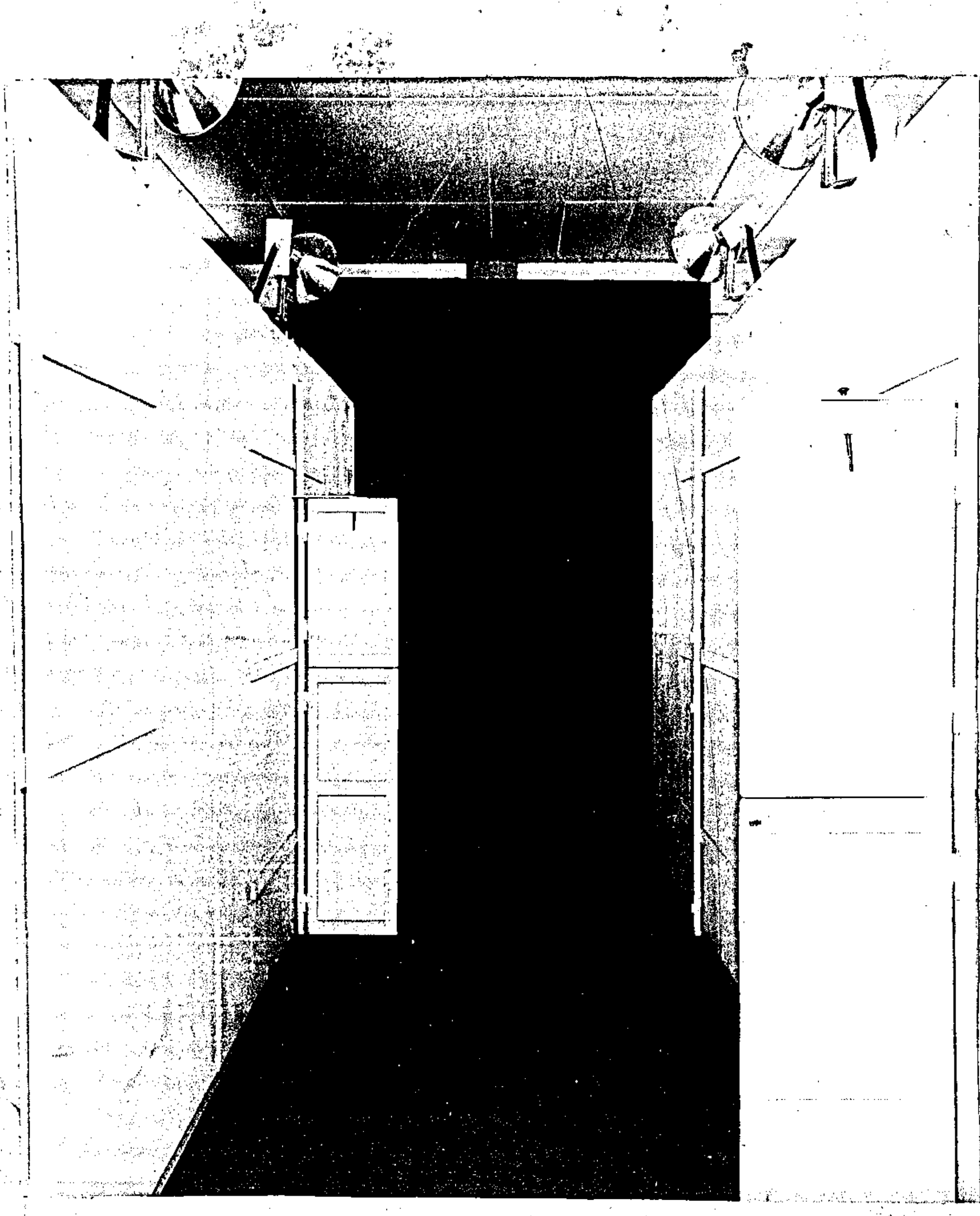


FIG.(22) SUBJECT'S VIEW OF THE PASSAGEWAY.

Narrow obstacles are shown together at typical R.H.CLOSE and L.H.DISTANT station points for comparison only.

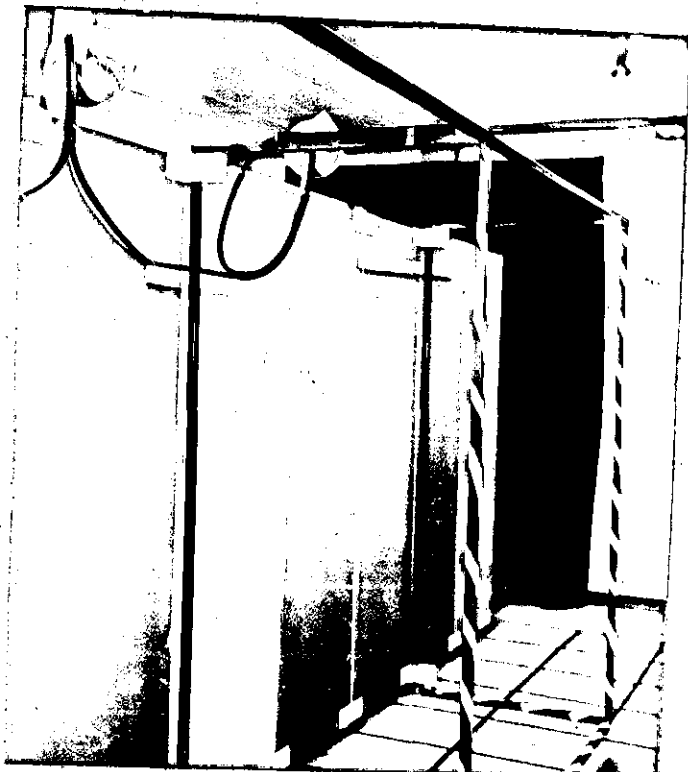


FIG. (23)

REAR VIEW OF PASSAGEWAY SHOWING SUPPORTING FRAMEWORK.

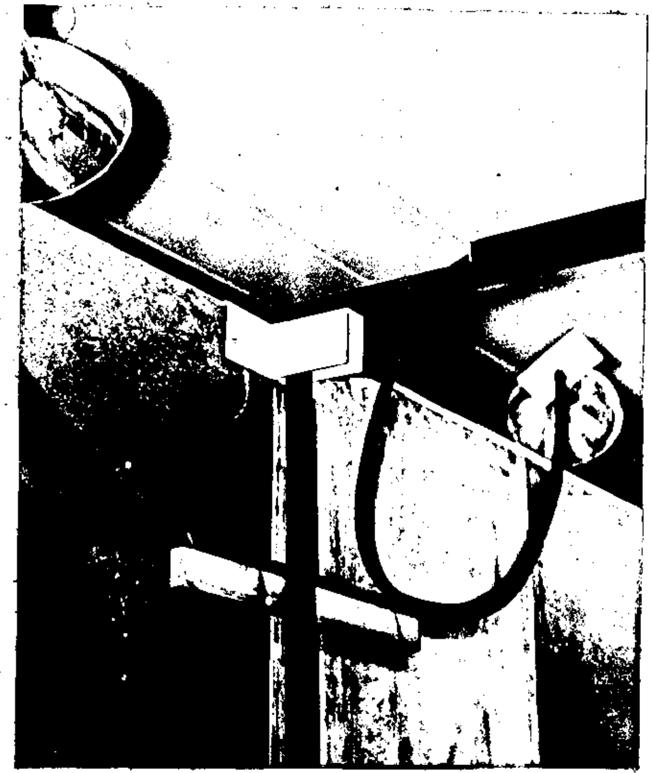
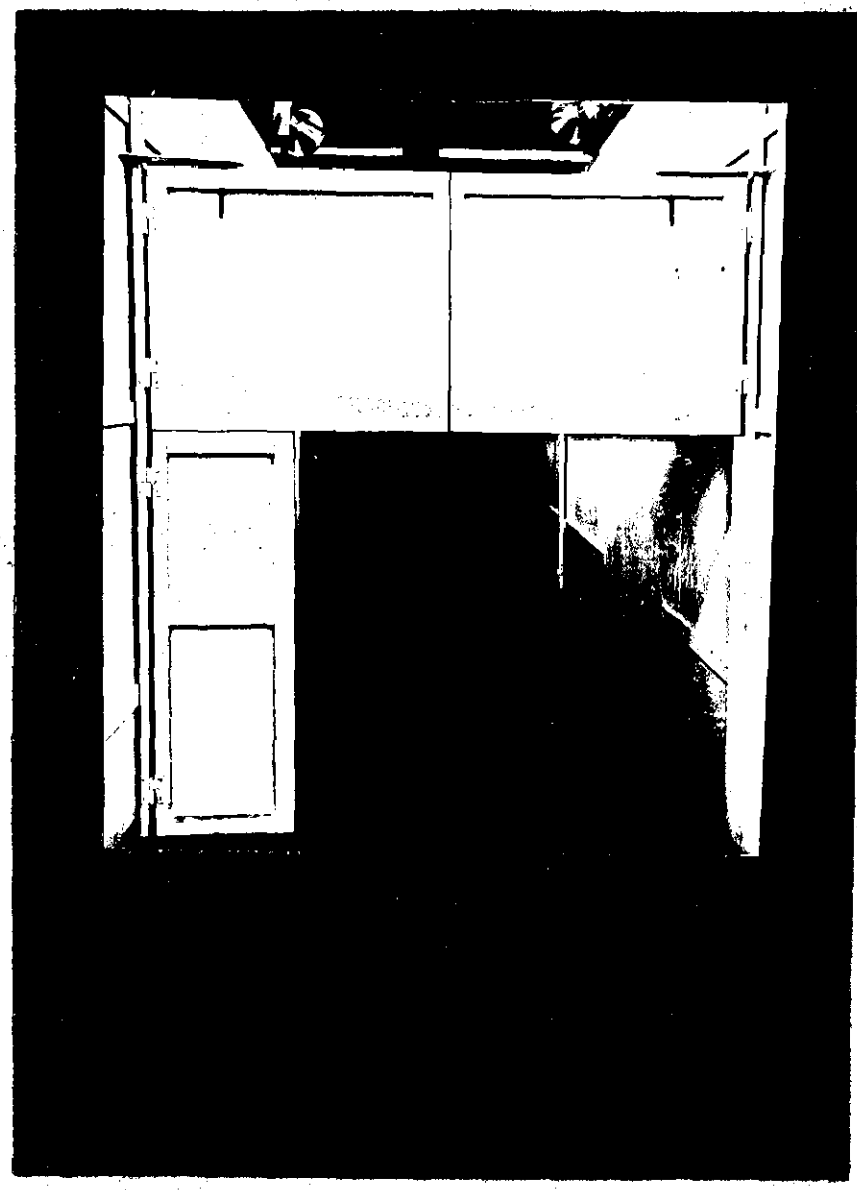


FIG. (24)

DETAIL OF WALL ASSEMBLY.



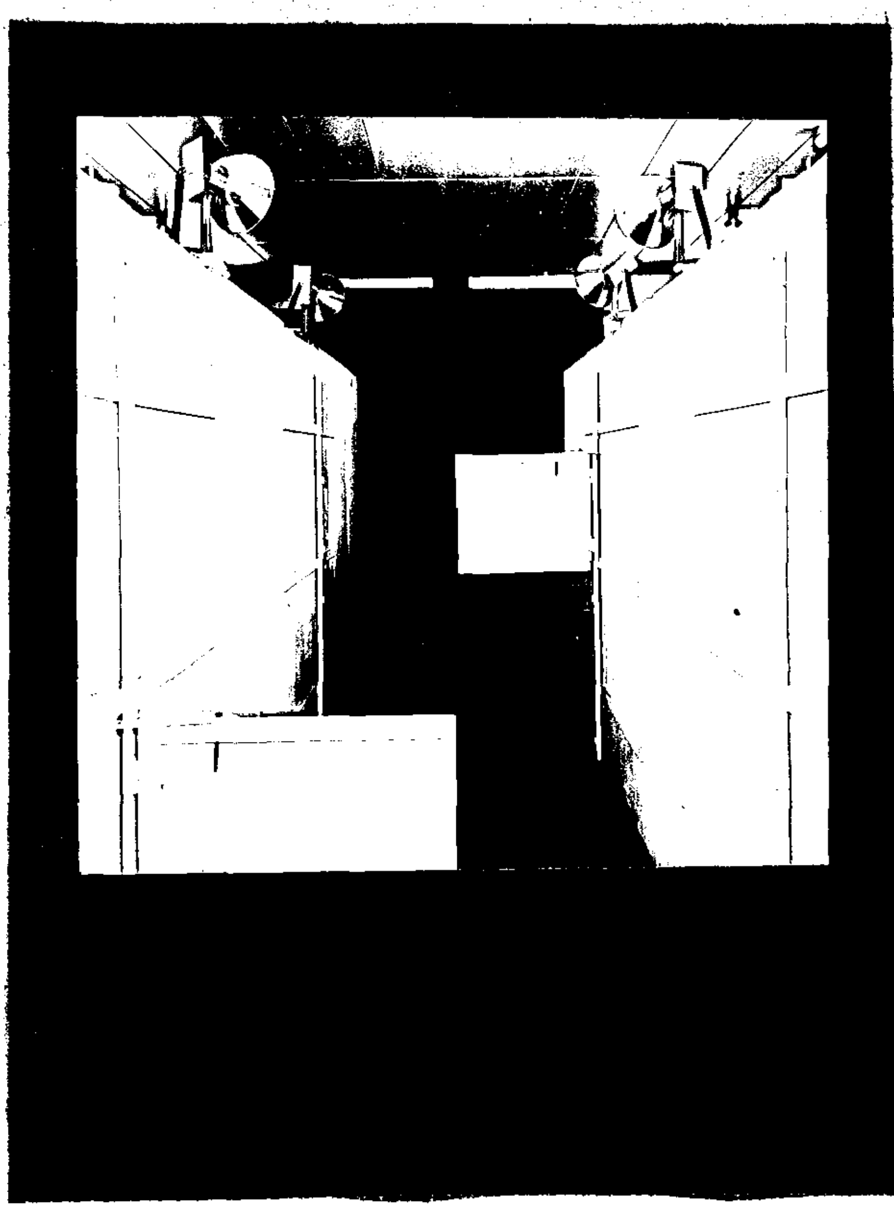


FIG.(27)

ATTACHING AN OBSTACLE PANEL
TO A TIMBER UPRIGHT.

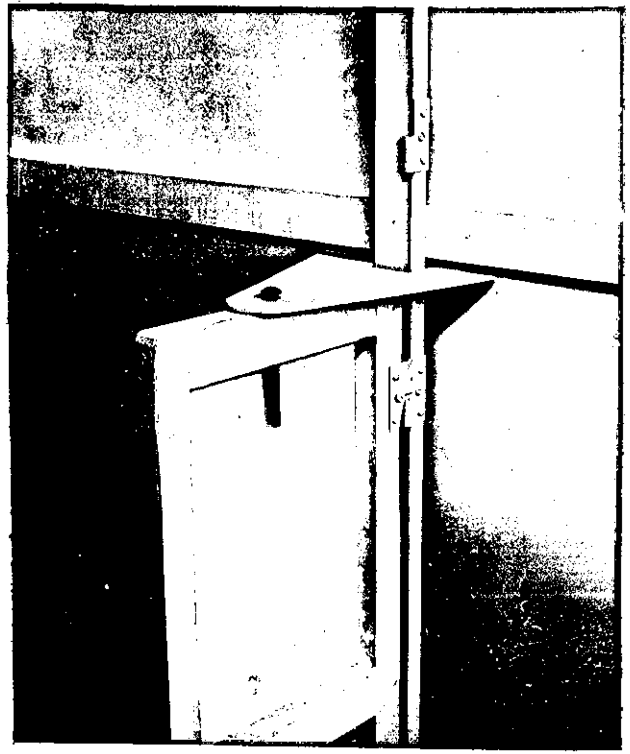


FIG.(28)

OBSTACLE PANEL LOCKED
IN POSITION.

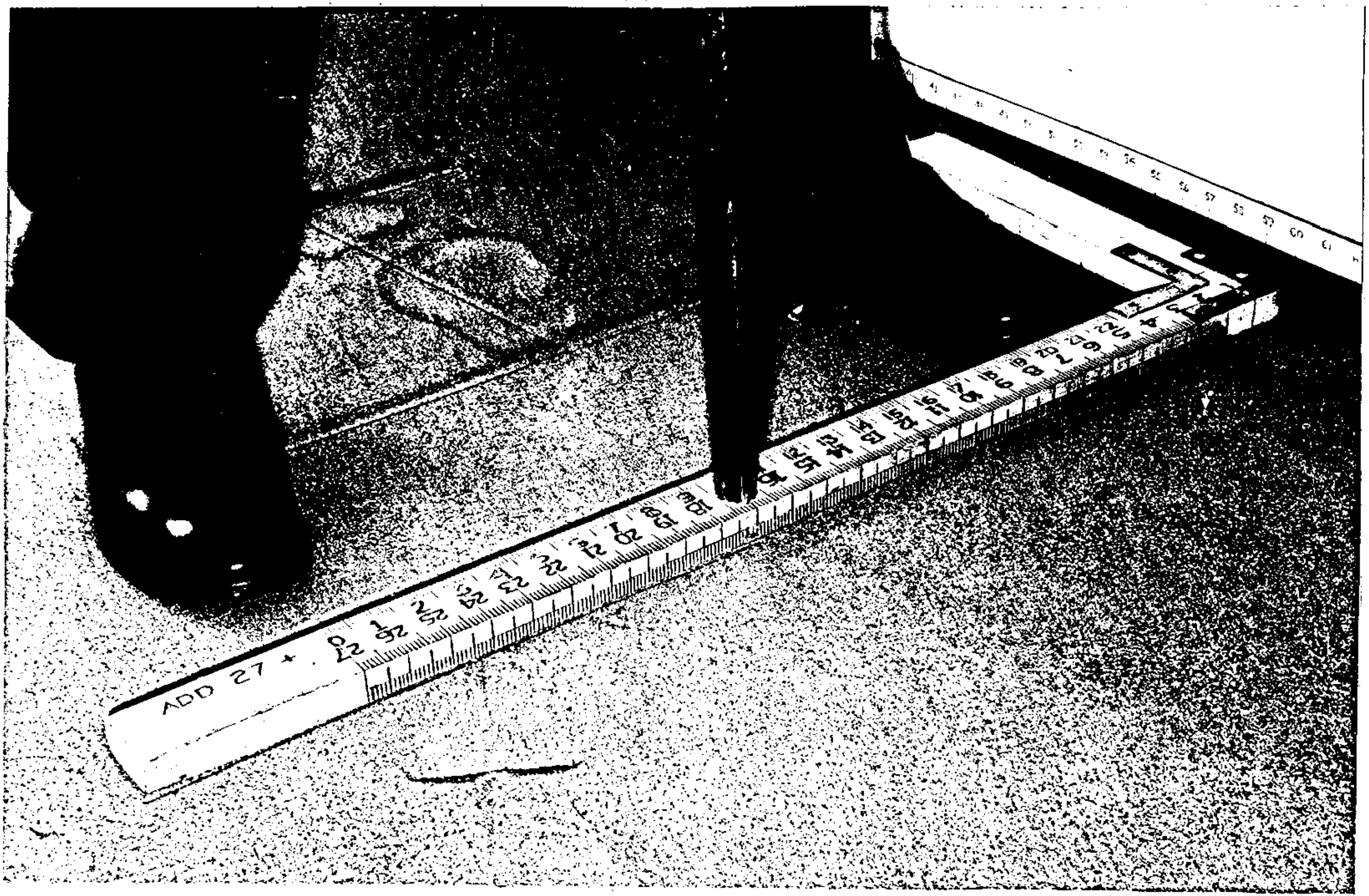


FIG.(29) MEASURING THE LOCATION OF A HEELMARK CENTRELINE FROM THE WALL SKIRTING.

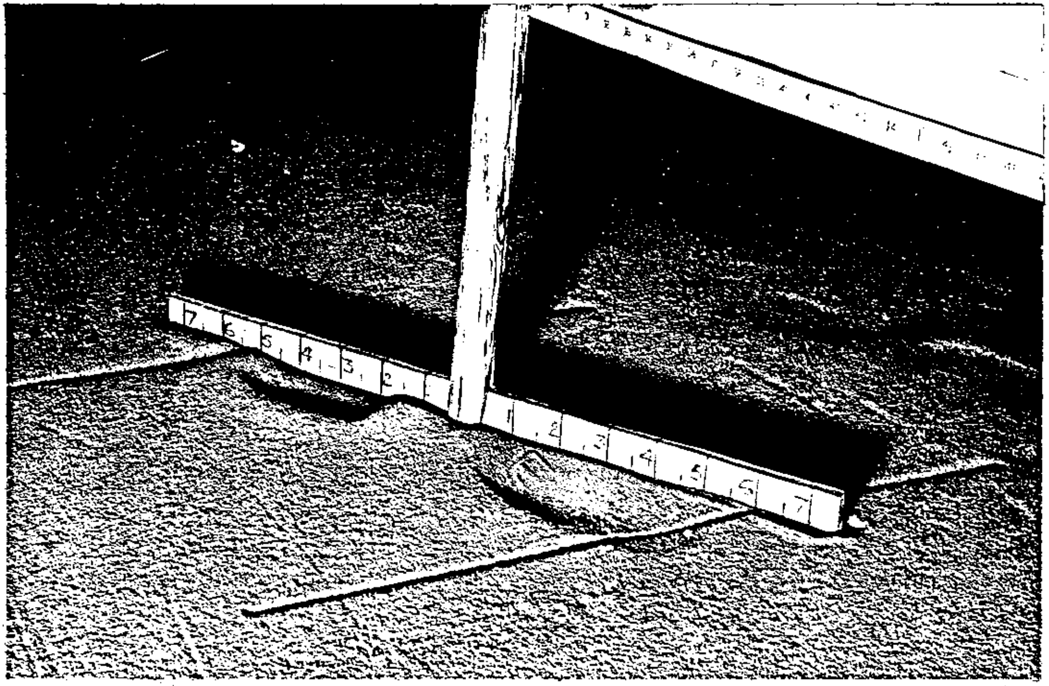


FIG.(30)

MARKING OUT A SUBJECT'S FOOTPRINT PRIOR TO MEASUREMENT.

(Inscribed marks indicate the boundaries of the heel and toe marks and the centreline of the footprint.)

FIG.(31)

LEVELLING SAND AND ERASING FOOT-PRINTS BETWEEN EACH TRIAL.

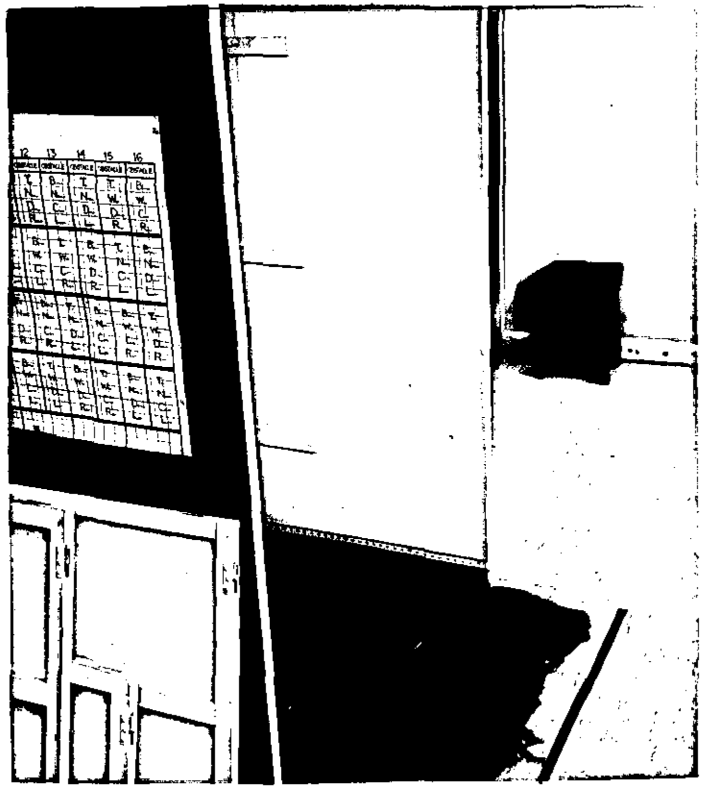
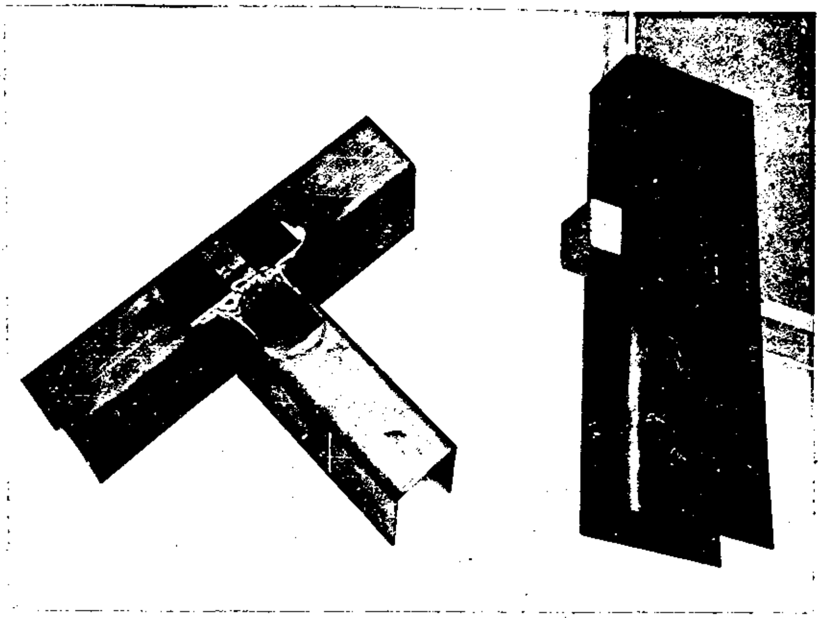


FIG.(32)

START OF PASSAGEWAY SHOWING STARTING LINE ON FLOOR.



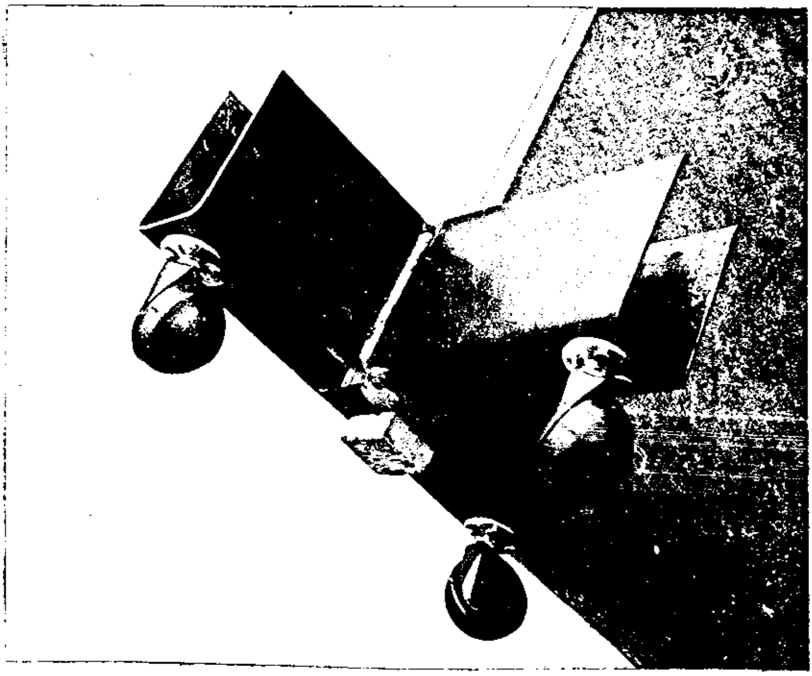


FIG.(33)
WALL CLAMPING BRACKETS (TOP & BOTTOM).

EXPERIMENT: PART I

THE UNOBSTRUCTED PASSAGEWAY

4.1 EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

The experiment was divided into two parts so that comparisons could be made between the routes taken by Ss. walking an unobstructed passageway with those taken when an obstacle was presented.

4.1.1 Procedure and instructions.

Subjects were required to traverse an empty passageway. After a few rehearsals to familiarise themselves with the sanded floor, each S. performed this ten times.

On the first five occasions, Ss. were allowed to orientate their own routes down the empty passageway (Undirected Trials 1-5); but as it was useful to know how far their footsteps would wander when they were instructed to walk down the centre of the passageway Ss. were suitably instructed after the completion of their fifth trial (Directed Trials 6-10). These were the instructions:

Undirected Trials (1-5)	In this experiment in which you have offered to help, we are interested in observing the way people walk down corridors. You can see that we have constructed a corridor, the floor of which is covered in sand. During the experiment you will be asked to toe a mark at the start of the corridor (see FIG.), and on the instruction "WALK" I want you to walk at your normal speed to the end of the corridor and then to stop on the coconut mat at the exit. There is no need to start each walk on the same foot (See footnote*). You will be asked to walk down the corridor ten times, and after you complete each walk I shall then take measurements of the footprints you will have left in the sand.
Directed Trials (6-10)	Before you start this time and on all subsequent tests, I want you to toe a mark either side of this centre-line (Experimenter demonstrates). And when I say "WALK" <u>I want you to walk down the centre of the corridor to the coconut mat</u>.

---

* Only one S. did not begin all trials on the same foot. This was of no consequence in Unobstructed Trials but such freedom complicated the analysis of footprint locations in Trials With Obstacles.

4.1 EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

4.1.2 RESULTS.

Directed and Undirected Trials.

Each S. walked ten times down the Unobstructed Passageway every walk constituting a separate Trial. Trials (1-5) were designated "Undirected" to differentiate them from "Directed" Trials (6-10) for which instructions were issued to walk down the centre of the passageway.

Measurement of Subject performance.

The heel and toe locations of all footprints ensuing from trials were obtained in the manner earlier shown in FIGS.(29) and (30), and they are reported in APPENDIX 1 (TABLES 39-44).

Preparation of data.

Two measures were derived from recorded S. performance, namely:

(a). STRIDE LENGTH

(b). DISTANCE OF FOOTPRINT FROM L.H.WALL

Stride length was calculated from the computed centres of adjacent footprints (APPENDIX 1 TABLES 27-32) and individual values are listed with Mean Stride Lengths in the RESULTS (TABLES 5-10); the distance of each footprint from the L.H. wall as measured between the nearest point on the wall skirting and the computed centre of the footprint (APPENDIX 1 TABLES 33-38) is listed with pertinent Mean Distance values in the RESULTS (TABLES 13-18). Means of Trials (1-5) and Trials (6-10) were computed separately.

Extraction of Difference Tables.

The differences between the means of Trials (1-5) and (6-10) were calculated and submitted to a statistical test for significance (RESULTS: TABLES 11 and 19).

Other data tables.

The data were further arranged to discover whether a S. took longer strides with one leg than with the other. TABLE (12) RESULTS sets out the observed differences and the data are illustrated by FIGS.(34-39).

Data to reveal the location of Ss.' footsteps about the centreline of the passageway were also prepared TABLE (20) RESULTS. The data are illustrated in FIG.(40) DISCUSSION (4.1.3).

Preparation of the data concluded with an assessment of S. error in maintaining a route along the centre of the passageway (TABLE 21). The Table is entered in DISCUSSION (4.1.3).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No. F.1

TRIALS	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
1	25.5	25.8	24.8	26.4	24.1	25.9	26.8	25.4	24.6	23.6
2	24.0	26.4	24.6	26.5	25.3	26.2	25.0	25.3	23.1	25.2
3	25.4	27.4	24.7	25.8	25.3	27.1	25.5	25.8	25.6	24.4
4	25.3	28.0	24.0	25.7	25.8	25.6	26.9	25.7	25.8	24.5
5	27.7	27.2	27.2	25.2	26.1	25.8	25.5	24.6	24.2	26.5
MEAN 1-5	25.5	27.0	25.1	25.9	25.3	26.0	26.0	25.3	24.7	24.6
6	27.7	25.1	25.6	24.5	25.5	24.8	27.3	25.7	26.7	24.6
7	26.2	27.5	26.1	26.5	26.4	28.0	25.4	27.5	26.5	24.1
8	25.1	25.7	26.4	25.7	25.0	26.8	24.4	26.2	25.6	25.8
9	24.7	26.2	23.5	25.6	25.3	25.7	25.4	25.3	23.3	25.2
10	26.4	25.4	27.2	26.0	24.6	26.7	25.3	26.5	24.1	26.9
MEAN 6-10	26.0	26.0	25.7	25.7	25.3	26.5	25.5	26.3	25.2	25.3

Dimensions in Inches. All trials began on right foot.
For data of Heel & Toe locations see APPENDIX 1 (TABLE 39).
For mean distance of footprint locations from start see APPENDIX 1 (TABLE 27).

TRIALS	OVERALL MEAN STRIDE LENGTH Left foot forward	Right foot forward
(1-5)	25.76	25.32
(6-10)	25.96	25.54

For comparison of overall mean differences between Ss.left and right foot strides see RESULTS (TABLE 12).

TRIALS	DIFFERENCES (D) IN MEAN STRIDE LENGTH (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	26.0	26.0	25.7	25.7	25.3	26.5	25.5	26.3	25.2	25.3
(1-5)	25.5	27.0	25.1	25.9	25.3	26.0	26.0	25.3	24.7	24.6
(D)	+0.5	-1.0	+0.6	-0.2	0	+0.5	-0.5	+1.0	+0.5	+0.7

For statistical significance of Differences (D) between Means see RESULTS (TABLE 11).
For test of significance of Differemces (D) see calculations APPENDIX 1: (TABLE 45).

TABLE (5).MEAN STRIDE LENGTH FROM START IN UNOBSTRUCTED PASSAGEWAY. (F.1).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No. F.2

	FOOTSTEP SEQUENCE									
TRIALS	1	2	3	4	5	6	7	8	9	10
1	21.9	24.6	22.2	25.3	22.7	24.3	23.2	25.5	24.0	25.3
2	24.4	23.2	23.7	26.1	24.1	24.6	23.6	24.7	24.5	25.3
3	25.0	27.2	25.0	26.4	25.3	26.4	25.7	26.3	31.4	22.2
4	26.3	26.1	26.3	28.5	24.7	28.9	26.9	29.4	24.8	26.3
5	23.9	26.6	25.3	28.7	25.7	26.5	26.7	25.6	25.0	27.8
MEAN 1-5	24.3	25.5	24.5	27.0	24.5	26.2	25.2	26.3	25.9	25.4
6	24.8	26.5	25.7	26.2	25.7	28.0	25.3	26.7	26.5	28.7
7	25.4	26.6	25.3	27.9	26.5	26.3	26.0	27.8	27.2	27.2
8	29.5	28.0	25.4	28.1	26.7	30.6	27.3	28.3	26.6	23.5
9	23.8	28.0	25.0	28.6	25.8	27.1	27.2	27.9	26.4	25.2
10	24.9	29.3	26.5	28.5	27.1	29.7	25.7	26.6	27.0	26.2
MEAN 6-10	25.7	27.7	25.5	27.9	26.4	28.3	26.3	27.5	26.7	26.2

Dimensions in Inches. All trials began on right foot.
For data of Heel & Toe locations see APPENDIX 1(TABLE 40).
For mean distance of footprint locations from start see APPENDIX 1 (TABLE 28).

TRIALS	OVERALL MEAN STRIDE LENGTH Left foot forward	Right foot forward
(1-5)	26.04	24.88
(6-10)	27.50	26.12

For comparison of overall mean differences between Ss.left and right foot strides see RESULTS (TABLE 12).

	DIFFERENCES (D) IN MEAN STRIDE LENGTH (Directed minus Undirected Trials)									
TRIALS	1	2	3	4	5	6	7	8	9	10
(6-10)	25.7	27.7	25.5	27.9	26.4	28.3	26.3	27.5	26.7	26.2
(1-5)	24.3	25.5	24.5	27.0	24.5	26.2	25.2	26.3	25.9	25.4
(D)	+1.4	+2.2	+1.0	+0.9	+1.9	+2.1	+1.1	+1.2	+0.8	+0.8

For statistical significance of Differences (D) between Means see RESULTS (TABLE 11).
For test of significance of Differences (D) see calculations APPENDIX 1: (TABLE 45).

TABLE (6).MEAN STRIDE LENGTH FROM START IN UNOBSTRUCTED PASSAGEWAY. (F.2).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No.F.3

TRIALS	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
1	28.2	28.2	29.3	28.8	28.2	27.4	27.7	27.8	28.5	-
2	28.0	28.8	27.4	29.0	28.9	28.2	28.1	28.3	26.8	-
3	30.6	29.0	29.7	28.5	29.2	28.6	28.8	28.5	28.7	-
4	27.9	26.9	29.1	28.5	28.3	28.1	28.1	26.7	27.3	-
5	27.6	27.2	28.6	28.7	27.8	27.9	26.9	27.3	26.0	-
MEAN 1-5	28.5	28.0	28.8	28.7	28.5	28.0	27.9	27.8	27.4	-
6	26.3	27.7	28.2	26.9	28.4	27.6	27.4	28.5	26.5	-
7	27.8	28.4	27.8	27.9	33.4	23.4	28.8	27.2	27.3	-
8	28.0	28.3	29.2	27.9	29.1	28.4	28.2	27.7	27.8	-
9	27.9	28.5	28.3	29.6	28.2	28.6	28.4	28.6	27.5	-
10	24.8	28.3	28.8	28.6	29.9	28.6	28.6	28.6	27.5	-
MEAN 6-10	27.0	28.2	28.5	28.1	29.8	27.4	28.2	28.2	27.3	-

Dimensions in Inches. All trials began on right foot.
For data of Heel & Toe locations see APPENDIX 1 (TABLE 41).
For mean distance of footprint locations from start see APPENDIX 1 (TABLE 29).

TRIALS	OVERALL MEAN STRIDE LENGTH Left foot forward	Right foot forward
(1-5)	28.12	28.22
(6-10)	27.97	28.16

For comparison of overall mean differences between Ss.left and right foot strides see RESULTS (TABLE 12).

TRIALS	DIFFERENCES (D) IN MEAN STRIDE LENGTH (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	27.0	28.2	28.5	28.1	29.8	27.4	28.2	28.2	27.3	-
(1-5)	28.5	28.0	28.8	28.7	28.5	28.0	27.9	27.8	27.4	-
(D)	-1.5	+0.2	-0.3	-0.6	+1.3	-0.6	+0.3	+0.4	-0.1	-

For statistical significance of Differences (D) between Means see RESULTS (TABLE 11).
For test of significance of Differences (D) see calculations APPENDIX 1: (TABLE 45).

TABLE (7).MEAN STRIDE LENGTH FROM START IN UNOBSTRUCTED PASSAGEWAY. (F.3).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No. M.1

TRIALS	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
1	27.8	26.5	28.6	27.2	27.3	25.7	26.0	27.0	19.9	30.2
2	30.3	27.3	28.8	27.5	26.8	26.7	26.4	27.5	25.6	25.3
3	27.7	27.7	28.1	27.2	26.8	26.2	27.9	25.7	24.5	24.3
4	30.4	26.5	28.0	26.4	26.9	27.7	25.9	23.8	26.3	25.7
5	27.8	26.9	27.0	27.5	27.4	26.8	27.9	27.4	25.8	25.6
MEAN 1-5	29.0	26.8	28.1	27.1	27.1	26.6	26.8	26.3	24.4	26.2
6	27.5	24.9	28.4	25.5	28.1	27.2	27.5	25.1	26.0	25.8
7	28.1	26.0	29.0	26.5	26.8	24.6	28.2	26.0	26.7	24.1
8	26.6	26.5	28.3	27.8	27.6	24.9	27.2	25.5	25.3	27.8
9	28.9	25.5	26.6	26.2	26.4	26.2	26.7	25.5	25.8	25.8
10	27.7	26.5	27.7	26.2	28.3	24.7	29.5	25.9	27.3	25.7
MEAN 6-10	27.8	25.9	28.0	26.5	27.4	25.2	27.9	25.6	26.2	25.8

Dimensions in Inches. All trials began on left foot.
For data of Heel & Toe locations see APPENDIX 1 (TABLE 42).
For mean distance of footprint locations from start see APPENDIX 1 (TABLE 30).

TRIALS	OVERALL MEAN STRIDE LENGTH Left foot forward	Right foot forward
(1-5)	27.08	26.6
(6-10)	27.46	25.8

For comparison of overall mean differences between Ss.left and right foot strides see RESULTS (TABLE 12).

TRIALS	DIFFERENCES (D) IN MEAN STRIDE LENGTH (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	27.8	25.9	28.0	26.5	27.4	25.2	27.9	25.6	26.2	25.8
(1-5)	29.0	26.8	28.1	27.1	27.1	26.6	26.8	26.3	24.4	26.2
(D)	-1.2	-0.9	-0.1	-0.6	+0.3	-1.4	+1.1	-0.7	+1.8	-0.4

For statistical significance of Differences (D) between Means see RESULTS (TABLE 11).
For test of significance of Differences (D) see calculations APPENDIX 1: (TABLE 46).

TABLE (8).MEAN STRIDE LENGTH FROM START IN UNOBSTRUCTED PASSAGEWAY. (M.1)

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No. M.2

TRIALS	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
1	28.1	28.1	30.4	28.0	30.0	28.1	30.3	26.5	-	-
2*	30.8	31.7	29.6	31.1	28.1	31.2	29.1	30.3	-	-
3	32.7	31.8	32.4	31.5	31.9	31.9	31.9	32.5	-	-
4*	29.9	33.6	30.5	33.3	30.3	32.8	28.9	33.5	-	-
5*	31.7	34.2	29.2	32.6	30.4	31.8	31.0	33.7	-	-
MEAN 1-5	30.6	31.9	30.4	31.3	30.1	31.2	30.3	31.3	-	-
6	32.9	31.1	33.6	32.1	31.8	32.2	32.5	33.0	-	-
7	37.6	30.0	33.8	33.6	33.5	33.0	33.7	31.6	-	-
8	32.6	31.1	33.8	30.6	33.0	29.3	33.3	31.2	-	-
9	34.9	32.6	29.9	37.2	34.6	29.9	34.1	28.8	-	-
10	34.9	32.8	30.7	36.8	31.6	35.8	33.9	31.5	-	-
MEAN 6-10	34.6	31.5	32.4	34.0	32.9	32.1	33.5	31.2	-	-

Dimensions in Inches.
*Trials 2,4 & 5 began on right foot,remainder began on left.
For data of Heel & Toe locations see APPENDIX 1 (TABLE 43).
For mean distance of footprint locations from start see APPENDIX 1 (TABLE 31).

TRIALS	OVERALL MEAN STRIDE LENGTH Left foot forward	Right foot forward
(1-5)	31.87	29.89
(6-10)	33.35	32.20

For comparison of S.performance see RESULTS (TABLE 12).

TRIALS	DIFFERENCES (D) IN MEAN STRIDE LENGTH (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	34.6	31.5	32.4	34.0	32.9	32.1	33.5	31.2	-	-
(1-5)	30.6	31.9	30.4	31.3	30.1	31.2	30.3	31.3	-	-
(D)	+4.0	-0.4	+2.0	+2.7	+2.8	+0.9	+3.2	-0.1	-	-

For statistical significance of Differences (D) between Means see RESULTS (TABLE 11).
For test of significance of Differences (D) see calculations APPENDIX 1: (TABLE 46).

TABLE (9).MEAN STRIDE LENGTH FROM START IN UNOBSTRUCTED PASSAGEWAY. (M.2)

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No.M.3

TRIALS	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
1	29.8	32.9	33.5	33.0	33.8	33.1	32.6	31.9	-	-
2	28.9	29.4	31.6	31.5	31.4	34.3	33.1	34.5	-	-
3	30.2	33.1	32.8	33.9	32.5	33.6	33.2	33.9	-	-
4	28.5	30.6	33.2	33.8	33.4	35.4	32.6	34.4	-	-
5	30.6	33.4	31.9	32.4	33.3	33.0	32.2	30.5	-	-
MEAN 1-5	29.6	31.9	32.6	32.9	32.9	33.9	32.7	33.0	-	-
6	26.0	31.9	33.0	32.5	33.1	33.7	33.4	32.2	-	-
7	27.5	30.7	32.7	32.5	31.9	32.5	31.6	32.2	-	-
8	29.1	31.7	34.1	33.6	35.6	34.4	33.7	31.4	-	-
9	26.9	30.2	33.9	31.3	34.7	34.2	34.4	33.3	-	-
10	28.4	31.9	32.6	32.4	33.5	31.8	32.9	32.5	-	-
MEAN 6-10	27.6	31.3	33.2	32.5	33.7	33.4	33.2	32.3	-	-

Dimensions in Inches. All trials began on left foot.
For data of Heel & Toe locations see APPENDIX 1 (TABLE 44).
For mean distance of footprint locations from start see APPENDIX 1 (TABLE 32).

TRIALS	OVERALL MEAN STRIDE LENGTH Left foot forward	Right foot forward
(1-5)	31.95	32.92
(6-10)	31.92	32.37

For comparison of overall mean differences between Ss.left and right foot strides see RESULTS (TABLE 12).

TRIALS	DIFFERENCES (D) IN MEAN STRIDE LENGTH (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	27.6	31.3	33.2	32.5	33.7	33.4	33.2	32.3	-	-
(1-5)	29.6	31.9	32.6	32.9	32.9	33.9	32.7	33.0	-	-
(D)	-2.0	-0.6	+0.6	-0.4	+0.8	-0.5	+0.5	-0.7	-	-

For statistical significance of Differences (D) between Means see RESULTS (TABLE 11).
For test of significance of Differences (D) see calculations APPENDIX 1 : (TABLE 46).

TABLE (10). MEAN STRIDE LENGTH FROM START IN UNOBSTRUCTED PASSAGEWAY. (M.3)

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

TEST OF SIGNIFICANCE OF DIFFERENCES BETWEEN MEANS OF TWO CORRELATED SAMPLES.

Sample (1): Means of Undirected Trials (1-5)
Sample (2): Means of Directed Trials (6-10)

Differences (D): Sample (1) from Sample (2).

For method of calculating t-ratio see APPENDIX 1 (TABLES 45 & 46).

STRIDE	DIFFERENCES (D) IN MEAN STRIDE LENGTH (Ins.)					
	Females			Males		
	F.1	F.2	F.3	M.1	M.2	M.3
1	+0.5	+1.4	-1.5	-1.2	+4.0	-2.0
2	-1.0	+2.2	+0.2	-0.9	-0.4	-0.6
3	+0.6	+1.0	-0.3	-0.1	+2.0	+0.6
4	-0.2	+0.9	-0.6	-0.6	+2.7	-0.4
5	0	+1.9	+1.3	+0.3	+2.8	+0.8
6	+0.5	+2.1	-0.6	-1.4	+0.9	-0.5
7	-0.5	+1.1	+0.3	+1.1	+3.2	+0.5
8	+1.0	+1.2	+0.4	-0.7	-0.1	-0.7
9	+0.5	+0.8	-0.1	+1.8	-	-
10	+0.7	+0.8	-	-0.4	-	-
t-ratio	1.073	7.969	0.3810	0.6522	3.309	0.8982
d.f.	9	9	8	9	7	7

CRITICAL VALUES OF "t"

Degrees of Freedom	Level of significance for 2-tailed test					
	0.20	0.10	0.05	0.02	0.01	0.001
7	1.415	1.895	2.365	2.998	3.499	5.405
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781

TABLE (11).STATISTICAL SIGNIFICANCE OF DIFFERENCES BETWEEN MEAN FOOTPRINT LOCATIONS IN DIRECTED AND UNDIRECTED TRIALS. (MEAN STRIDE LENGTH).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Ss.	TRIALS	OVERALL MEAN STRIDE LENGTH Left foot leading(L)	Right foot leading(R)	DIFFERENCES BETWEEN FEET (L) minus (R)
F.1	(6-10)	25.96	25.54	+0.42
	(1-5)	25.76	25.32	+0.44
DIFFERENCES BETWEEN TRIALS		+0.20	+0.22	-0.02
F.2	(6-10)	27.50	26.12	+1.38
	(1-5)	26.04	24.88	+1.16
DIFFERENCES BETWEEN TRIALS		+1.46	+1.24	+0.22
F.3	(6-10)	27.97	28.16	-0.19
	(1-5)	28.12	28.22	-0.10
DIFFERENCES BETWEEN TRIALS		-0.15	-0.06	-0.09
M.1	(6-10)	27.46	25.80	+1.66
	(1-5)	27.08	26.60	+0.48
DIFFERENCES BETWEEN TRIALS		+0.38	-0.80	+1.18
M.2	(6-10)	33.35	32.20	+1.15
	(1-5)	31.87	29.89	+1.98
DIFFERENCES BETWEEN TRIALS		+1.48	+2.31	-0.83
M.3	(6-10)	31.92	32.37	-0.45
	(1-5)	31.95	32.92	-0.97
DIFFERENCES BETWEEN TRIALS		-0.03	-0.55	+0.52

Dimensions in Inches.

For data of individual mean stride lengths see RESULTS (TABLES 5-10).

TABLE (12). DIFFERENCES BETWEEN OVERALL MEAN STRIDE LENGTHS IN UNOBSTRUCTED PASSAGEWAY.

EXPERIMENT Pt.1 THE UNOBSTRUCTED PASSAGEWAY RESULTS

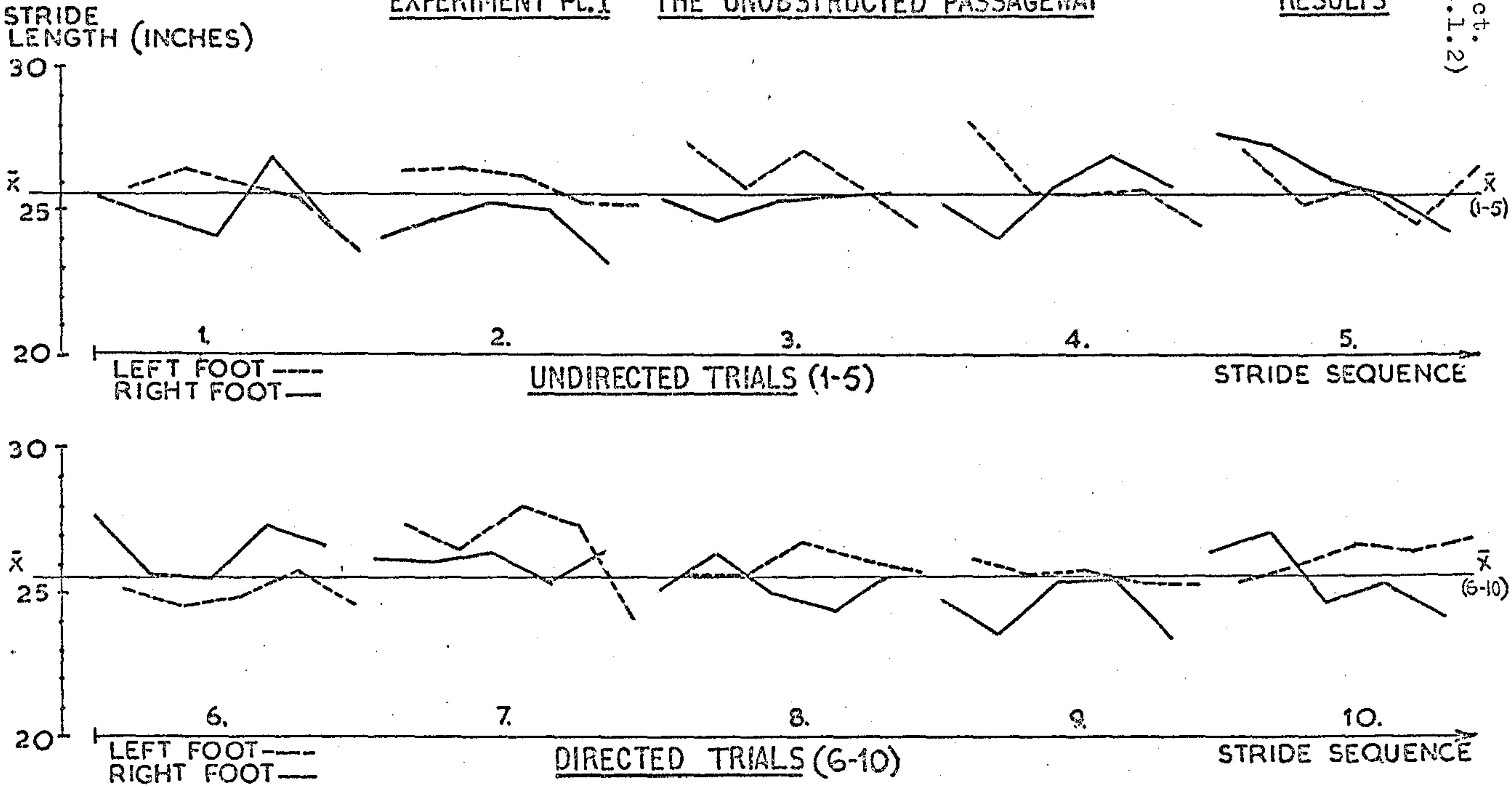


FIG.(34) INDIVIDUAL STRIDE LENGTHS RELATED TO LEADING FOOT (SUBJECT F.1)

EXPERIMENT Pt.1 THE UNOBSTRUCTED PASSAGEWAY RESULTS

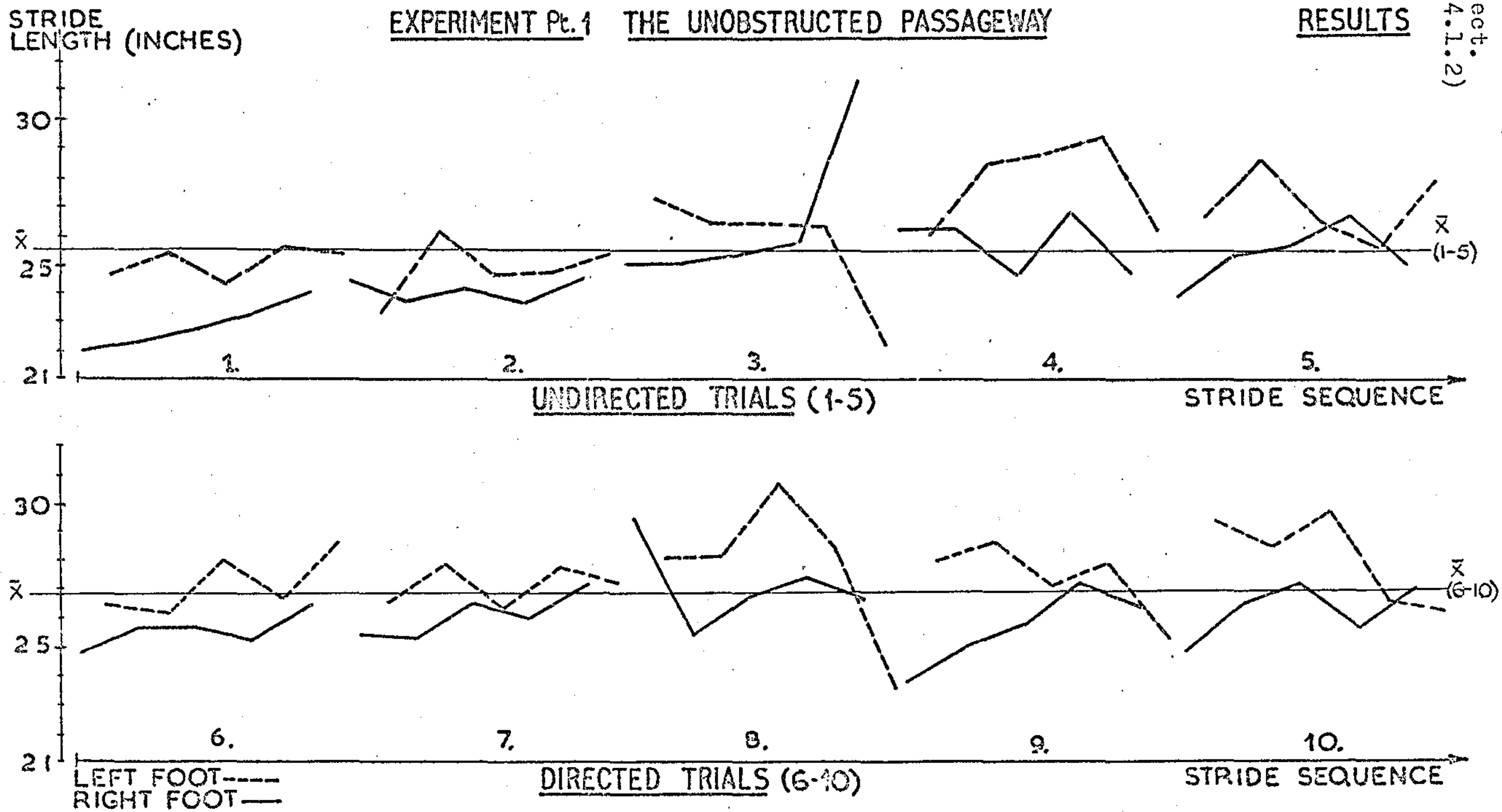


FIG.(35) INDIVIDUAL STRIDE LENGTHS RELATED TO LEADING FOOT (SUBJECT F.2)

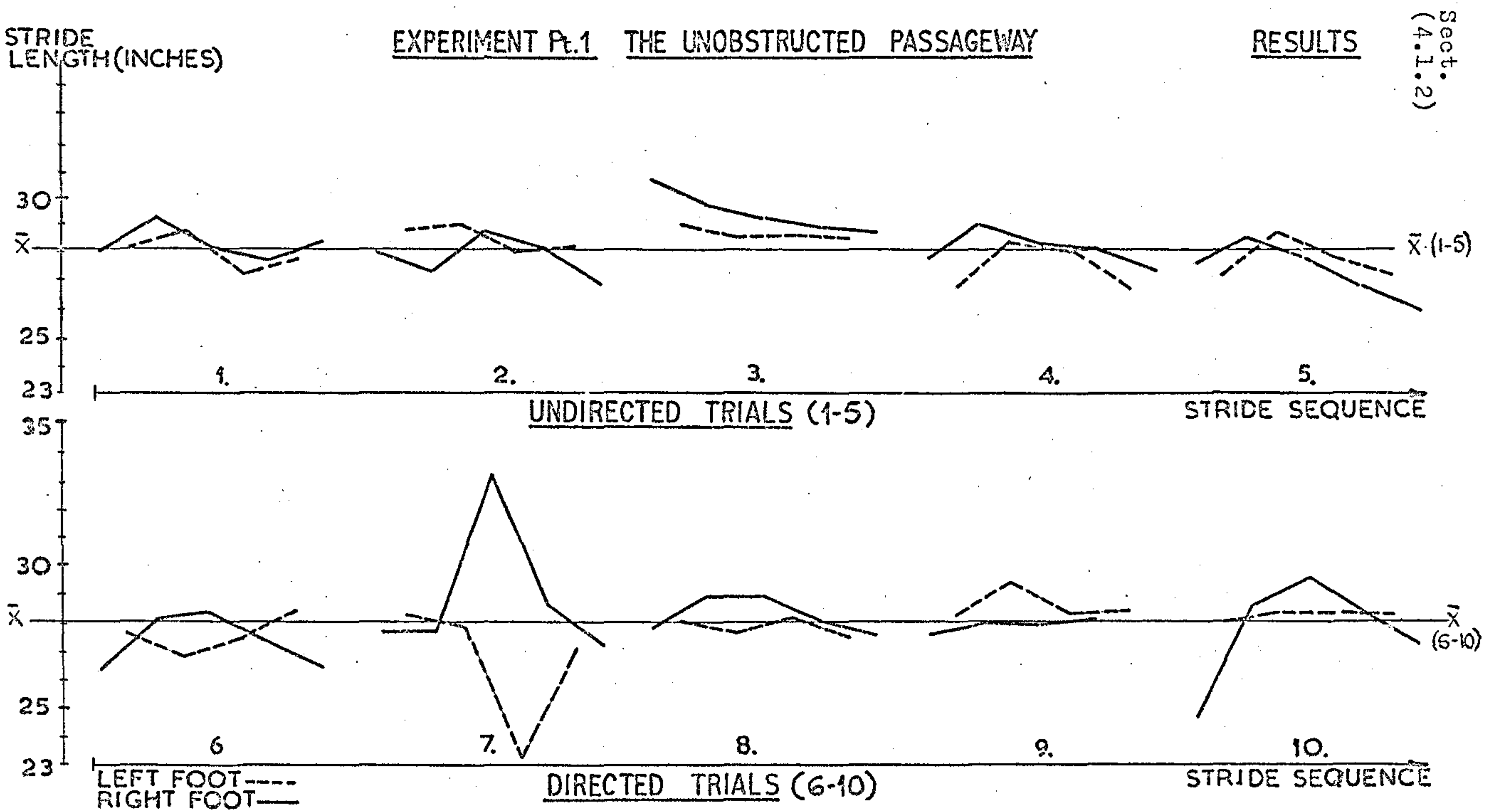


FIG.(36) INDIVIDUAL STRIDE LENGTHS RELATED TO LEADING FOOT (SUBJECT F.3)

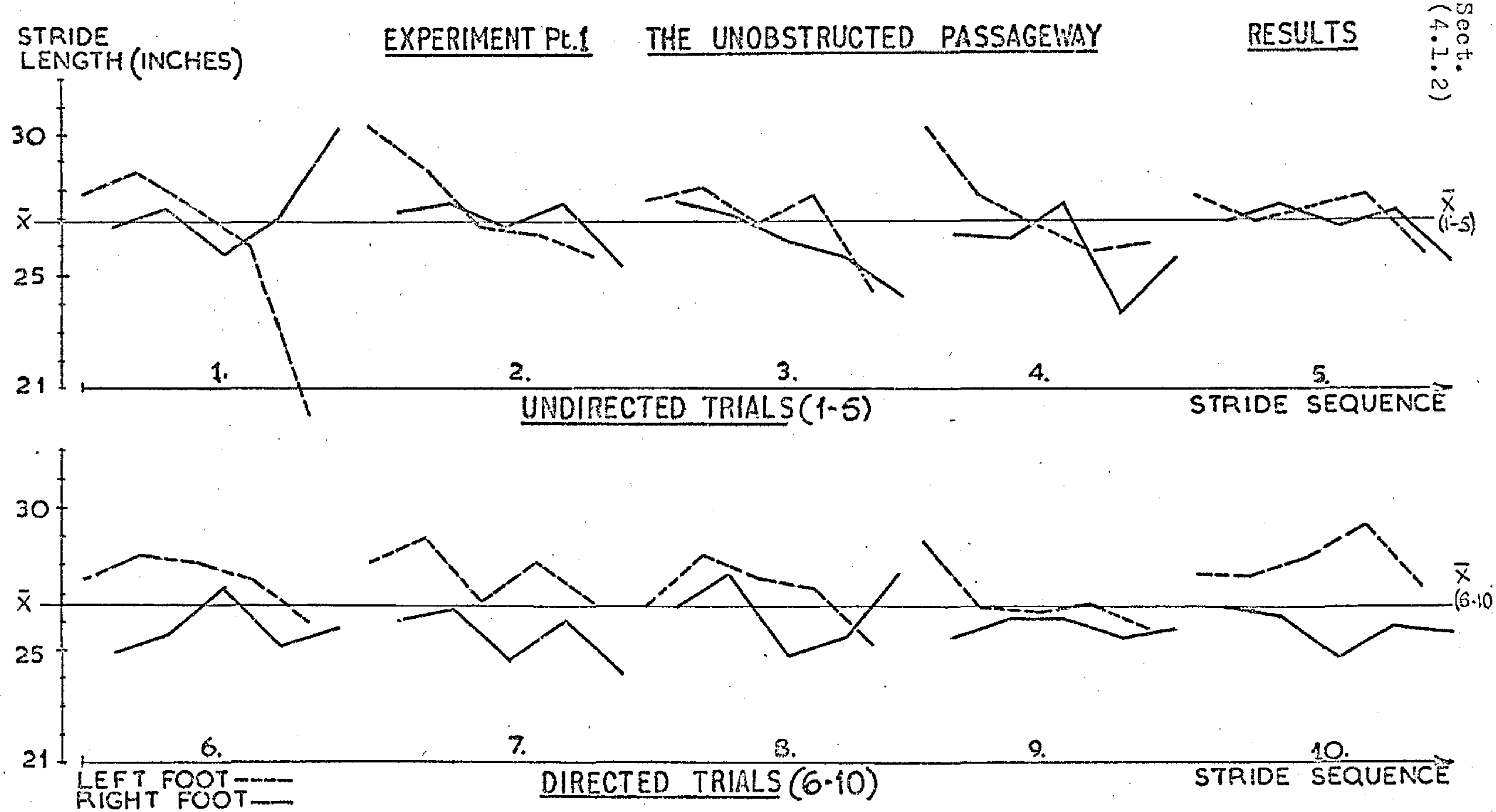


FIG.(37) INDIVIDUAL STRIDE LENGTHS RELATED TO LEADING FOOT (SUBJECT M.I)

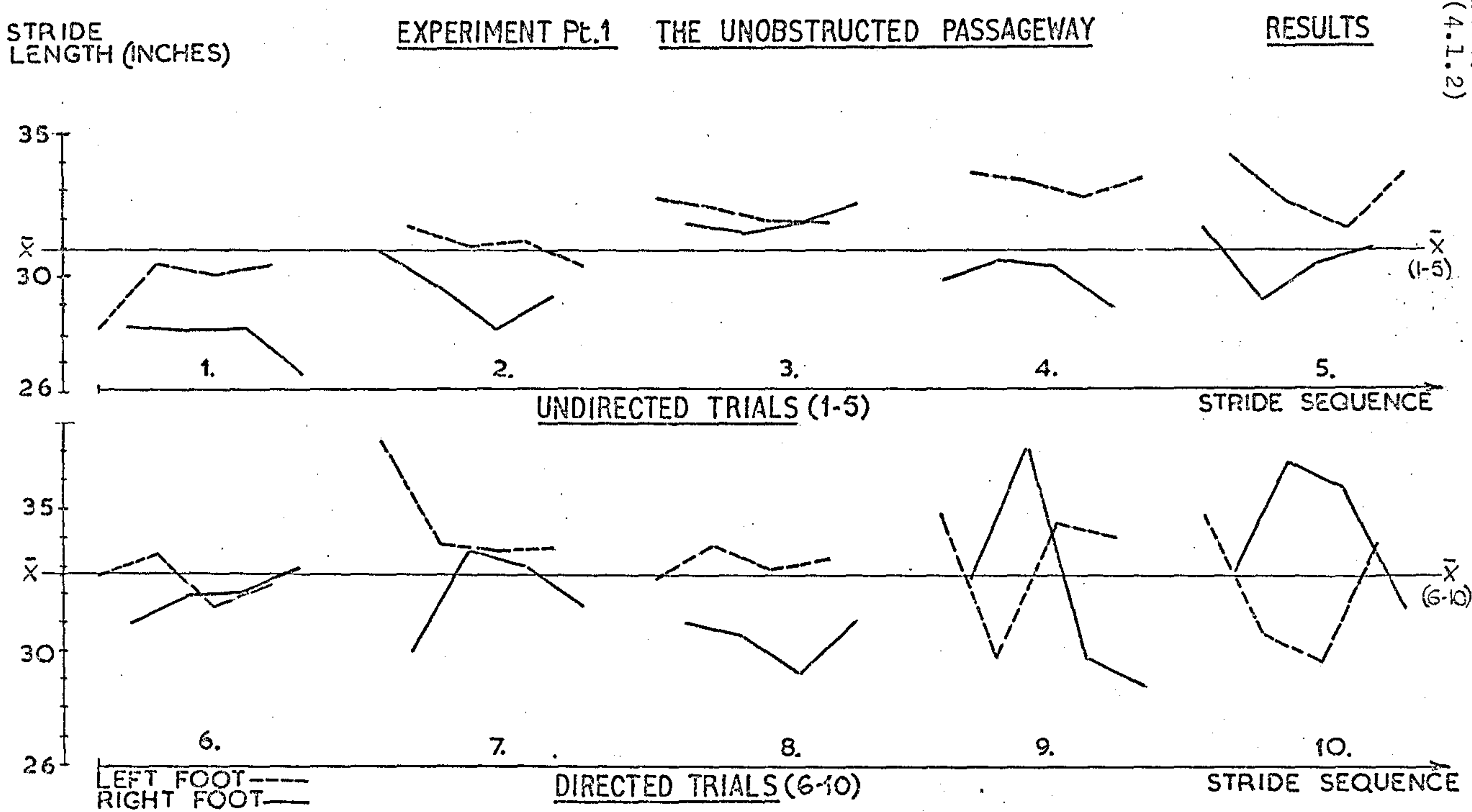


FIG. (38) INDIVIDUAL STRIDE LENGTHS RELATED TO LEADING FOOT (SUBJECT M.2)

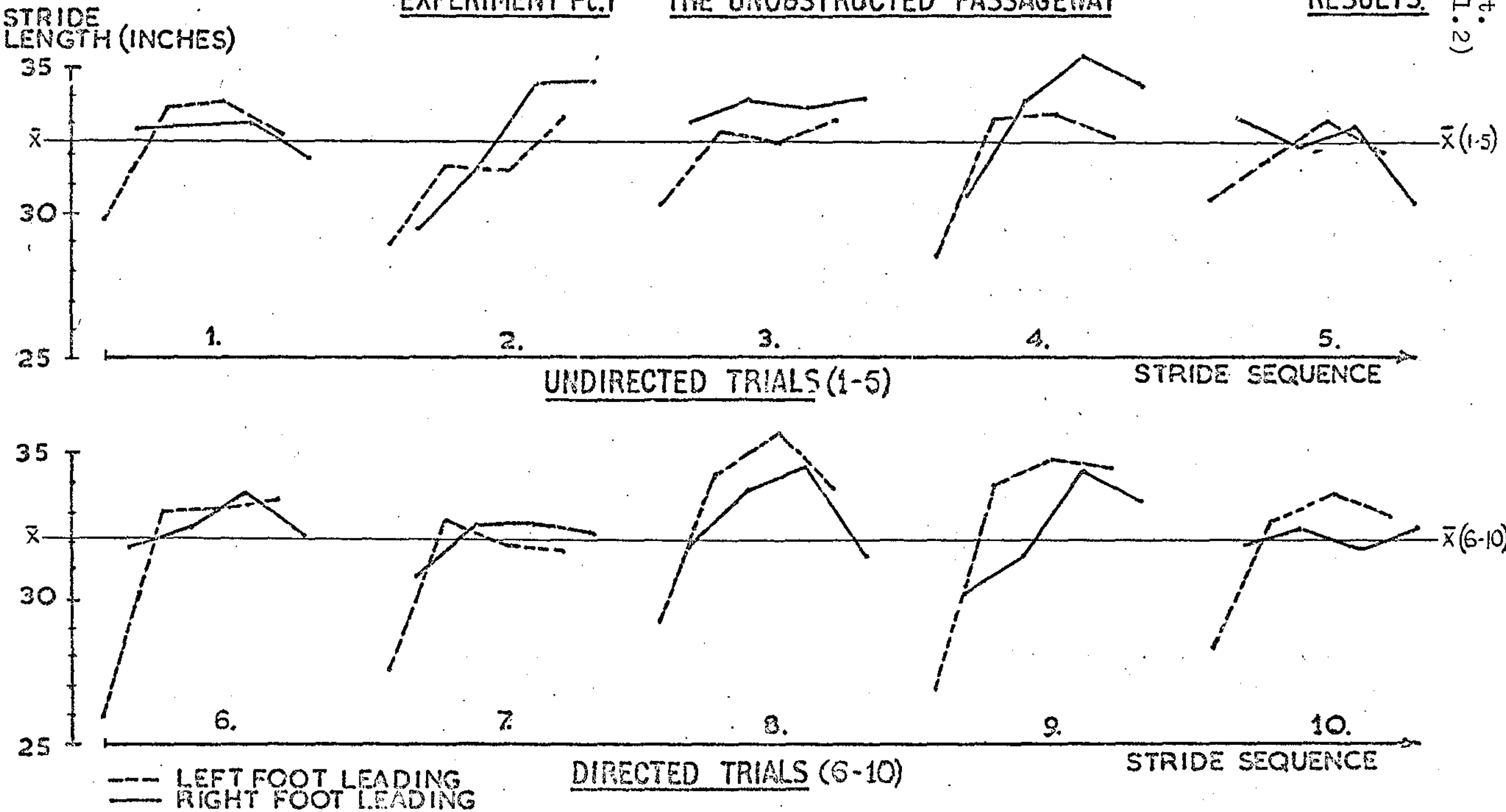


FIG.(39). INDIVIDUAL STRIDE LENGTHS RELATED TO LEADING FOOT. (SUBJECT M3)

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No.F.1

TRIALS	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
1	29.8	26.1	29.1	25.9	29.3	25.8	28.4	24.2	26.6	23.0
2	28.0	24.2	28.3	25.4	28.0	23.5	26.8	25.1	29.0	25.3
3	29.0	23.9	29.1	25.6	29.6	25.4	28.3	24.6	26.8	23.6
4	28.2	25.0	27.6	24.7	28.1	24.4	26.8	24.5	26.8	23.4
5	28.7	24.5	26.8	24.0	26.1	22.9	26.3	23.4	27.0	25.5
MEAN 1-5	28.7	24.8	28.2	25.1	28.2	24.4	27.3	24.4	27.2	24.1
6	25.8	22.5	26.7	24.3	26.7	24.0	26.6	23.6	26.5	21.6
7	28.4	24.4	28.0	25.4	29.0	26.3	29.4	26.3	28.3	23.5
8	28.3	24.3	26.7	23.9	27.4	24.5	28.9	26.3	28.5	25.1
9	28.5	22.9	28.0	25.9	30.0	25.0	27.3	24.3	27.9	24.9
10	27.9	24.1	26.8	24.3	27.8	24.4	27.5	25.1	29.0	25.0
MEAN 6-10	27.8	23.6	27.2	24.7	28.2	24.8	27.9	25.1	28.0	24.0

Dimensions in Inches. All trials began on right foot.
For data of Heel & Toe locations see APPENDIX 1 (TABLE 39).

TRIALS	OVERALL MEAN DISTANCE FROM L.H.WALL Left Foot	Right Foot
(1-5)	24.6	27.9
(6-10)	24.5	27.8

For diagram see 4.1.3 DISCUSSION (FIG.40).

TRIALS	DIFFERENCES (D) IN MEAN DISTANCE FROM L.H.WALL (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	27.8	23.6	27.2	24.7	28.2	24.8	27.9	25.1	28.0	24.0
(1-5)	28.7	24.8	28.2	25.1	28.2	24.4	27.3	24.4	27.2	24.1
(D)	-0.9	-1.2	-1.0	-0.4	0	+0.4	+0.6	+0.7	+0.8	-0.1

For statistical significance of Differences (D) between Means see RESULTS (TABLE 19).
For test of significance of Differences (D) see APPENDIX 1 (TABLE 47).

TABLE (13).MEAN DISTANCE OF FOOTPRINT CENTRE-LINE LOCATIONS FROM L.H.WALL IN UNOBSTRUCTED PASSAGEWAY. (F.1).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No.F.2

	FOOTSTEP SEQUENCE									
TRIALS	1	2	3	4	5	6	7	8	9	10
1	27.5	26.8	31.1	28.6	31.5	27.3	28.7	25.9	29.7	28.9
2	24.8	24.0	30.2	28.3	33.3	30.1	34.3	30.9	34.8	30.8
3	27.9	25.4	31.3	27.8	33.0	29.1	33.4	29.8	32.3	27.8
4	23.8	21.8	28.6	26.6	32.8	29.9	32.8	26.5	30.3	27.8
5	26.5	24.8	29.3	24.9	29.1	23.7	26.5	22.3	26.9	26.0
MEAN 1-5	26.1	24.6	30.1	27.2	31.9	28.0	31.1	27.1	30.8	28.3
6	27.4	23.0	26.2	23.4	26.3	22.9	27.2	24.0	27.8	26.9
7	27.5	25.4	30.3	28.3	32.5	30.2	32.7	29.5	32.6	30.1
8	26.7	25.5	28.2	25.3	29.5	26.2	28.7	26.3	29.9	27.3
9	29.5	26.5	29.8	27.8	30.8	28.4	29.6	26.5	29.0	26.0
10	28.8	26.6	29.3	24.8	30.2	26.2	31.7	28.1	31.6	26.1
MEAN 6-10	28.0	25.4	28.8	25.9	29.9	26.8	30.0	26.9	30.2	27.3

Dimensions in Inches. All trials began on right foot.
For data of Heel & Toe locations see APPENDIX 1 (TABLE 40).

TRIALS	OVERALL MEAN DISTANCE FROM L.H.WALL Left Foot	Right Foot
(1-5)	27.0	30.0
(6-10)	26.5	29.4

For diagram see 4.1.3 DISCUSSION (FIG.40).

	DIFFERENCES (D) IN MEAN DISTANCE FROM L.H.WALL (Directed minus Undirected Trials)									
TRIALS	1	2	3	4	5	6	7	8	9	10
(6-10)	28.0	25.4	28.8	25.9	29.9	26.8	30.0	26.9	30.2	27.3
(1-5)	26.1	24.6	30.1	27.2	31.9	28.0	31.1	27.1	30.8	28.3
(D)	+1.9	+0.8	-1.3	-1.3	-2.0	-1.2	-1.1	-0.2	-0.6	-1.0

For statistical significance of Differences (D) between Means see RESULTS (TABLE 19).
For test of significance of Differences (D) see APPENDIX 1 (TABLE 47).

TABLE(14).MEAN DISTANCE OF FOOTPRINT CENTRE-LINE LOCATIONS FROM L.H.WALL IN UNOBSTRUCTED PASSAGEWAY. (F.2).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No.F.3

TRIALS	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
1	28.9	27.7	29.5	27.4	27.6	26.3	28.7	26.8	27.6	-
2	28.9	26.2	27.8	26.2	27.6	26.6	29.7	26.2	28.0	-
3	30.5	25.1	28.4	26.7	28.2	25.2	26.9	25.3	27.6	-
4	29.9	27.5	27.8	25.3	25.9	23.0	26.7	25.1	28.4	-
5	30.8	28.2	29.9	28.1	30.3	27.2	28.0	25.7	27.7	-
MEAN 1-5	29.8	26.9	28.7	26.7	27.9	25.7	28.0	25.8	27.9	-
6	28.9	27.5	28.6	26.9	28.6	27.5	29.2	28.3	29.1	-
7	27.9	24.0	27.1	25.2	28.0	24.3	26.4	28.7	24.1	-
8	27.7	26.0	28.4	25.3	28.3	26.8	29.2	26.4	30.1	-
9	28.7	26.6	28.9	26.4	28.9	26.4	26.8	23.6	26.6	-
10	28.3	25.4	27.5	25.8	28.8	25.8	29.8	27.9	29.5	-
MEAN 6-10	28.3	25.9	28.1	25.9	28.5	26.2	28.3	27.0	27.9	-

Dimensions in Inches. All trials began on right foot.
For Heel & Toe locations see APPENDIX 1 (TABLE 41).

TRIALS	OVERALL MEAN DISTANCE FROM L.H.WALL Left Foot	Right Foot
(1-5)	26.3	28.5
(6-10)	26.2	28.2

For diagram see 4.1.3 DISCUSSION (FIG.40).

TRIALS	DIFFERENCES (D) IN MEAN DISTANCE FROM L.H.WALL (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	28.3	25.9	28.1	25.9	28.5	26.2	28.3	27.0	27.9	-
(1-5)	29.8	26.9	28.7	26.7	27.9	25.7	28.0	25.8	27.9	-
(D)	-1.5	-1.0	-0.6	-0.8	+0.6	+0.5	+0.3	+1.2	0	-

For statistical significance of Differences (D) between Means see RESULTS (TABLE 19).
For test of significance of Differences (D) see APPENDIX 1 (TABLE 47).

TABLE (15).MEAN DISTANCE OF FOOTPRINT CENTRE-LINE LOCATIONS FROM L.H.WALL IN UNOBSTRUCTED PASSAGEWAY. (F.3).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No. M.1

TRIALS	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
1	13.5	22.4	15.7	23.8	18.7	25.5	19.7	27.3	18.7	24.5
2	18.1	25.7	21.0	26.3	18.6	23.8	18.0	23.5	17.0	25.5
3	14.3	22.6	16.5	23.5	15.8	24.6	17.0	25.0	19.4	27.0
4	16.4	23.9	16.6	24.9	16.9	24.5	17.0	24.2	17.5	26.6
5	16.6	24.3	18.5	24.3	16.5	24.9	17.6	24.6	17.5	26.5
MEAN 1-5	15.8	23.8	17.7	24.6	17.3	24.7	17.9	24.9	18.0	26.0
6	24.1	31.2	24.5	30.8	24.7	31.0	24.9	32.1	24.8	33.1
7	23.5	31.6	22.7	31.3	22.7	31.7	25.0	32.5	23.4	33.8
8	22.1	31.2	23.6	30.7	22.4	32.1	26.0	34.0	26.5	34.0
9	23.9	32.7	24.0	33.1	24.2	33.0	25.3	33.1	25.3	34.5
10	22.7	31.9	23.6	30.2	21.3	30.1	23.1	31.5	23.7	31.0
MEAN 6-10	23.3	31.7	23.7	31.2	23.1	31.6	24.9	32.6	24.8	33.3

Dimensions in Inches. All trials began on left foot.
For data of Heel & Toe locations see APPENDIX 1 (TABLE 42).

TRIALS	OVERALL MEAN DISTANCE FROM L.H.WALL Left Foot	Right Foot
(1-5)	17.3	24.8
(6-10)	23.9	32.1

For diagram see 4.1.3 DISCUSSION (FIG. 40).

TRIALS	DIFFERENCES (D) IN MEAN DISTANCE FROM L.H.WALL (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	23.3	31.7	23.7	31.2	23.1	31.6	24.9	32.6	24.8	33.3
(1-5)	15.8	23.8	17.7	24.6	17.3	24.7	17.9	24.9	18.0	26.0
(D)	+7.5	+7.9	+6.0	+6.6	+5.8	+6.9	+7.0	+7.7	+6.8	+7.3

For statistical significance of Differences (D) between Means see RESULTS (TABLE 19).
For test of significance of Differences (D) see APPENDIX 1 (TABLE 48).

TABLE (16). MEAN DISTANCE OF FOOTPRINT CENTRE-LINE LOCATIONS FROM L.H.WALL IN UNOBSTRUCTED PASSAGEWAY. (M.1).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No. M.2

FOOTSTEP SEQUENCE

TRIALS	1	2	3	4	5	6	7	8	9	10
1	23.8	30.5	25.0	29.6	23.5	29.0	24.0	28.4	-	-
2 R	27.2	21.0	25.8	22.9	28.4	24.9	29.3	24.7	-	-
3	24.5	31.2	31.5	32.9	28.4	31.7	29.2	32.3	-	-
4 R	30.0	24.5	29.3	23.5	28.5	26.6	30.7	27.0	-	-
5 R	28.6	25.0	28.4	24.7	29.5	27.3	32.1	31.5	-	-
MEAN*	24.1	23.5	28.2	23.7	25.9	26.3	26.6	27.7	-	-
MEAN**	28.6	30.8	27.8	31.2	28.8	30.3	30.7	30.3	-	-
6	26.2	30.7	26.8	32.2	30.4	33.6	31.3	34.4	-	-
7	25.9	33.5	30.2	32.5	27.9	32.0	26.6	29.9	-	-
8	24.4	29.7	24.5	28.8	23.1	29.8	25.1	30.3	-	-
9	25.0	29.0	22.7	27.2	24.1	28.6	23.5	28.6	-	-
10	25.2	29.6	26.4	32.7	27.7	31.7	26.1	31.4	-	-
MEAN 6 10	25.3	30.5	26.1	30.7	26.6	31.1	26.5	30.9	-	-

Dimensions in Inches. All trials except(2,4,5) began on left foot. For Heel & Toe locations see APPENDIX 1 (TABLE 43).
*Mean of left footsteps. **Mean of right footsteps.

TRIALS	OVERALL MEAN DISTANCE FROM L.H.WALL Left Foot	Right Foot
(1-5)	25.7	29.7
(6-10)	26.2	30.8

For diagram see 4.1.3 DISCUSSION (FIG. 40).

TRIALS	DIFFERENCES (D) IN MEAN DISTANCE FROM L.H.WALL (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	25.3	30.5	26.1	30.7	26.6	31.1	26.5	30.9	-	-
(1-5)※	23.8	29.5	25.5	29.2	26.1	29.4	27.3	30.6	-	-
(D)	+1.5	+1.0	+0.6	+1.5	+0.5	+1.7	-1.2	+0.3	-	-

※ Means for Left Foot* and Right Foot** in top TABLE are for 2-trials and 3-trials respectively. Means for trials(1-5) immediately above are for five trials. I.e.Step (1)left foot is obtained by averaging Step (1)Trials (1 & 3) and Step (2)Trials (2,4,5). Step (2)right foot is mean of Step (2)Trials (1 & 3) and Step (1)Trials (2,4,5) etc.,

For statistical significance of Differences (D) between Means see RESULTS (TABLE 19).
For test of significance see APPENDIX 1 (TABLE 48).

TABLE.(17).MEAN DISTANCE OF FOOTPRINT CENTRE-LINE LOCATIONS FROM L.H.WALL IN UNOBSTRUCTED PASSAGEWAY. (M.2).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Subject No. M.3

TRIALS	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
1	24.8	28.2	23.7	26.3	20.9	24.6	19.7	24.3	-	-
2	25.7	31.4	26.5	29.5	24.2	28.1	24.1	26.2	-	-
3	23.3	28.9	23.1	30.8	24.5	28.2	22.4	25.5	-	-
4	22.8	26.9	22.6	27.6	22.9	27.7	23.8	29.0	-	-
5	22.8	23.9	20.7	27.6	24.8	27.8	24.0	28.2	-	-
MEAN 1-5	23.9	27.9	23.3	28.4	23.5	27.3	22.8	26.6	-	-
6	22.1	27.5	22.6	27.2	23.6	28.0	24.7	27.7	-	-
7	23.7	28.5	24.0	27.3	23.8	26.5	23.5	27.6	-	-
8	23.0	29.0	25.5	29.7	23.5	25.5	23.4	28.7	-	-
9	23.3	27.6	22.3	26.3	23.3	29.1	25.5	28.6	-	-
10	23.6	29.0	24.6	29.0	24.5	26.4	23.2	28.6	-	-
MEAN 6-10	23.1	28.3	23.8	27.9	23.7	27.1	24.1	28.2	-	-

Dimensions in Inches. All trials began on left foot.
For data of Heel & Toe locations see APPENDIX 1 (TABLE 44).

TRIALS	OVERALL MEAN DISTANCE FROM L.H.WALL Left Foot	Right Foot
(1-5)	23.4	27.6
(6-10)	23.7	27.9

For diagram see 4.1.3 DISCUSSION (FIG. 40).

TRIALS	DIFFERENCES (D) IN MEAN DISTANCE FROM L.H.WALL (Directed minus Undirected Trials) 1	2	3	4	5	6	7	8	9	10
(6-10)	23.1	28.3	23.8	27.9	23.7	27.1	24.1	28.2	-	-
(1-5)	23.9	27.9	23.3	28.4	23.5	27.3	22.8	26.6	-	-
(D)	-0.8	+0.4	+0.5	-0.5	+0.2	-0.2	+1.3	+1.6	-	-

For statistical significance of Differences (D) between Means see RESULTS (TABLE 19).
For test of significance of Differences (D) see APPENDIX 1 (TABLE 48).

TABLE (18).MEAN DISTANCE OF FOOTPRINT CENTRE-LINE LOCATIONS FROM L.H.WALL IN UNOBSTRUCTED PASSAGEWAY. (M.3)

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

TEST OF SIGNIFICANCE OF DIFFERENCES BETWEEN MEANS OF TWO CORRELATED SAMPLES.

Sample (1): Means of Undirected Trials (1-5)
Sample (2): Means of Directed Trials (6-10)

Differences (D): Sample (1) from Sample (2).

For method of calculating t-ratio see APPENDIX 1 CALCULATIONS (TABLES 47&48).

STRIDE	DIFFERENCES (D) IN MEAN DISTANCE FROM L.H.WALL (Inches).					
	Females			Males		
	F.1	F.2	F.3	M.1	M.2	M.3
1	-0.9	+1.9	-1.5	+7.5	+1.5	-0.8
2	-1.2	+0.8	-1.0	+7.9	+1.0	+0.4
3	-1.0	-1.3	-0.6	+6.0	+0.6	+0.5
4	-0.4	-1.3	-0.8	+6.6	+1.5	-0.5
5	0	-2.0	+0.6	+5.8	+0.5	+0.2
6	+0.4	-1.2	+0.5	+6.9	+1.7	-0.2
7	+0.6	-1.1	+0.3	+7.0	-1.2	+1.3
8	+0.7	-0.2	+1.2	+7.7	+0.3	+1.6
9	+0.8	-0.6	0	+6.8	-	-
10	-0.1	-1.0	-	+7.3	-	-
t-ratio	0.4691	0.1638	0.4908	13.66	1.614	1.018
d.f.	9	9	8	9	7	7

CRITICAL VALUES OF "t"

Degrees of Freedom	Level of significance for 2-tailed test					
	0.20	0.10	0.05	0.02	0.01	0.001
7	1.415	1.895	2.365	2.998	3.499	5.405
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781

TABLE (19).STATISTICAL SIGNIFICANCE OF DIFFERENCES BETWEEN MEAN FOOTPRINT LOCATIONS IN DIRECTED AND UNDIRECTED TRIALS. (MEAN DISTANCE FROM L.H.WALL).

4.1(4.1.2) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

HALF-WIDTH OF PASSAGEWAY (27 Inches) MINUS MEAN DISTANCE OF FOOTPRINT CENTRE-LINE LOCATIONS FROM L.H.WALL

SUBJECT		F.1		F.2		F.3	
TRIALS *		(1-5)	(6-10)	(1-5)	(6-10)	(1-5)	(6-10)
FOOTPRINT							
1	R	+1.7	+0.8	-0.9	+1.0	+2.8	+1.7
2	L	-2.2	-3.4	-2.4	-1.6	-0.1	-1.1
3	R	+1.2	+0.2	+3.1	+1.8	+1.7	+1.1
4	L	-1.9	-2.3	+0.2	-1.1	-0.3	-1.1
5	R	+1.2	+1.2	+4.9	+2.9	+0.9	+1.5
6	L	-2.6	-2.2	+1.0	-0.2	-1.3	-0.8
7	R	+0.3	+0.9	+4.1	+3.0	+1.0	+1.3
8	L	-2.6	-1.9	+0.1	-0.1	-1.2	0
9	R	+0.2	+1.0	+3.8	+3.2	+0.9	+0.9
10	L	-2.9	-3.0	+1.3	+0.3	-	-
MEAN	R	+0.92	+0.82	+3.00	+2.38	+1.46	+1.30
MEAN	L	-2.44	-2.56	+0.04	-0.54	-0.72	-0.75
MEAN OF (R + L)		-0.76	-0.87	+1.48	+0.92	+0.37	+0.28

SUBJECT		M.1		M.2		M.3	
TRIALS *		(1-5)	(6-10)	(1-5)	(6-10)	(1-5)	(6-10)
FOOTPRINT							
1	L	-11.2	-3.7	-3.2	-1.7	-3.1	-3.9
2	R	-3.2	+4.7	+2.5	+3.5	+0.9	+1.3
3	L	-9.3	-3.3	-1.5	-0.9	-3.7	-3.2
4	R	-2.4	+4.2	+2.2	+3.7	+1.4	+0.9
5	L	-9.7	-3.9	-0.9	-0.4	-3.5	-3.3
6	R	-2.3	+4.6	+2.4	+4.1	+0.3	+0.1
7	L	-9.1	-2.1	+0.3	-0.5	-4.2	-2.9
8	R	-2.1	+5.6	+3.6	+3.9	-0.4	+1.2
9	L	-9.0	-2.2	-	-	-	-
10	R	-1.0	+6.3	-	-	-	-
MEAN	R	-2.20	+5.08	+2.67	+3.80	+0.55	+0.87
MEAN	L	-9.66	-3.04	-1.32	-0.87	-3.62	-3.32
MEAN OF (R + L)		-5.93	+1.02	+0.68	+1.46	-1.53	-1.23

*Means of Trials (1-5) & (6-10) from RESULTS (TABLES 13-18).

TABLE (20). MEAN DISTANCE OF FOOTPRINT CENTRELINE LOCATIONS FROM CENTRELINE OF UNOBSTRUCTED PASSAGEWAY.

4.1 EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

4.1.3 DISCUSSION.

Assumption.

Underlying the division of the experiment into PART (1) and PART (2) was the assumption that the performance characteristics displayed by Ss. during trials in an unobstructed passageway (PART 1) would be predictive of their performance in the same passageway prior to confrontation with an obstacle (PART 2), and that departures outside the range of variation disclosed by unobstructed trials (PART 1) would constitute detour behaviour in trials with obstacles (PART 2).

Directed and Undirected Trials.

The purpose of the further subdivision of PART (1) of the experiment into the sections "Directed Trials" and "Undirected Trials" was to enable assessment of the influence of the instruction to walk down the centre of the passageway on subsequent S. performance. This is the immediate concern below.

Approach behaviour: variables and criteria.

A preliminary study of the simple task of walking down a passageway was valuable in several ways.

Firstly, it enabled the acquisition of basic information about human locomotion which - broadly speaking - was goal directed.

Secondly, it provided information about the way Ss. walked when unimpeded which it was necessary to know to discern changes in their gait arising from encounters with obstacles.

Thirdly, it allowed the identification of those characteristics of human gait which were subject to variation in so far as they might be registered by footprint impressions, as well as giving some measure of their range of variation in terms of individual differences.

Nevertheless, it was not supposed that conclusions drawn from such a small sample could be much more than suggestive of possible results from wider tests. The Directed and Undirected Trials were designed merely to enable Ss. to display their propensities toward particular patterned actions and to give E. the opportunity to test the stability of those propensities.

Changes in stride length.

Examination of the t-test of differences between Directed and Undirected Trials extracted in TABLE (11) reveals that only two Ss. made significant alterations in their length of stride. The change in Mean Stride Length by S. (F.2) during Trials (6-10) has a chance probability of occurring of less than once in a thousand. The odds against the stride change of S.(M.2) being due to chance are greater than fifty to one.

A possible explanation for the marked increase in stride length by S.(F.2) during Trials (6-10) which is seen to occur in her every stride (1-10) might be that she hurried Trials (6-10); but there are no means of proving this.

It is more easy to account for the change in performance of S.(M.2). The latter S. also took significantly longer strides in Trials (6-10), but whereas he began all Trials (6-10) on the left foot he alternated the beginning foot in Trials (1-5). Mean values of his strides (1-8) in Trials (1-5) are derived from an aggregate of strides some taken with the left foot others taken with the right (TABLE 9). The importance of this is seen on reference to TABLE (12), where it is shown that the average stride of S.(M.2) when taken with the left leg is sufficiently longer (approximately 2 inches) than the corresponding value for the right leg to bias the t-value for the ensuing differences between right and left leg stride performance.

It is curious that all Ss. consistently took longer strides with one leg in both Directed and Undirected Trials, i.e. the sign values ± for stride length "differences between feet" in TABLE (12) are in the same direction for each S. And although in the case of S.(F.3) the differences in average stride length between the two sets of trials are so small (0.10 - 0.19) as to be within the possible range of E's. error in the measurement of stride length, the larger differences (0.4 - 2.0) registered by the other Ss. invites speculation.

For instance, one might ask whether the longer or the shorter strides were taken with the "preferred" foot (Ss. were not asked to specify this); preferment might affect response in a way related to the R.H. or L.H. presentation of obstacles. One could even conjecture that such a tendency if more widely shared might explain why people when lost are supposed to walk in circles. The veering tendency of people walking without vision or without visual sight lines is well-known (e.g. refer CRATTY,B.J. 1968). More pertinent to this enquiry, evidence that an individual habitually takes longer strides with a particular leg could suggest his need to rely partially on kinaesthetic cues to maintain a straight course of movement. Perhaps such cues have diminishing effectiveness as we tire for it is a familiar sight to see tired individuals seeming to gravitate towards objects parallel to their obviously intended line of movement? The strong tendency of all Ss. apart from S.(F.3) to take longer strides with one leg is clearly illustrated in FIGS.(34-39). It will be seen later (in PART 2) that S.(F.3) was extremely cautious in her negotiation of obstacles, and it is suggested that the absence of significant disparity in her stride length as determined by the leading foot may be due in part to the "measured" quality of her caution.

On the basis of available data, it would seem that E's. instruction to walk down the centre of the passageway had no proven effect on the Ss. length of stride.

4.1(4.1.3) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

Changes in distance maintained from L.H. Wall.

A t-test was also applied to the differences in route taken by Ss. in Directed and Undirected Trials as evidenced by the distance of their footprints from the left-hand wall of the passageway. Reference to TABLE (19) will reveal that the route taken by S.(M.1) as a result of E's instruction to walk down the centre of the passageway was considerably different from the route he took during his Undirected Trials (1-5). The t-value (13.66) indicates the statistical probability of this change occurring by chance as beyond a thousand to one. The differences between Directed and Undirected routes for the remaining Ss. were not significant at the ten per cent level.

Taking account of the performance of S.(M.1) during his Undirected Trials, it was concluded that it would be necessary to instruct Ss. to walk down the centre of the passageway during their Trials with Obstacles (PART 2). But it was not thought that this would unduly burden the free choice of Ss. the majority of whom had anyway shown a disposition to walk down the centre of a relatively narrow passageway. Moreover, it was considered that the proposed instruction in conjunction with Trials with Obstacles was not inconsistent with a common practice outside the experimental situation where we skirt the perimeters of objects of a familiar kind rather than plan a more direct path which would require no further modification for its success. In other words, the proposed instruction was not inconsistent with avoidance measures taken in conditions of disregarded utility.

The mean lateral displacement of each S's. footprints in relation to the centreline of the passageway during Directed and Undirected Trials is illustrated by FIG.(40) DISCUSSION. The body-centreline of each S. has been assumed to bisect the range of foot displacement across the transverse plane of the body although individuals may not throw their feet laterally an equal distance.

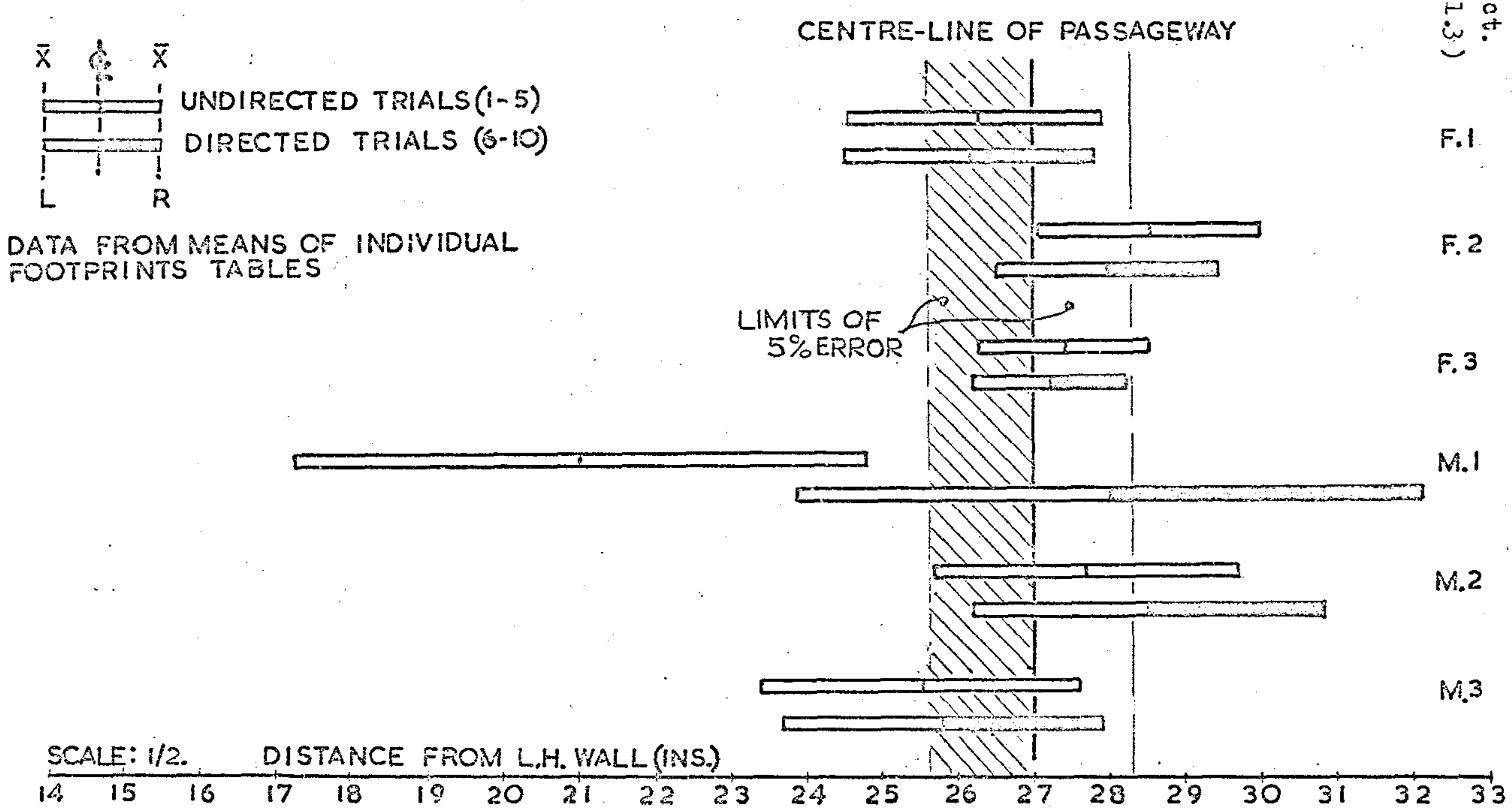


FIG. (40) OVERALL MEAN DISTANCE OF LEFT & RIGHT FOOTPRINT CENTRE-LINE LOCATIONS FROM CENTRE-LINE OF UNOBSTRUCTED PASSAGEWAY.

4.1(4.1.3) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

The overall length of each bar in the illustration is derived from two factors: the inclination or splay of the foot, and how widely Ss. placed their feet. The congruency of paired bars suggests that foot placement is a highly structured motor skill (Sect.3.1.9,Spatial Preference).

Subject Error and Experimental Error.

The shift in route obtaining between the Directed and Undirected Trials consequent on the directive to walk down the centre of the passageway is estimated in TABLE (21) DISCUSSION. Values relate to the displacement of the estimated S. body-centreline from the centreline of the passageway. It can be seen that for all Ss. with the exception of S.(M.1) the displacement was less than one inch. That is to say, apart from S.(M.1), Ss. revealed an unprompted tendency when walking down an empty passageway to walk down the centre of that passageway.

During Directed Trials all Ss. aligned their routes down the centre of the passageway within an estimated error of less than 5.5 per cent (1.5 inches) maintained over a distance of more than 250 inches (i.e. an average error in the worst case of no more than 1:166).

It was generally possible for E. to record the central point of footprint impressions within an accuracy of ± 0.1 inch. Footprint impressions made in sand vary in size according to its grain size, moisture content, and the weight of tread. The recording of mean values of the aggregated heel and toe marks to pinpoint footprint location therefore afforded a more accurate measure of stride length than might have been obtained from calculations involving heelmark-to-heelmark or toemark-to-toemark sand impressions.

4.1(4.1.3) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

* MEAN DISPLACEMENT OF ESTIMATED ROUTE OF Ss. BODY C.L. FROM C.L. OF PASSAGEWAY. (Inches).						
SUBJECT:	F.1	F.2	F.3	M.1	M.2	M.3
Undirected Trials (1-5)	-0.76	+1.48	+0.37	-5.93	+0.68	-1.53
Directed Trials (6-10)	-0.87	+0.92	+0.28	+1.02	+1.46	-1.23
Change in displacement with Directed Trials	0.11	0.56	0.09	4.91	0.78	0.30
Increase Decrease	I	D	D	D	I	D
Estimated Subject Error in aligning body centreline with centreline of passageway in Directed Trials.	3.22%	3.40%	1.04%	3.77%	5.40%	4.55%

*Body centreline is assumed to bisect the S's.right and left foot centreline locations.

Data for Undirected and Directed Trials from RESULTS (TABLE 20).

Estimated Subject Error: e.g. $\left[0.87 \times \frac{100}{27}\right]$

TABLE (21). ESTIMATED SUBJECT ERROR IN ALIGNING ROUTE WITH CENTRELINE OF PASSAGEWAY IN DIRECTED TRIALS (6-10).

4.1(4.1.3) EXPERIMENT (PART 1): THE UNOBSTRUCTED PASSAGEWAY

SUMMARY OF FINDINGS.

Influence of the direction to walk down the centre of the passageway given after Trial No.5.

1. On choice of route.

Five Ss. out of six made an unprompted choice to walk down the centre of the passageway during Trials (1-5). Except for S.(M.1), the mean lateral shift in route in subsequent Trials (6-10) was less than 1.0 inch.

2. On stride length.

One S.(F.2) recorded a significant increase in stride length in Trials (6-10) over Trials (1-5). She was observed to perform the later Trials more quickly although individual performances were neither paced by metronome nor timed by clock. Another S.(M.2) returned a longer mean stride length in Trials (6-10) than in Trials (1-5). The data is affected by a statistical bias arising from him alternating the beginning foot in the earlier Trials.

3. Peculiarities in gait.

All Ss. took consistently longer strides with one leg than with the other. The differences were small except for S.(M.2) where they amounted to a discrepancy of 2.0 inches.

4. Range of variation.

All Ss. were able to align their routes down the centreline of the passageway on being directed to do (Trials 6-10) within an approximate error of about five per cent.

. . . . .

It was concluded that E.'s instruction to Ss. to walk down the centre of the passageway had no proven effect on their stride length, but that it would be necessary to repeat that instruction in Trials with Obstacles.

EXPERIMENT: PART 2

TRIALS WITH OBSTACLES

4.2 EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

4.2.1 Procedure and instructions.

The physical arrangements of the passageway for Obstacle Trials were the same as those for Unobstructed Trials, but during each Obstacle Trial the free passageway of the S. was restricted by the presentation of a single obstacle panel within the passageway.

Obstacle panels were selected according to the protocol of the Schedule of Trials (TABLE 22), the scheme of presentation being determined by a permutation of the characteristics of the obstacles. The obstacles were mounted at distances and heights along the passageway according to the physical attributes of the S. under test. (See: Sect.4.0.2; APPENDIX 2 TABLE 63).

In this part of the experiment, Ss. were required to walk down the passageway sixty-four times to complete four sets of trials. They were given these instructions at the start of their test:

Obstacle Trials (1-64) In this, the major part of the experiment, I want you to walk down the corridor as you did before, but this time you will find that I have put an obstacle there which will be changed for each trial.

I want you to toe the mark again either side of the centreline, and to walk down the centre of the corridor to the coconut mat after I give you the command "WALK". Do not stop when you reach the mat but return to this point.

I want you to approach the obstacle at your normal walking speed, and without unnecessary caution or extravagant evasive action to keep as close as you can to the centre of the corridor before and after passing the obstacle.

Subjects were then asked to confirm that they understood what to do, and they were permitted to inspect the firmness of the mounted obstacles before their first trial. They were asked not to speak while actually performing trials. Each S. was tested in private.

4.2 (4.2.1) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

SCHEDULE OF TRIALS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RUN 1	T N C R	B N D R	B W D L	T W C L	B W D R	T W C R	T N C L	B N D L	T W D L	B W C L	B N C R	T N D R	B N C L	T N D L	T W D R	B W C R
RUN 2	B W D L	T W C L	B N D R	T N C R	B N C L	T N D L	B W C R	T W D R	T N D R	B N C R	T W D L	B W C L	T W C R	B W D R	T N C L	B N D L
RUN 3	B N D R	T N C R	T W C L	B W D L	T W C R	B W D R	B N D L	T N C L	B W C L	T W D L	T N D R	B N C R	T N D L	B N C L	B W C R	T W D R
RUN 4	T W C L	B W D L	T N C R	B N D R	T N D L	B N C L	T W D R	B W C R	B N C R	T N D R	B W C L	T W D L	B W D R	T W C R	B N D L	T N C L

Key to obstacle coding:

T	Top	N	Narrow	D	Distant	R	Right-hand
B	Bottom	W	Wide	C	Close	L	Left-hand

TABLE (22). OBSTACLE SELECTION SCHEDULE

4.2 EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

4.2.2 RESULTS

The identification of obstacle situations.

The experiment entailed trials in sixteen different obstacle situations each of which was identified by the initial letter of terms designating the particular circumstances of the situation. For example, a trial designated "TWCR" indicates that the presented obstacle was "TOP, WIDE, CLOSE, and RIGHT-handed", i.e. it was fitted to obstruct the upper part of the body (TOP), it was half the width of the passageway (WIDE), it was positioned at the S's. third mean heelmark from the start of the passageway (CLOSE), and it was presented on the (RIGHT)-hand of the S. Similarly, trial "BNDL" designates the characteristics: to obstruct the lower part of the body (BOTTOM), a quarter the width of the passageway (NARROW), positioned at the seventh mean heelmark from the start for that S. (DISTANT), on his (LEFT)-hand side. This nomenclature is used throughout the tabulation and discussion of RESULTS.

Measurement of subject performance.

The procedure for recording footprints in PART (2) was the same as for the Unobstructed Trials. Particulars of each footprint impression for all TRIALS WITH OBSTACLES are reported in APPENDIX 2 (TABLES 97-102).

Data reduction.

Data was consolidated by reducing the four runs by each S. per obstacle situation to mean values which are presented in APPENDIX 2 (TABLES 91-96). Mean stride length performances and mean distances maintained from the left-hand wall for each S. trial were compiled separately (APPENDIX 2 TABLES 70-75; 85-90).

Extraction of Difference Tables.

The aim of the analysis was to assess the influence of the obstacles on the S's. progress down the passageway, and since TRIALS WITH OB-

STACLES had been "directed", i.e. the S. had been instructed to walk down the centre of the passageway, the detour behaviour of a S. was ascertained by comparing his performance in TRIALS WITH OBSTACLES with his performance during his Directed Trials (6-10) in the Unobstructed Passageway.

Tables of differences were compiled relating TRIALS WITH OBSTACLES to Unobstructed Trials (6-10); the data are presented in APPENDIX 2 (TABLES 64-69 : MEAN STRIDE LENGTH) and (TABLES 77-82 : DISTANCE FROM L.H.WALL). Other tables of differences in APPENDIX 2 (TABLES 83-84) were derived to compare male with female mean performance. Similar tables for narrow obstacles were not attempted for statistical reasons. (See DISCUSSION).

Diagrammatic presentation of Difference Tables.

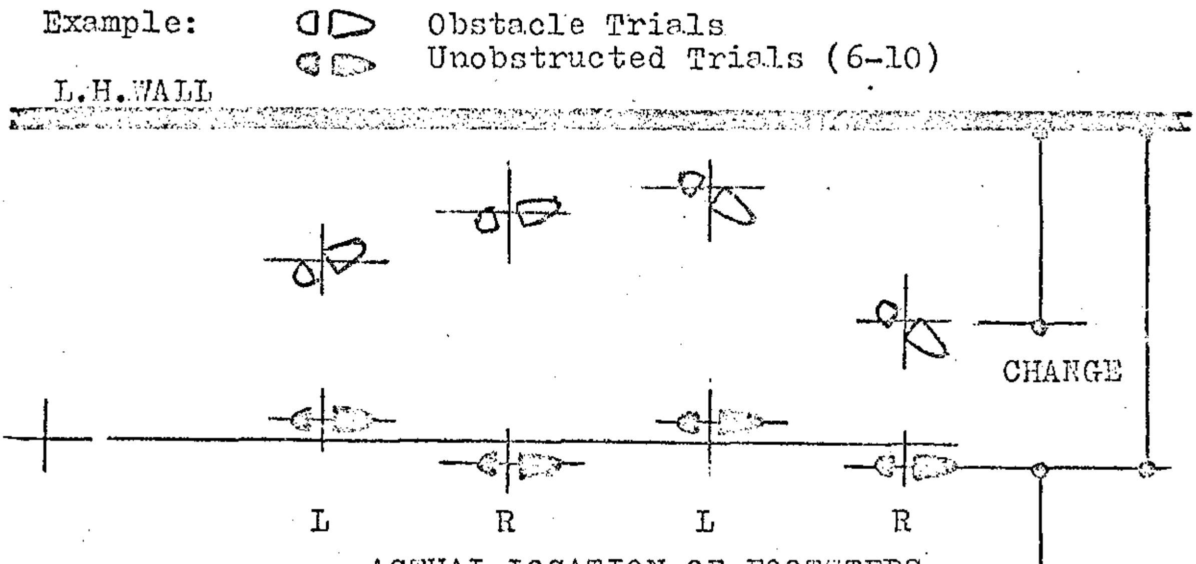
The difference tables are presented in diagrammatic form in the RESULTS. There are two kinds of diagram. The first show differences in MEAN STRIDE LENGTH in response to obstacles as bar charts (FIGS.42-73); the length of each bar signifying the magnitude of the difference between the OVERALL mean stride length of the S. during DIRECTED TRIALS (6-10) in the Unobstructed Passageway, and his MEAN STRIDE LENGTH FOR A PARTICULAR STRIDE from four encounters with a particular obstacle situation.

It was assumed that a S's. stride length during Unobstructed Trials (6-10) would have a Normal Distribution. Use of the overall mean stride length allowed an "n"-value of forty or greater necessary to the derivation of Confidence Limits for those trials. The Confidence Interval shown is for the "sample" mean stride length and "sample" standard deviation (APPENDIX 1, TABLES 49-54). Comparison with the Confidence Interval for the estimated "population" parameters is made in APPENDIX 1 (TABLE 55).

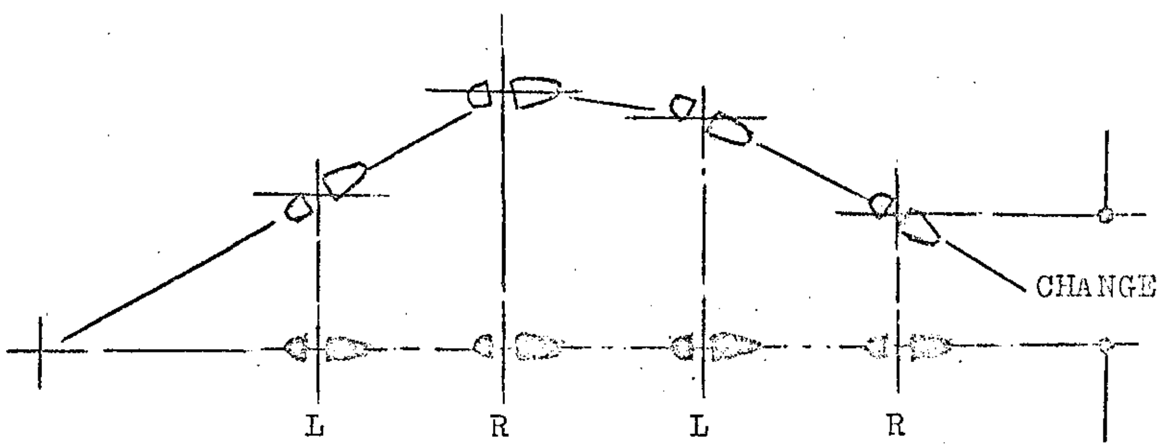
It can be remembered when examining the bar charts that CLOSE obstacles were located at the S's. third step and DISTANT obstacles at his seventh step from start.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

The second set of diagrams (FIGS. 75-124) have another style. They illustrate the magnitude and direction of the CHANGES IN MEAN DISTANCE FROM THE L.H.WALL between each footprint in TRIALS WITH OBSTACLES and the corresponding footprint in Directed Trials (6-10) in the Unobstructed Passageway.



ACTUAL LOCATION OF FOOTSTEPS



CHANGE IN LOCATION OF FOOTSTEPS AS PLOTTED

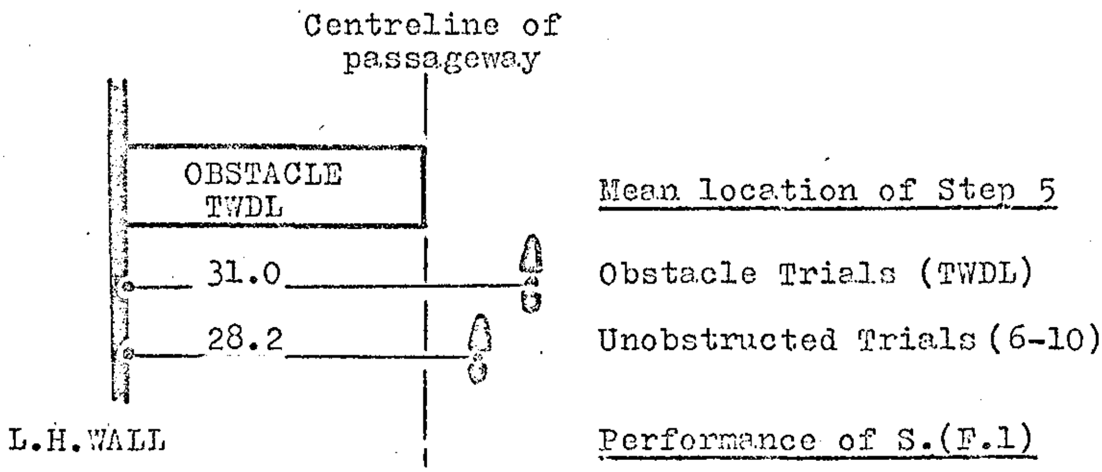
Figures (75 - 124) do not present changes in location about the centreline of the passageway, but show departures from the centreline of the mean route actually followed during Unobstructed Trials (6-10). In effect, the diagrams compare the assumed paths of the S's. body centreline during Obstacle Trials and Unobstructed Trials (6-10); that is to say, the recorded detours are measured <u>changes</u> in performance from established standards of performance. The statistical significance of the changes for individual performances is tested by applying Confidence Limits at the five per cent level obtained from the corresponding Unobstructed Trials (6-10). The main departure from the format of bar charts presented in the earlier diagrams is that differences in magnitude are connected as though points on a graph to provide a better if somewhat foreshortened visual analogy with the S's. actual movement over the ground.

Interpretation of Difference Tables and related diagrams.

All difference tables were derived by subtracting "Unobstructed values" from "values in Obstacle Trials" and the remainders were given positive or negative signs accordingly. By this practice, positive values represent an increase in mean stride length during Obstacle Trials and negative values a corresponding decrease in mean stride length.

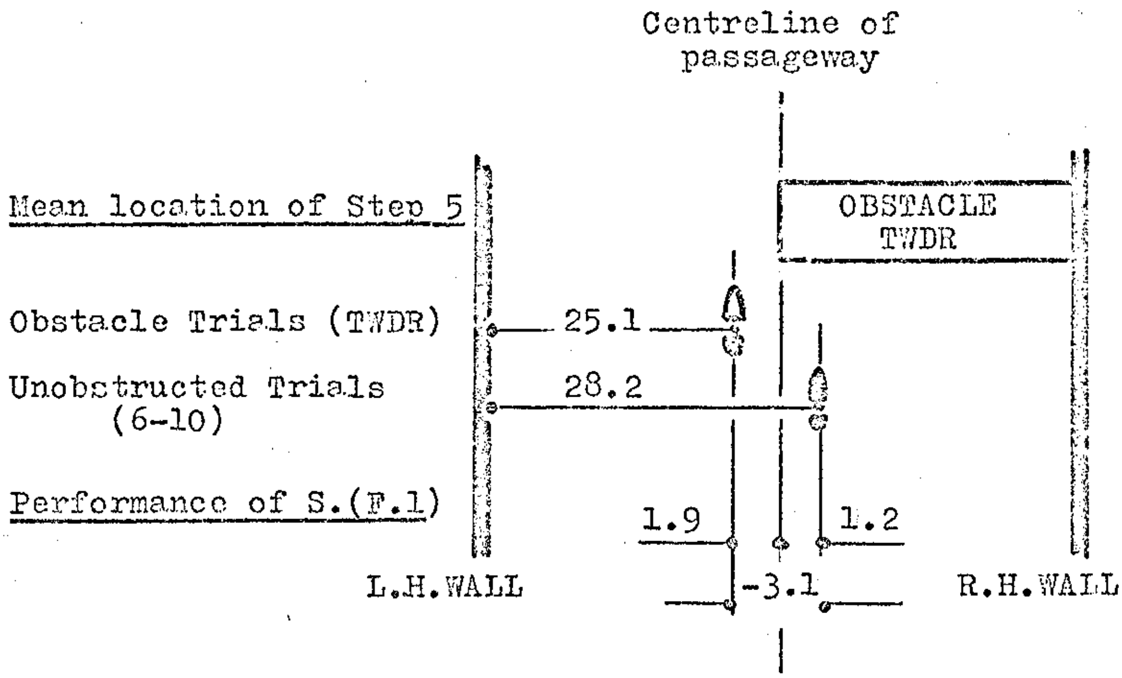
As regards recorded differences in footprint location from the L.H.Wall, positive values represent a shift to the right from the route taken in Unobstructed Trials and negative values a corresponding shift to the left.

Example: Positive difference value (+2.8)



It is shown below how use of the L.H.Wall as a datum for measures of shift in route between Unobstructed Trials and Obstacle Trials avoided the risk of arithmetical errors which might have been incurred in evaluating the additive significance of shifts about a datum based on the centre-line of the passageway.

Example: Negative difference value (-3.1)



4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

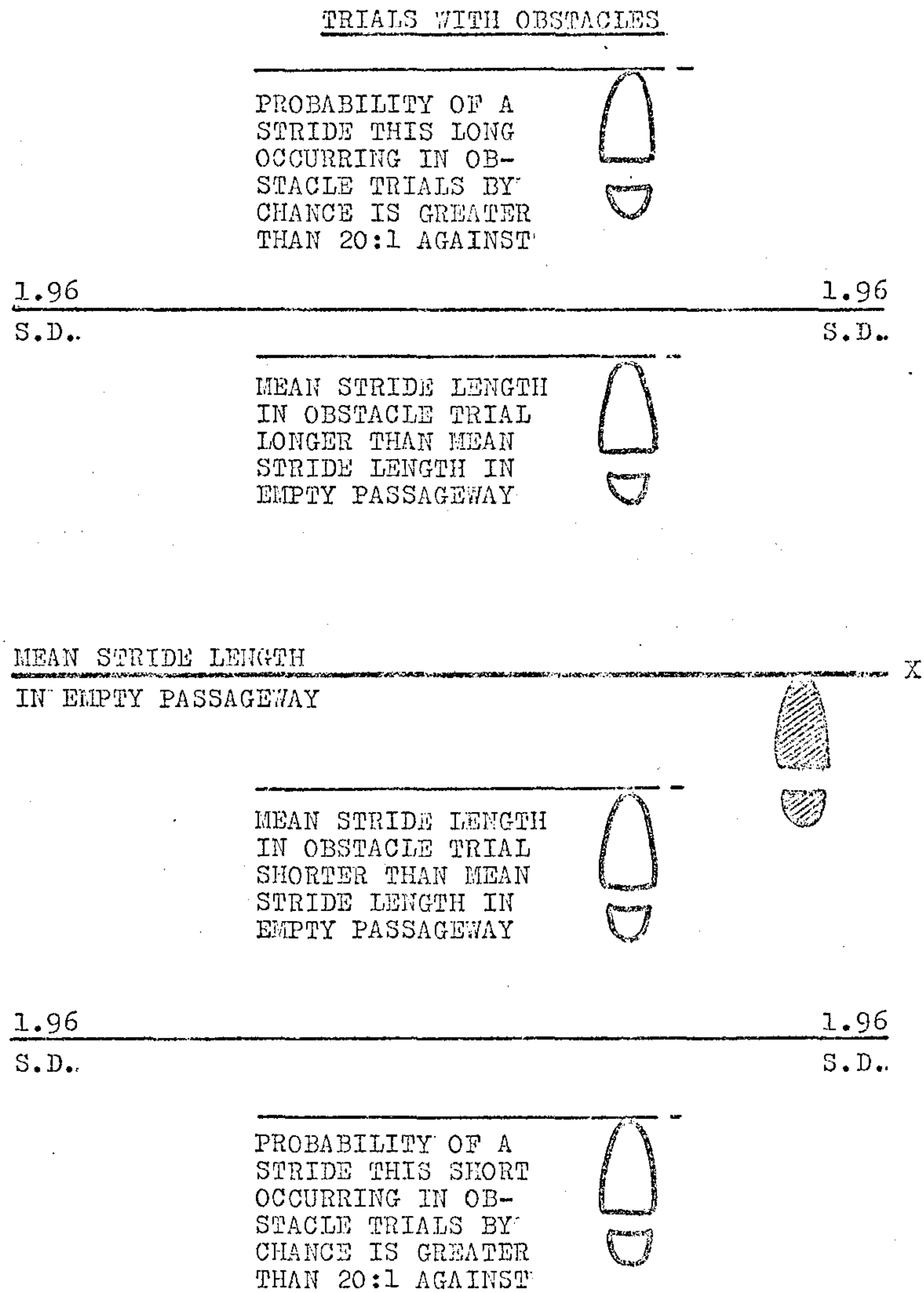
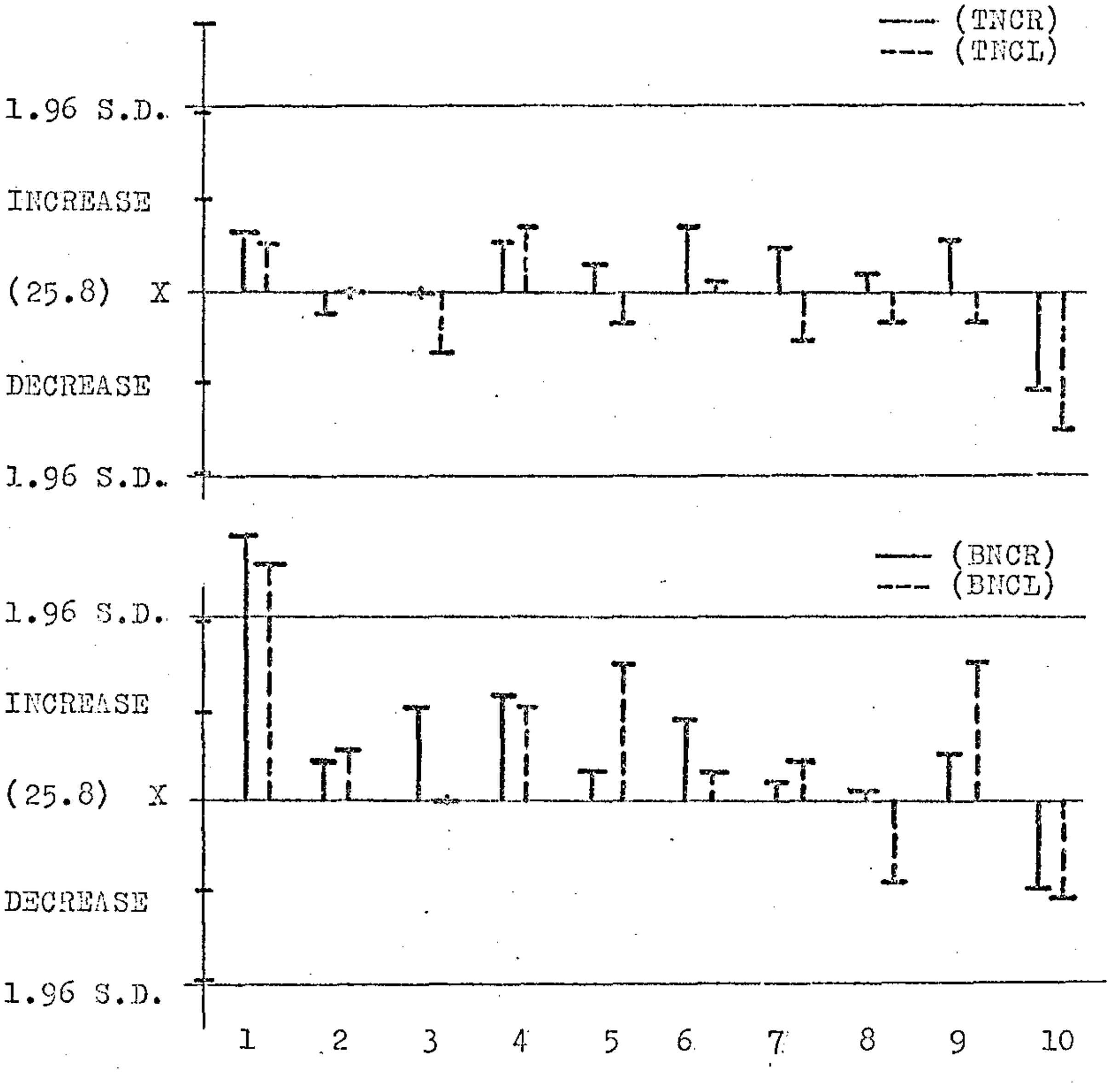


FIG. (41) FORMAT OF BAR CHARTS COMPARING MEAN STRIDE LENGTHS IN UNOBSTRUCTED PASSAGEWAY WITH MEAN STRIDE LENGTHS TAKEN IN OBSTACLE TRIALS.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (25.8inches) of Subject (F.1) in Unobstructed Trials (6-10). (Number of strides n=50).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

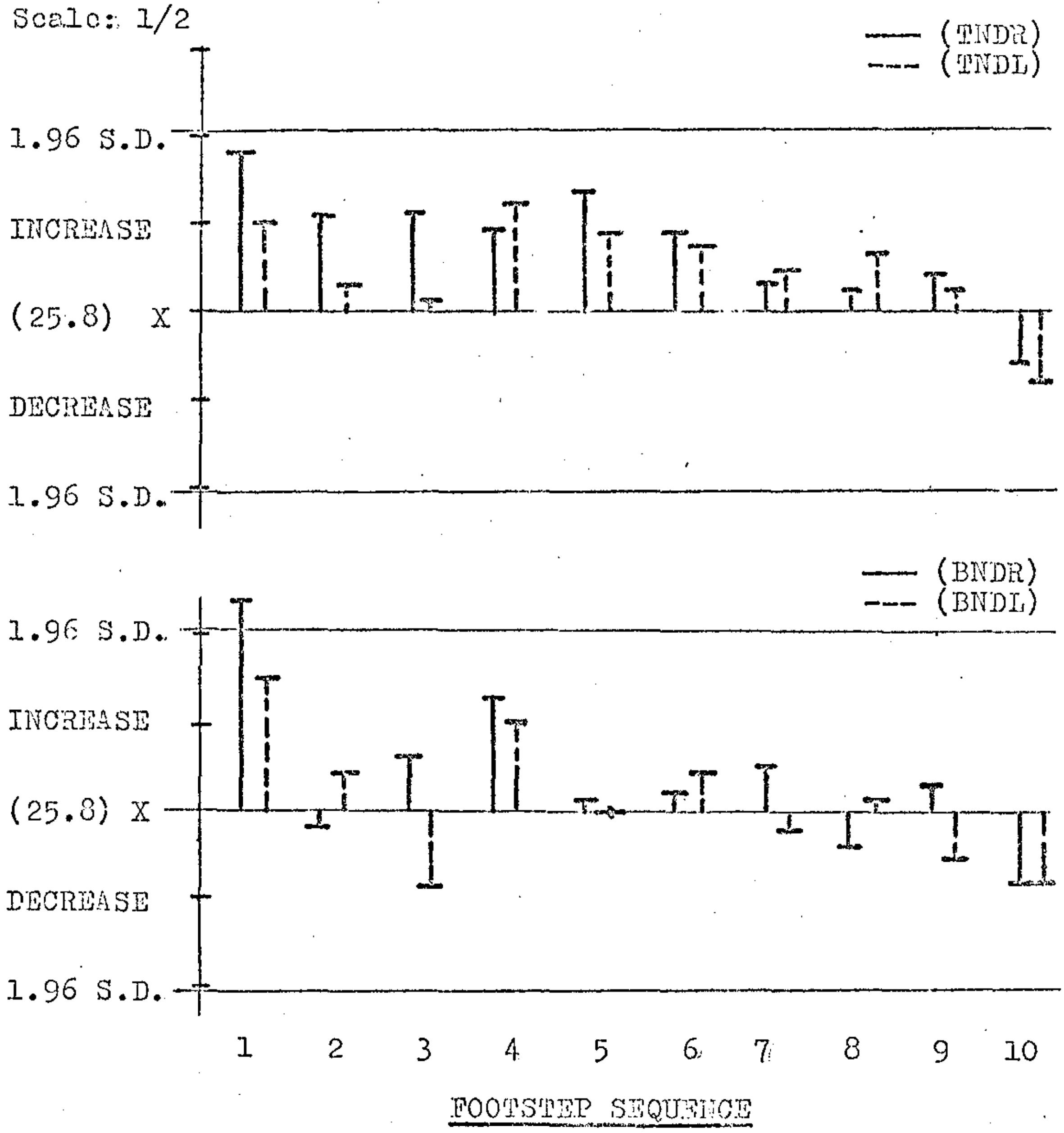
For data of diagrams see APPENDIX 2 (TABLE 64).

FIG.(42) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNCR,TNCL) & (BNCR,BNCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.1)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (25.8 inches) of Subject (F.1) in Unobstructed Trials (6-10). (Number of strides n=50).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

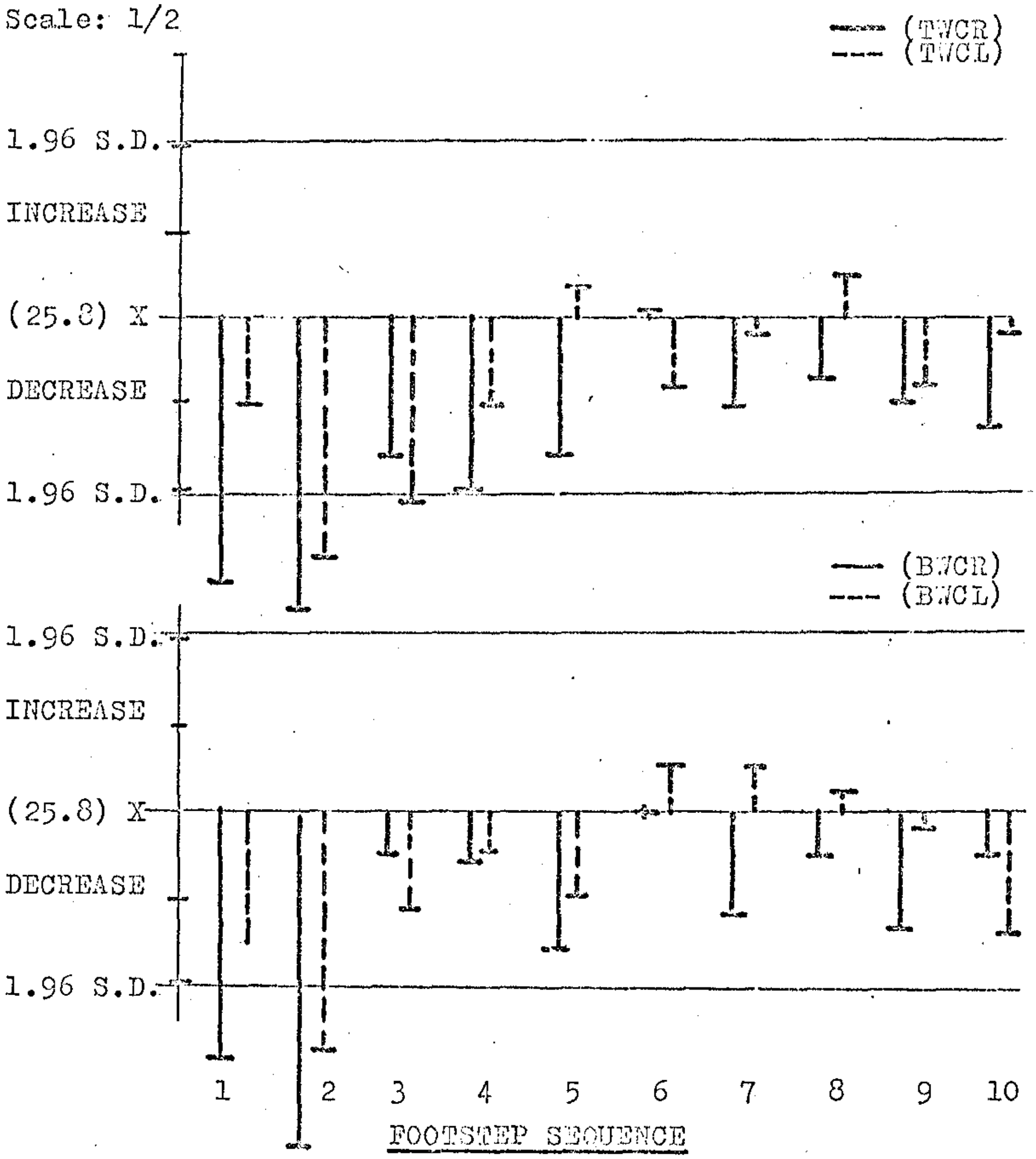
For data of diagrams see APPENDIX 2 (TABLE 64).

FIG.(43) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNDR, TNDL) & (BNDR, BNDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.1)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (25.8 inches) of Subject (F.1) in Unobstructed Trials (6-10). (Number of strides n=50).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

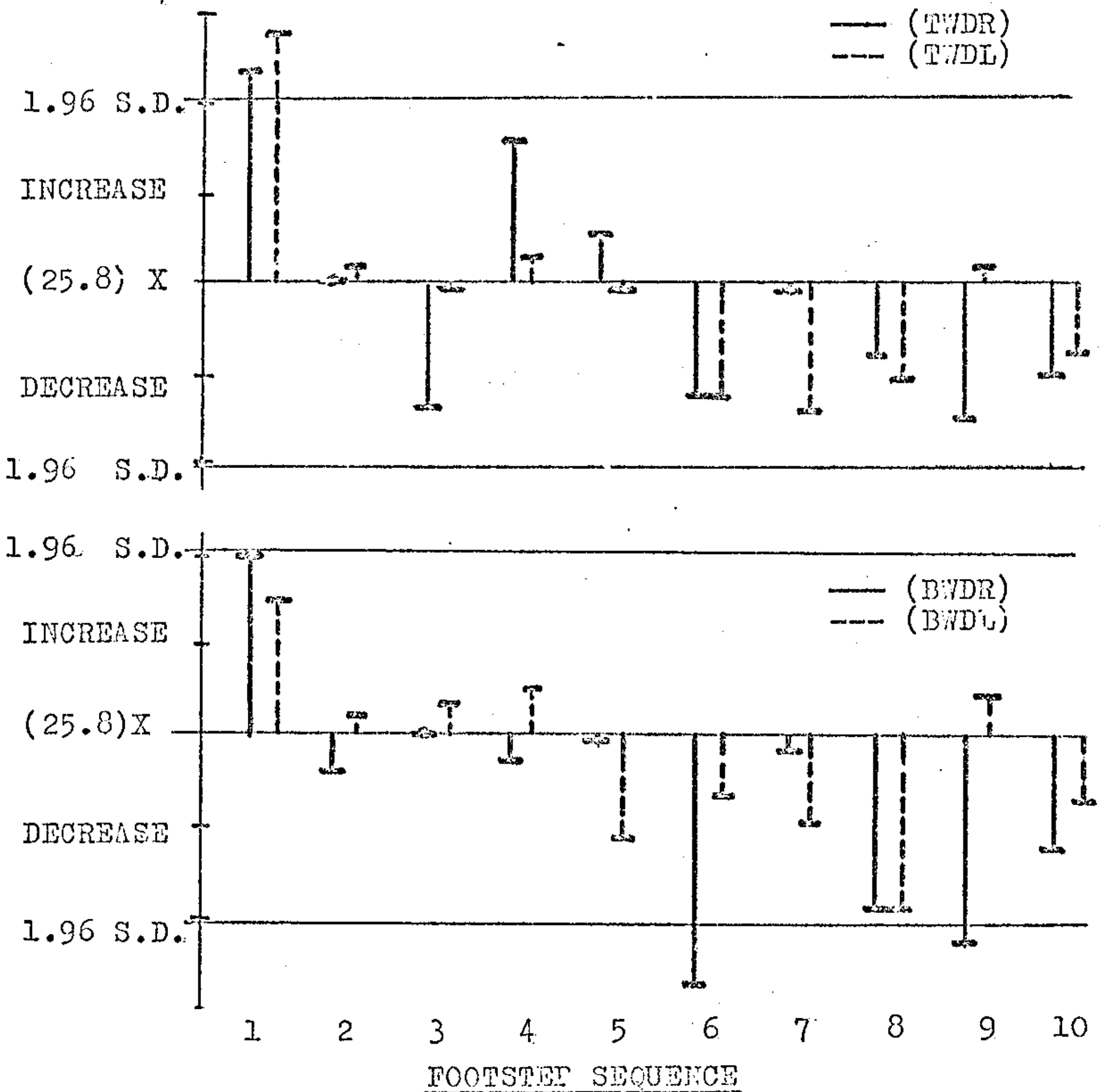
For data of diagrams see APPENDIX 2 (TABLE 64).

FIG.(44) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWCR,TWCL) & (BWCR,BWCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.1)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (25.8 inches) of Subject (F.1) in Unobstructed Trials (6-10). (Number of strides n=50).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

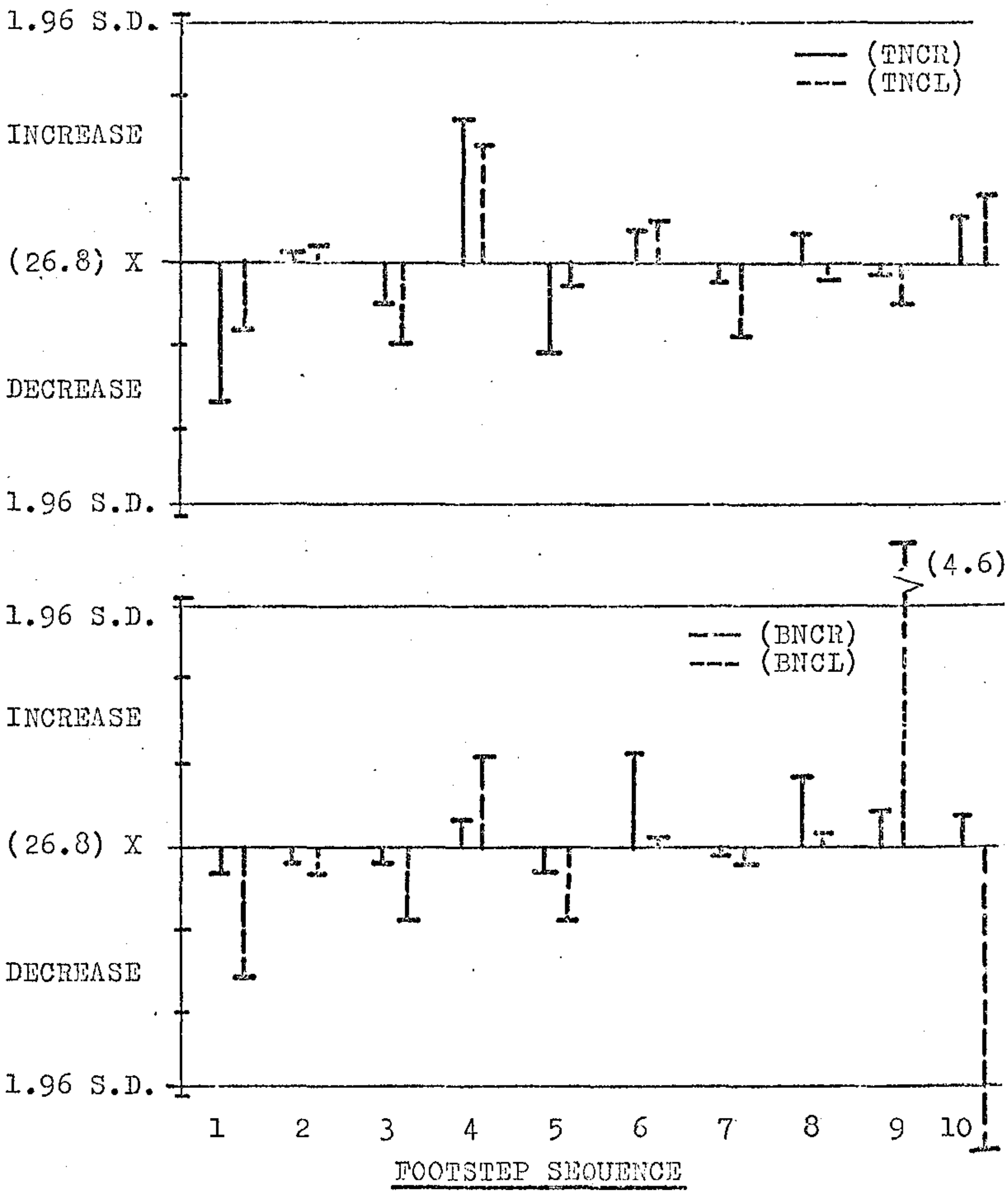
For data of diagrams see APPENDIX 2 (TABLE 64).

FIG.(45) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWDR, TWDL) & (BWDR, BWDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.1)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (26.8 inches) of Subject (F.2) in Unobstructed Trials (6-10). (Number of strides n=50).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

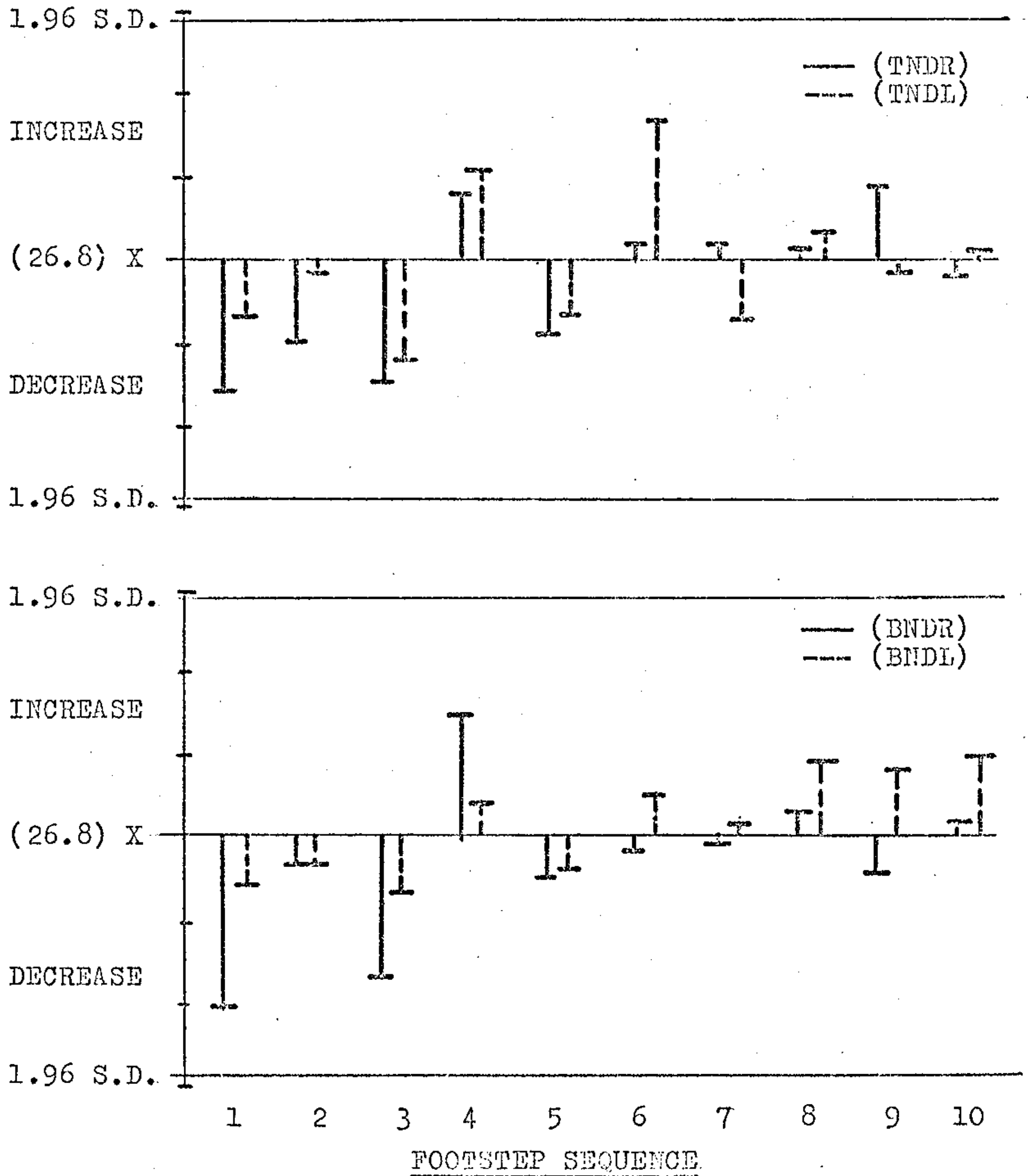
For data of diagrams see APPENDIX 2 (TABLE 65).

FIG.(46) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNCR,TNCL) & (BNCR,BNCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



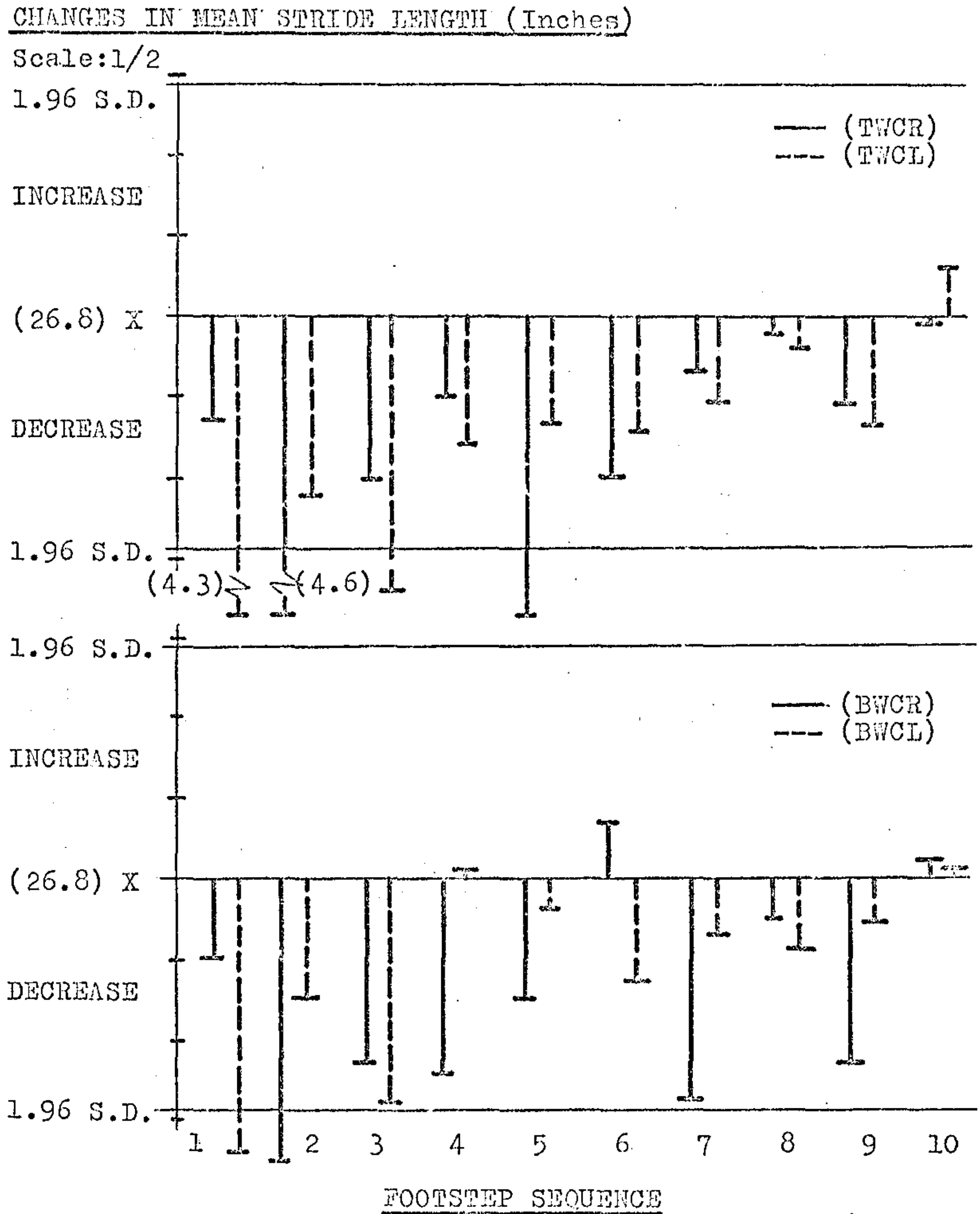
The (X) axis represents the overall mean stride length (26.8 inches) of Subject (F.2) in Unobstructed Trials (6-10). (Number of strides n=50).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagrams see APPENDIX 2 (TABLE 65).

FIG.(47) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNDR,TNDL) & (BNDR,BNDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



The (X) axis represents the overall mean stride length (26.8 inches) of Subject (F.2) in Unobstructed Trials (6-10). (Number of strides n=50).

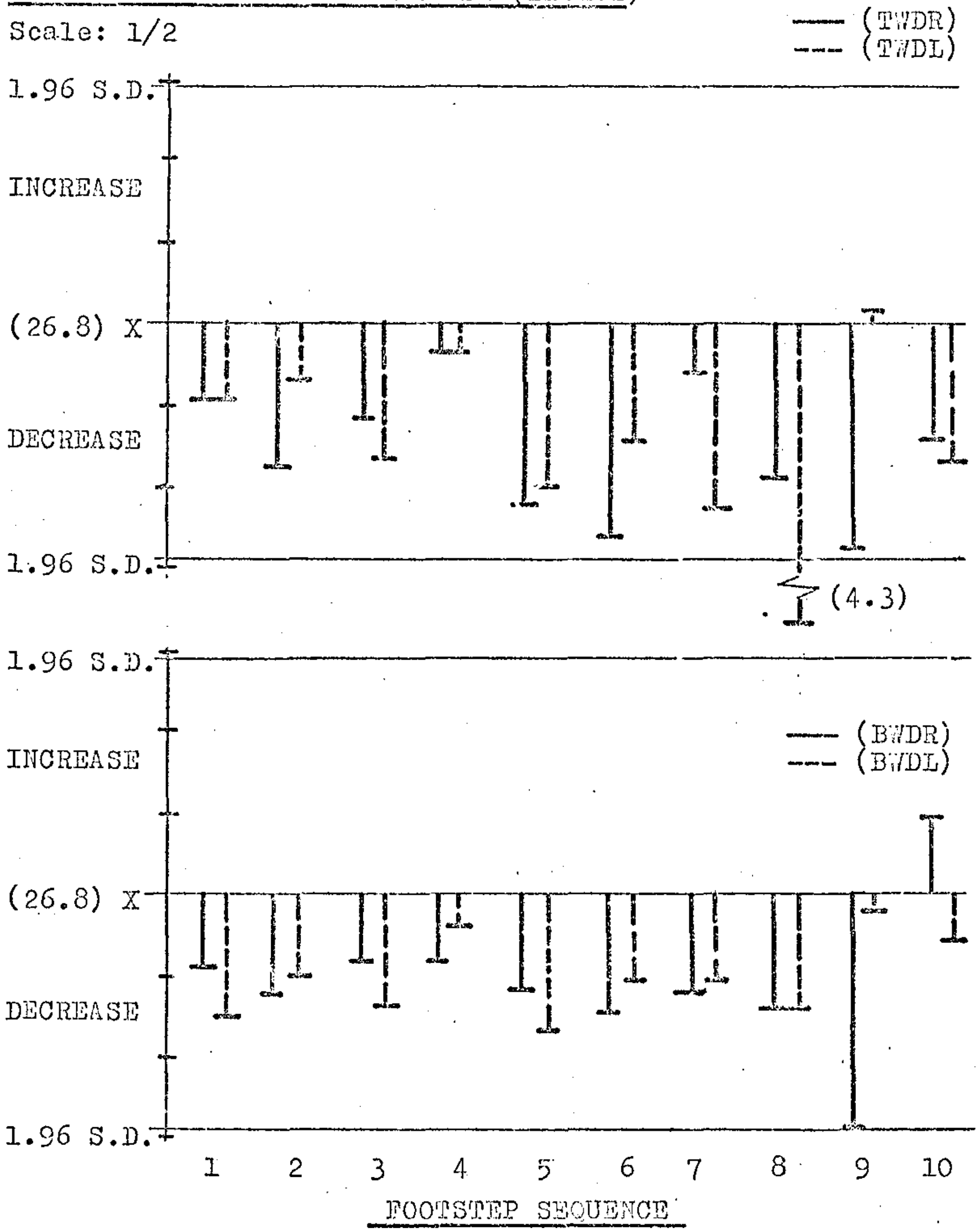
Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.
For data of diagrams see APPENDIX 2 (TABLE 65).

FIG.(48) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWCR,TWCL) & (BWCR,BWCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (26.8 inches) of Subject (F.2) in Unobstructed Trials (6-10). (Number of strides n=50).

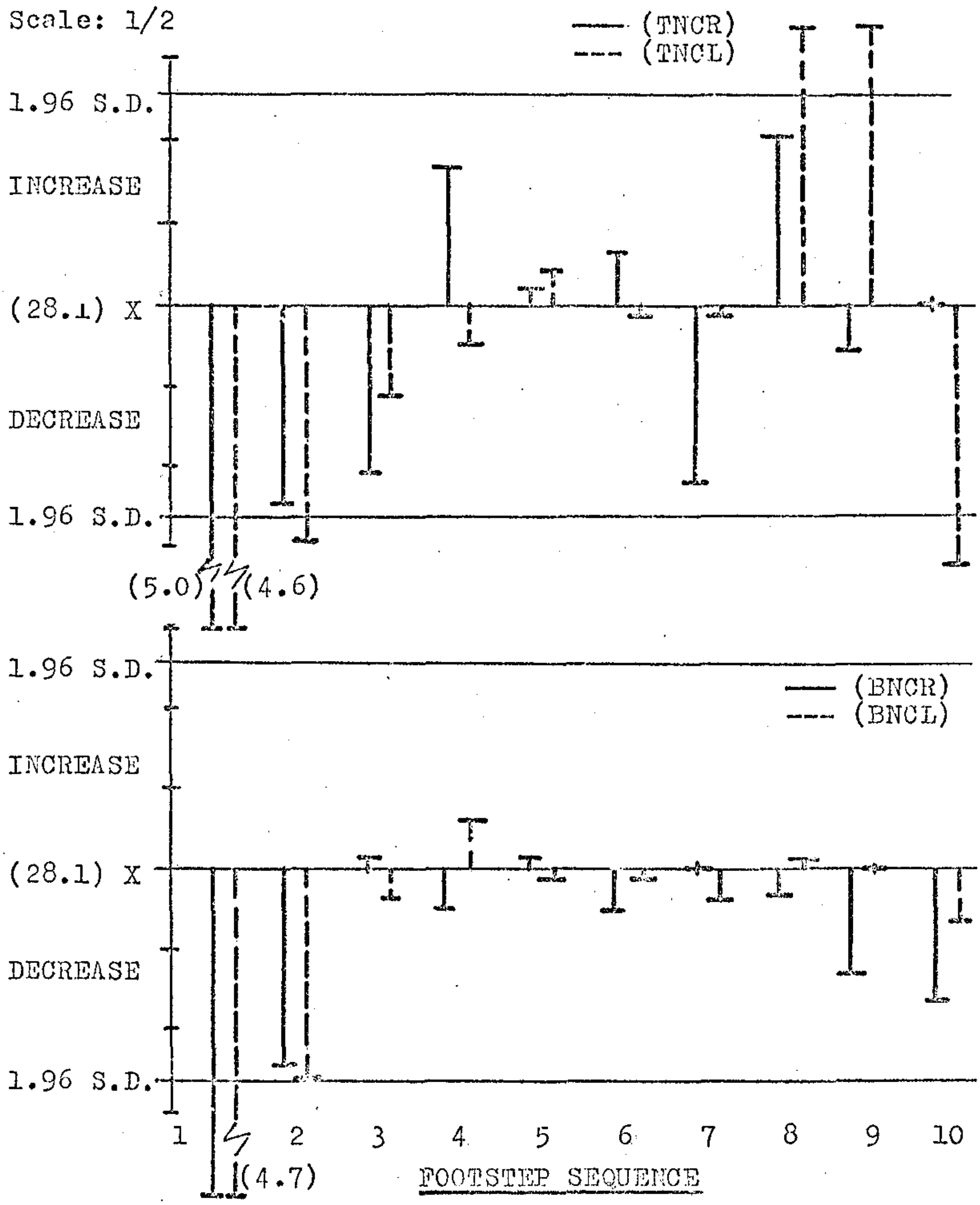
Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagrams see APPENDIX 2 (TABLE 65).

FIG.(49) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWDR,TWDL) & (BWDR,BWDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)



The (X) axis represents the overall mean stride length (28.1 inches) of Subject (F.3) in Unobstructed Trials (6-10). (Number of strides n=45).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

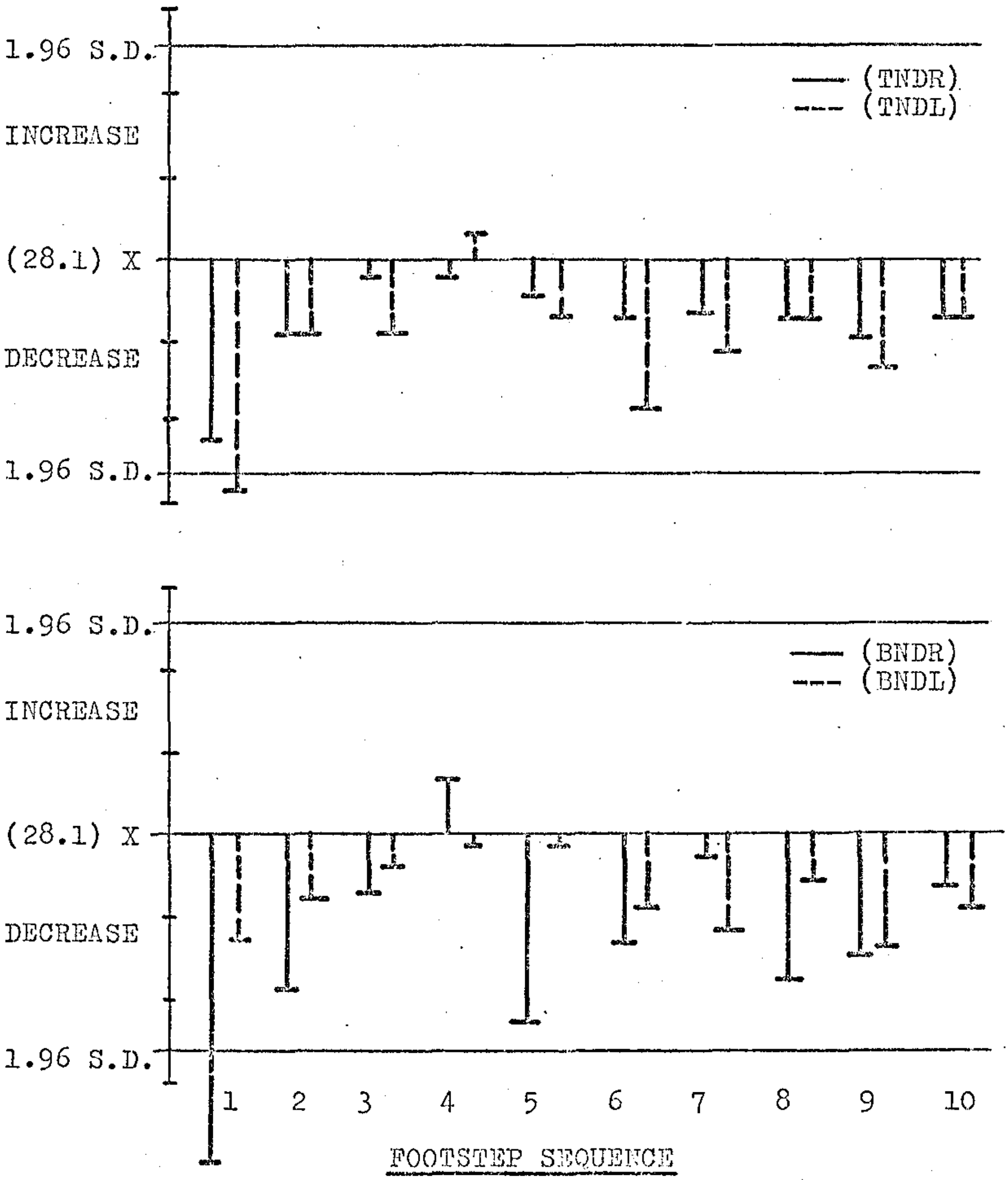
For data of diagrams see APPENDIX 2 (TABLE 66).

FIG.(50) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNCR,TNCL) & (BNCR,BNCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (28.1 inches) of Subject (F.3) in Unobstructed Trials (6-10). (Number of strides n=45).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

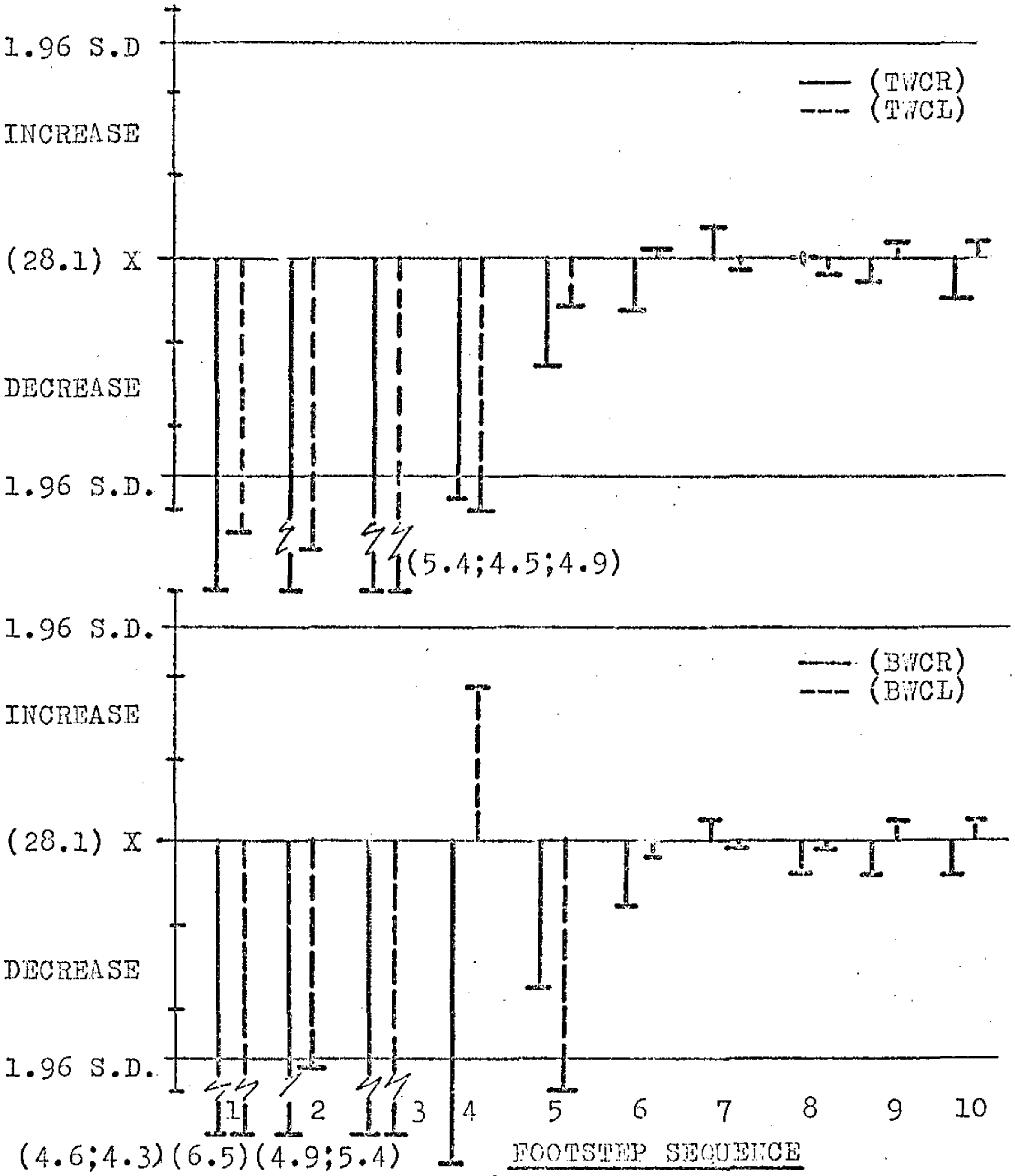
For data of diagrams see APPENDIX 2 (TABLE 66).

FIG.(51) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNDR,TNDL) & (BNDR,BNDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (28.1inches) of Subject (F.3) in Unobstructed Trials (6-10). (Number of strides n=45).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

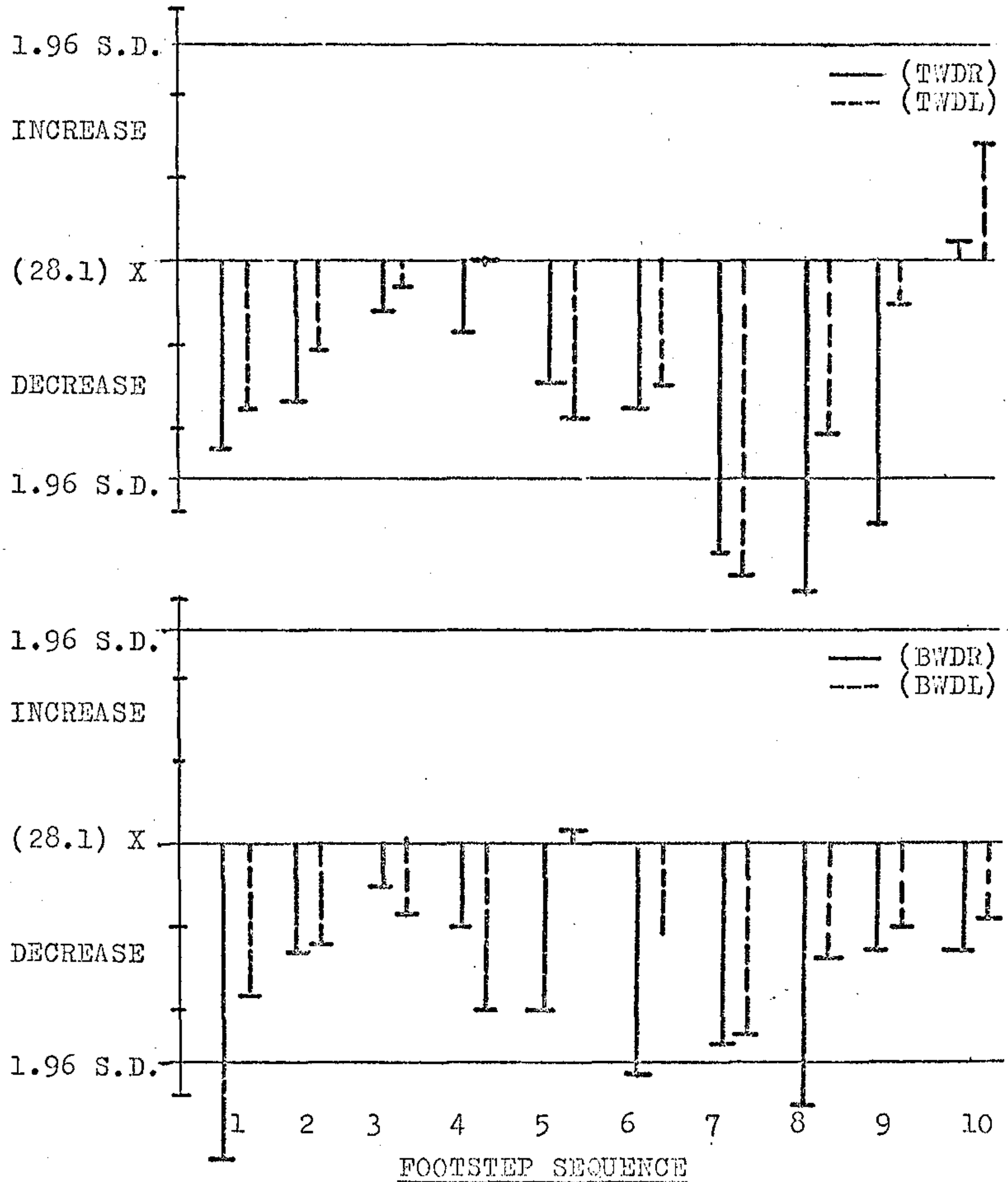
For data of diagrams see APPENDIX 2 (TABLE 66).

FIG.(52) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWCR,TWCL) & (BWCR,BWCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (28.1 inches) of Subject (F.3) in Unobstructed Trials (6-10). (Number of strides n=45).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

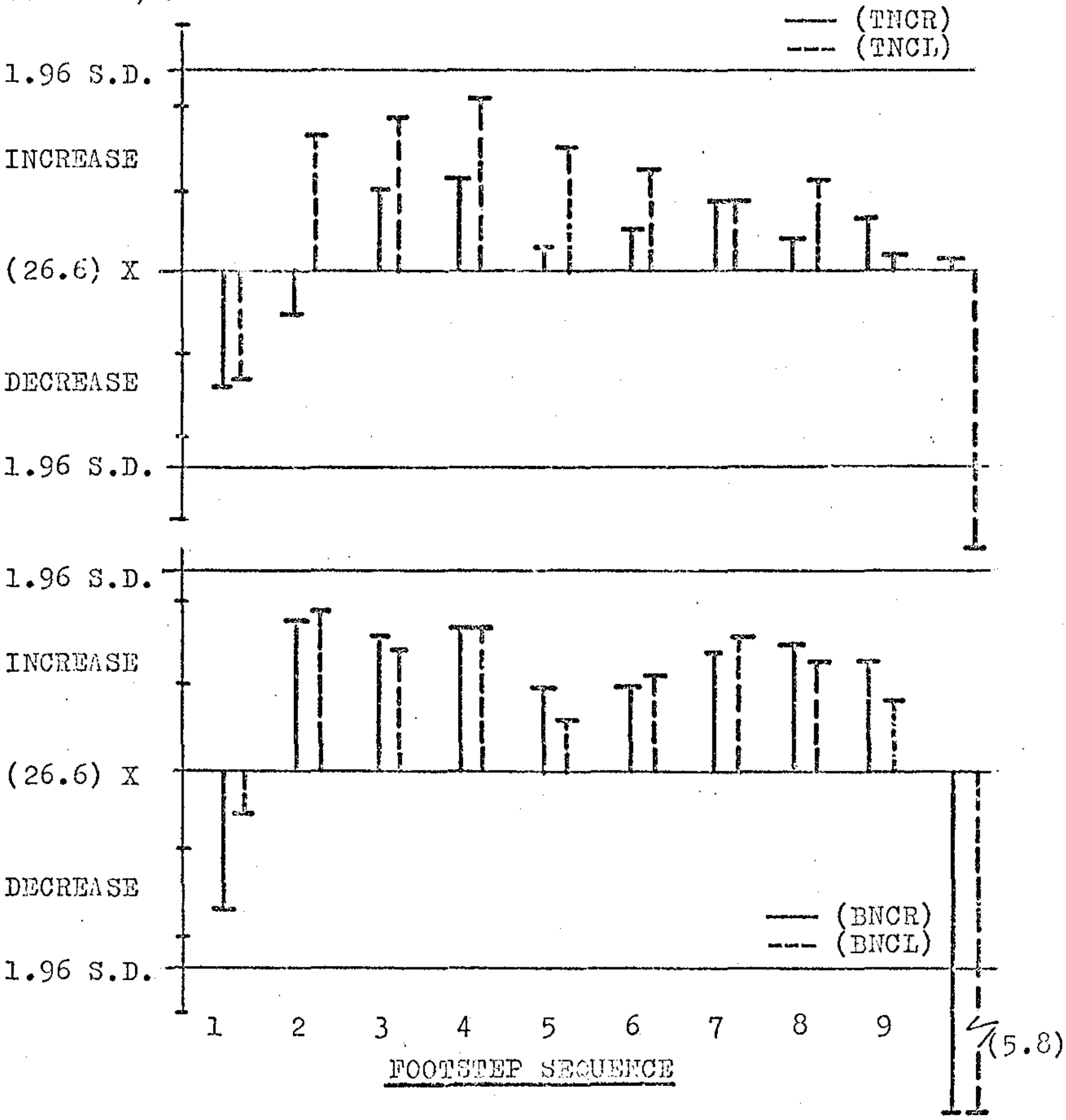
For data of diagrams see APPENDIX 2 (TABLE 66).

FIG.(53) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWDR,TWDL) & (BWDR,BWDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (F.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



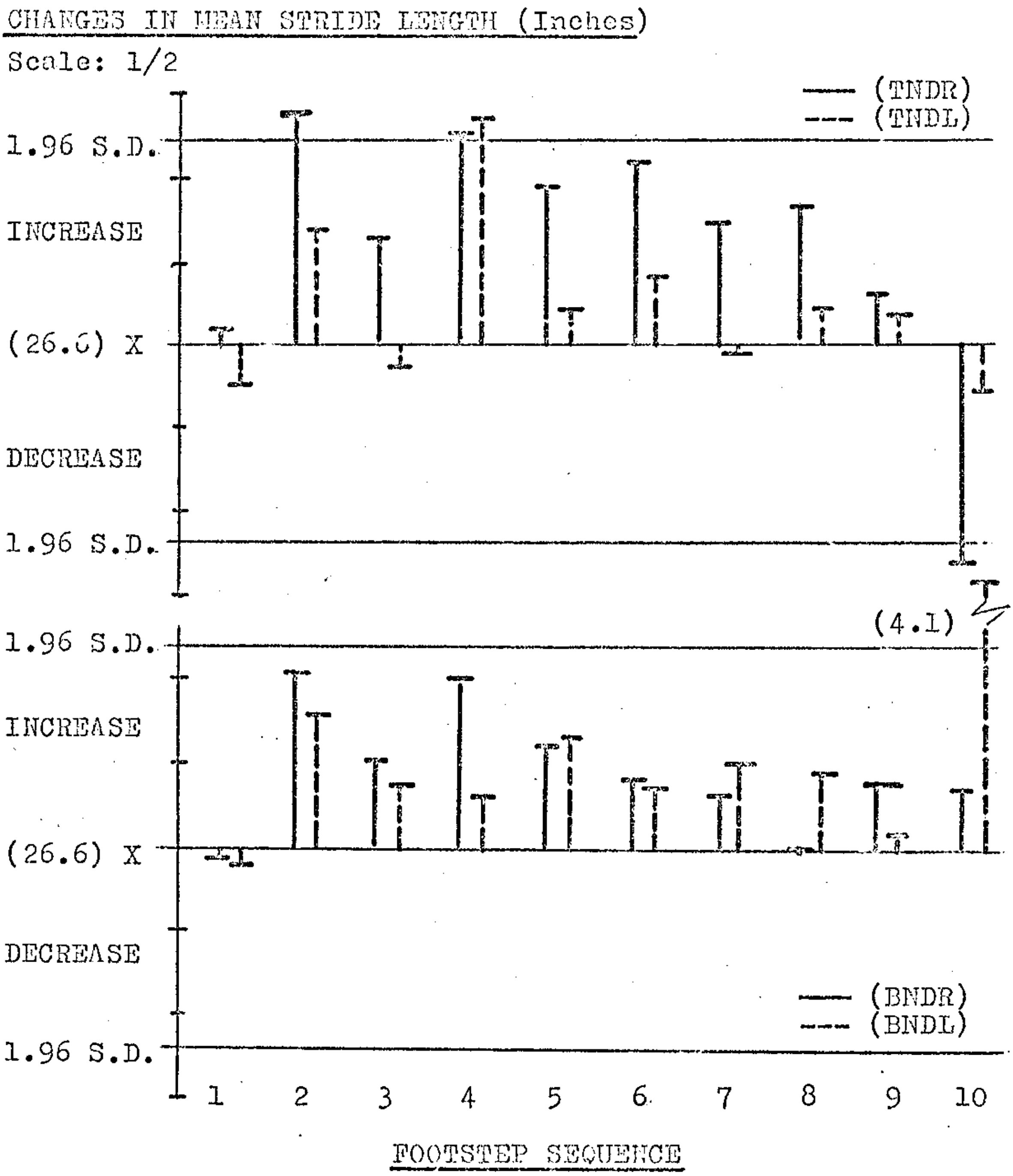
The (X) axis represents the overall mean stride length (26.6 inches) of Subject (M.1) in Unobstructed Trials (6-10). (Number of strides n=50).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagrams see APPENDIX 2 (TABLE 67).

FIG.(54) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNCR,TNCL) & (BNCR,BNCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.1)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



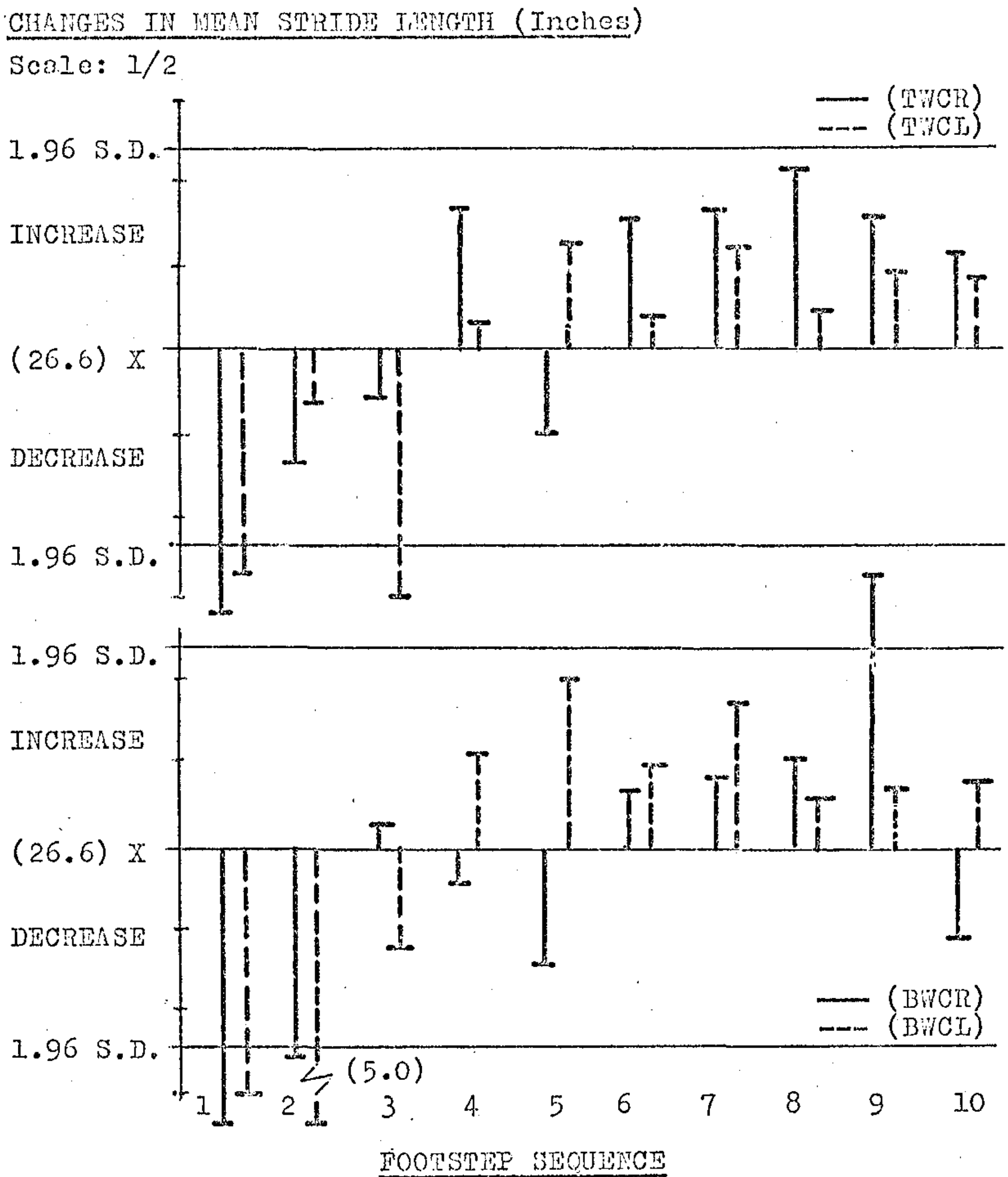
The (X) axis represents the overall mean stride length (26.6 inches) of Subject (M.1) in Unobstructed Trials (6-10). (Number of strides n=50).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagrams see APPENDIX 2 (TABLE 67).

FIG.(55) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNDR, TNDL) & (BNDR, BNDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.1)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



The (X) axis represents the overall mean stride length (26.6 inches) of Subject (M.1) in Unobstructed Trials (6-10). (Number of strides n=50).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

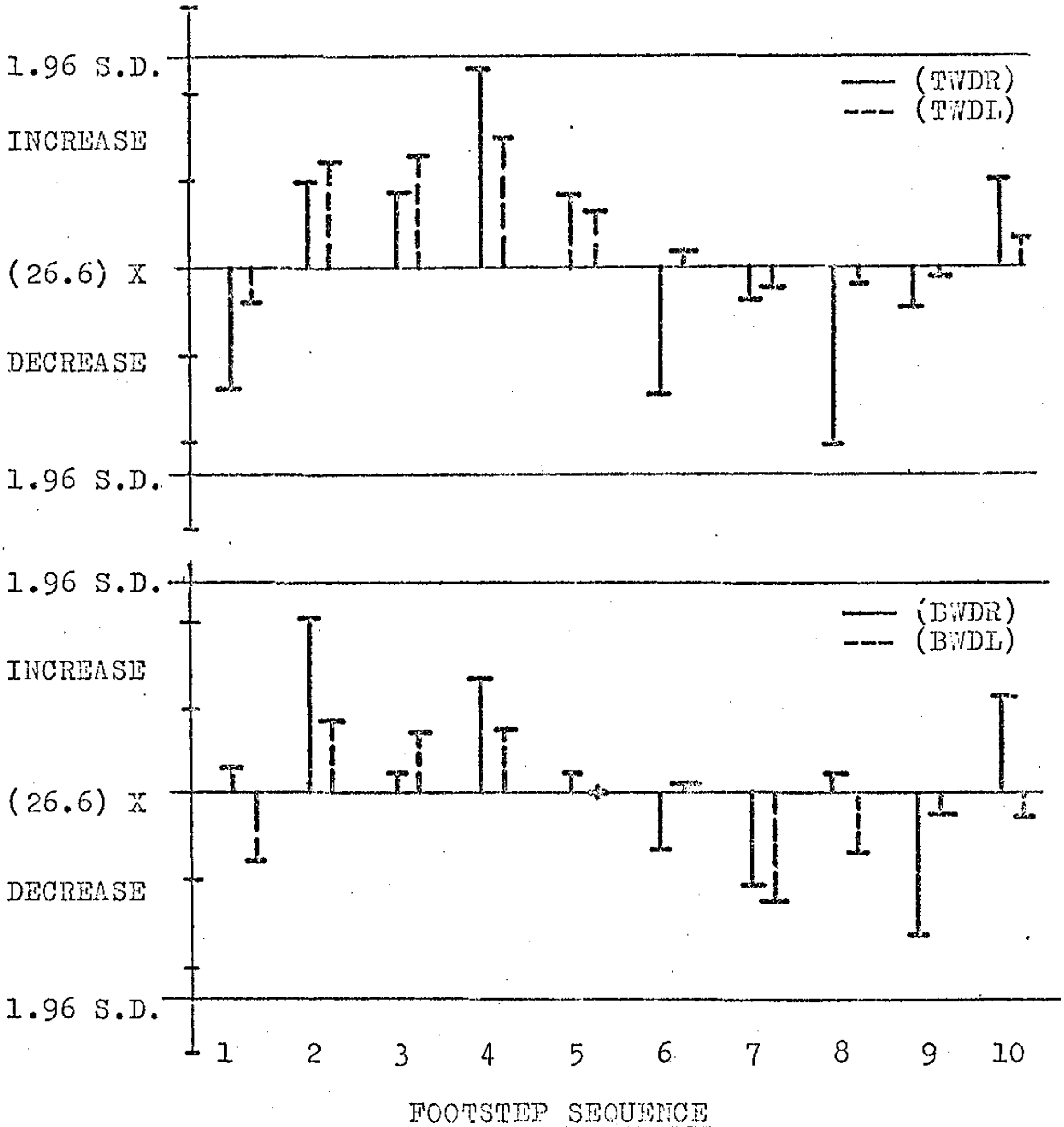
For data of diagrams see APPENDIX 2 (TABLE 67).

FIG.(56) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWCR,TWCL) & (BWCR,BWCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.1)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (26.6 inches) of Subject (M.1) in Unobstructed Trials (6-10). (Number of strides n=50).

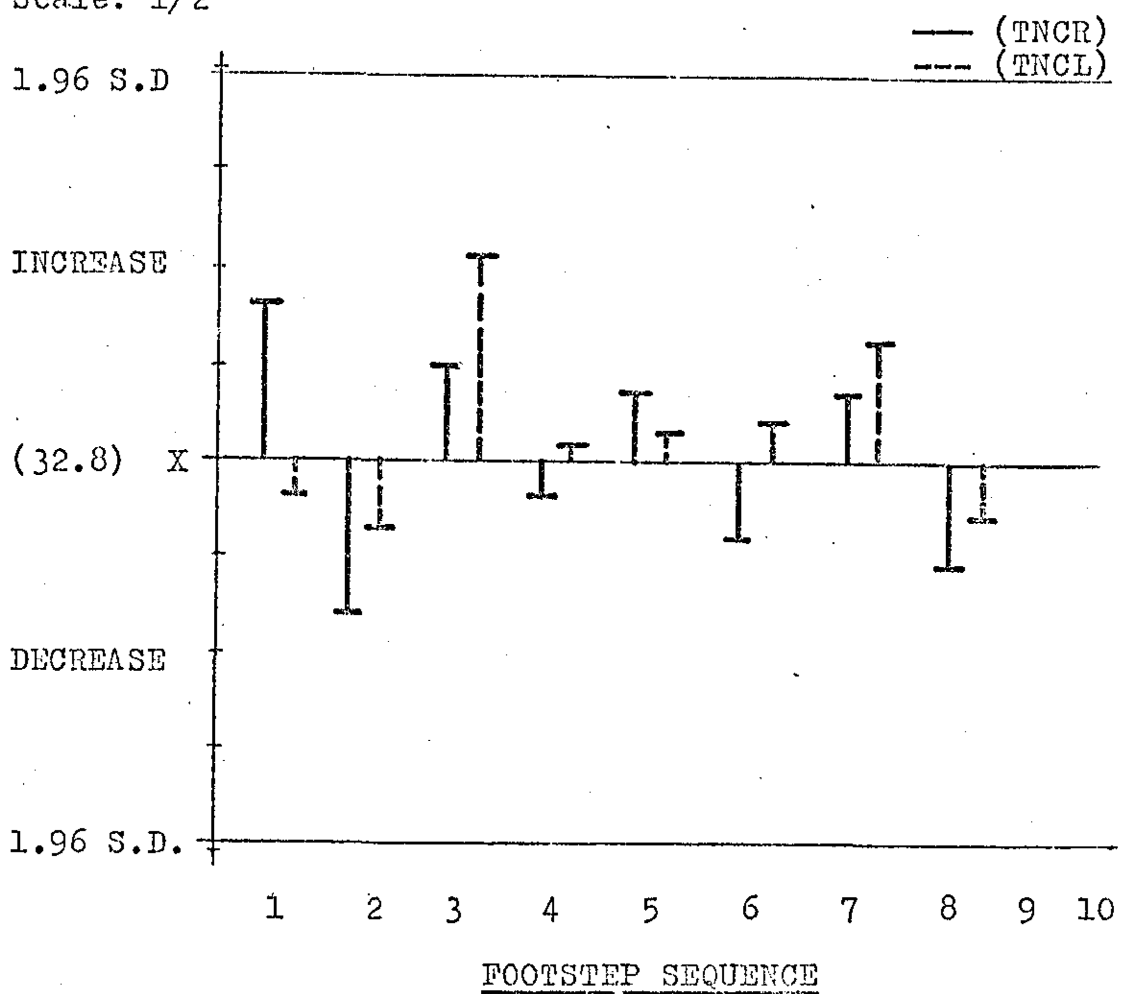
Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagrams see APPENDIX 2 (TABLE 67).

FIG.(57) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWDR,TWDL) & (BWDR,BWDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY (M.1)

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (32.8 inches) of Subject (M.2) in Unobstructed Trials (6-10). (Number of strides n=40).

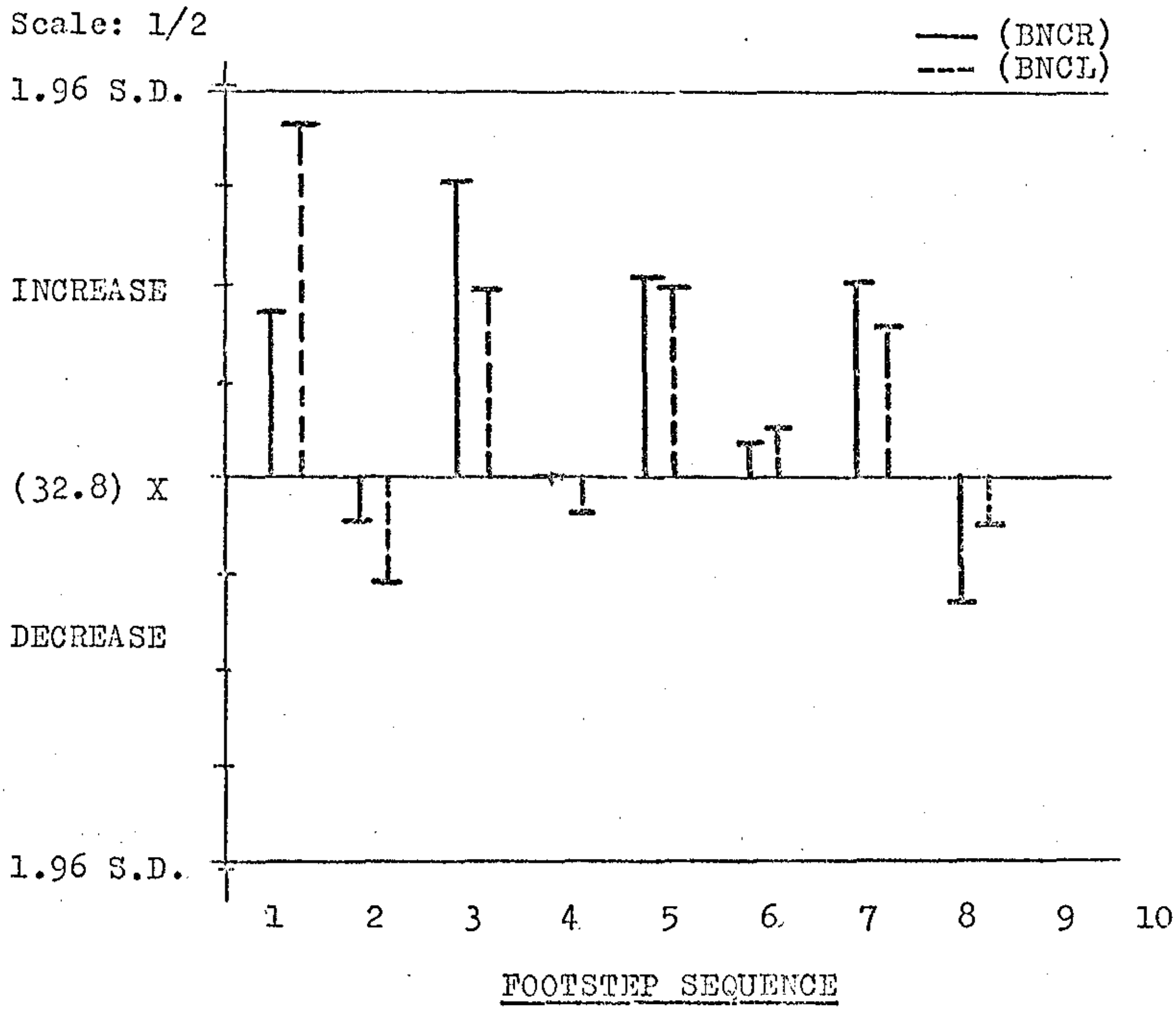
Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 68).

FIG.(58) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNCR,TNCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)



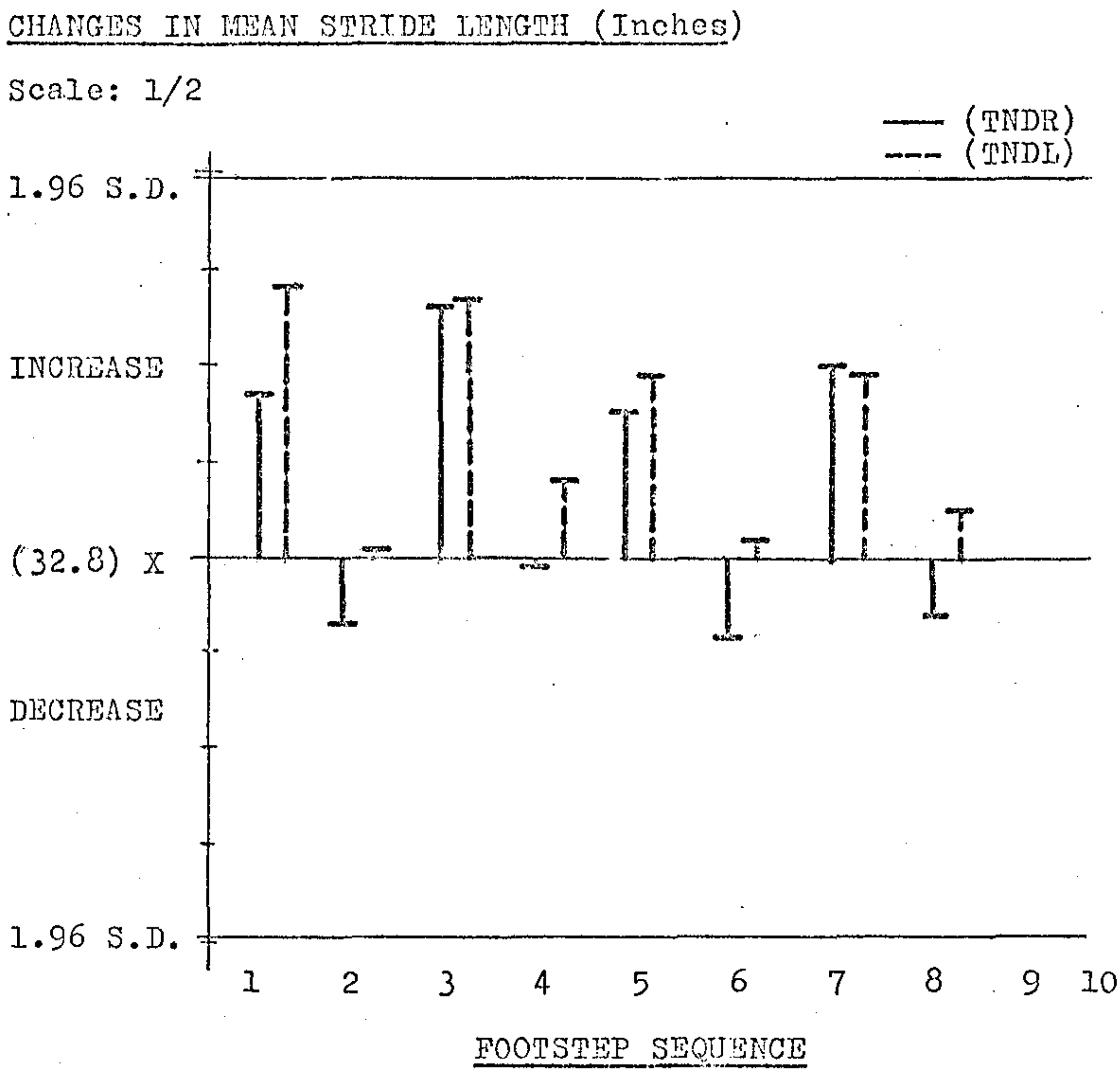
The (X) axis represents the overall mean stride length (32.8 inches) of Subject (M.2) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 68).

FIG.(59) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (BNCR,BNCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



The (X) axis represents the overall mean stride length (32.8 inches) of Subject (M.2) in Unobstructed Trials (6-10). (Number of strides n=40).

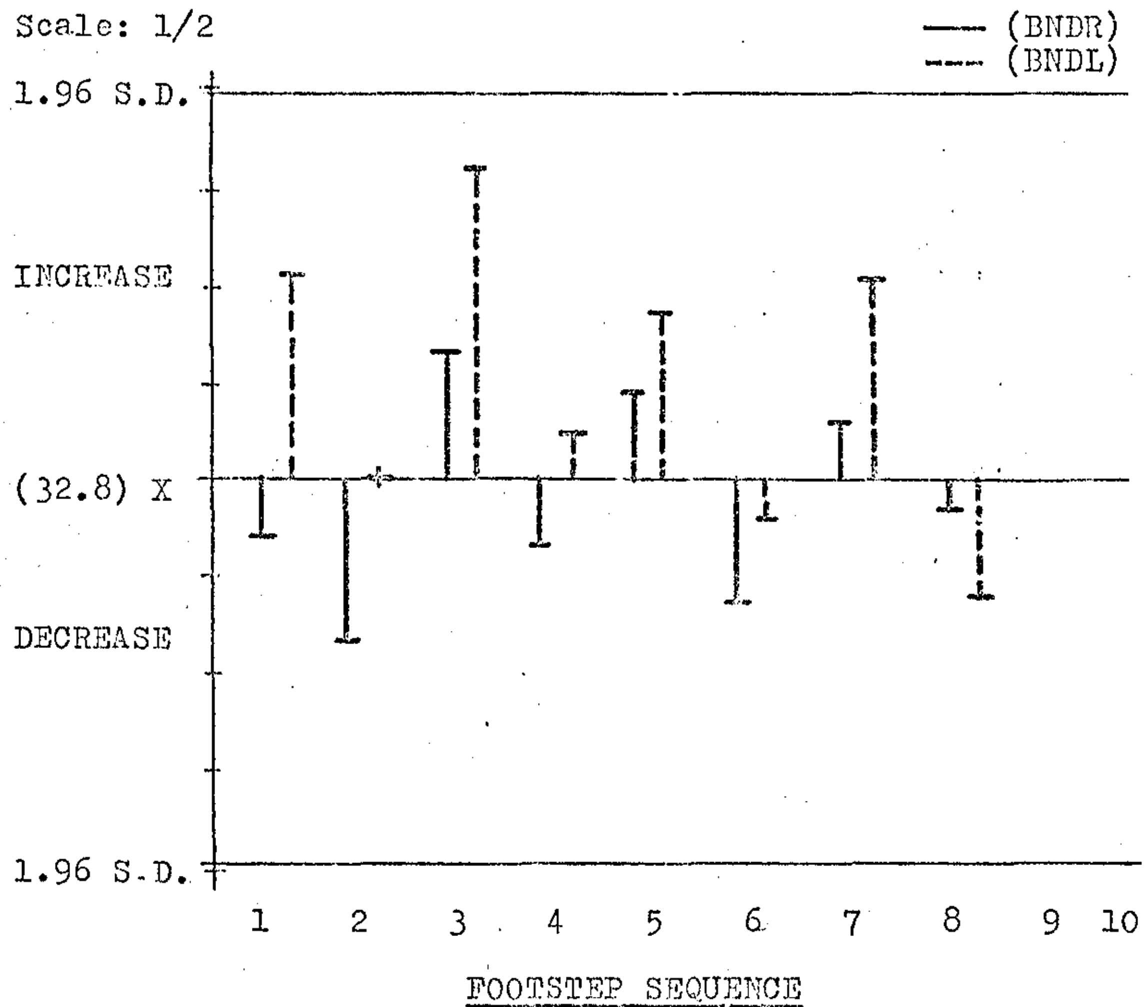
Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 68).

FIG.(60) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNDR,TNDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY.(M.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)



The (X) axis represents the overall mean stride length (32.8 inches) of Subject (M.2) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

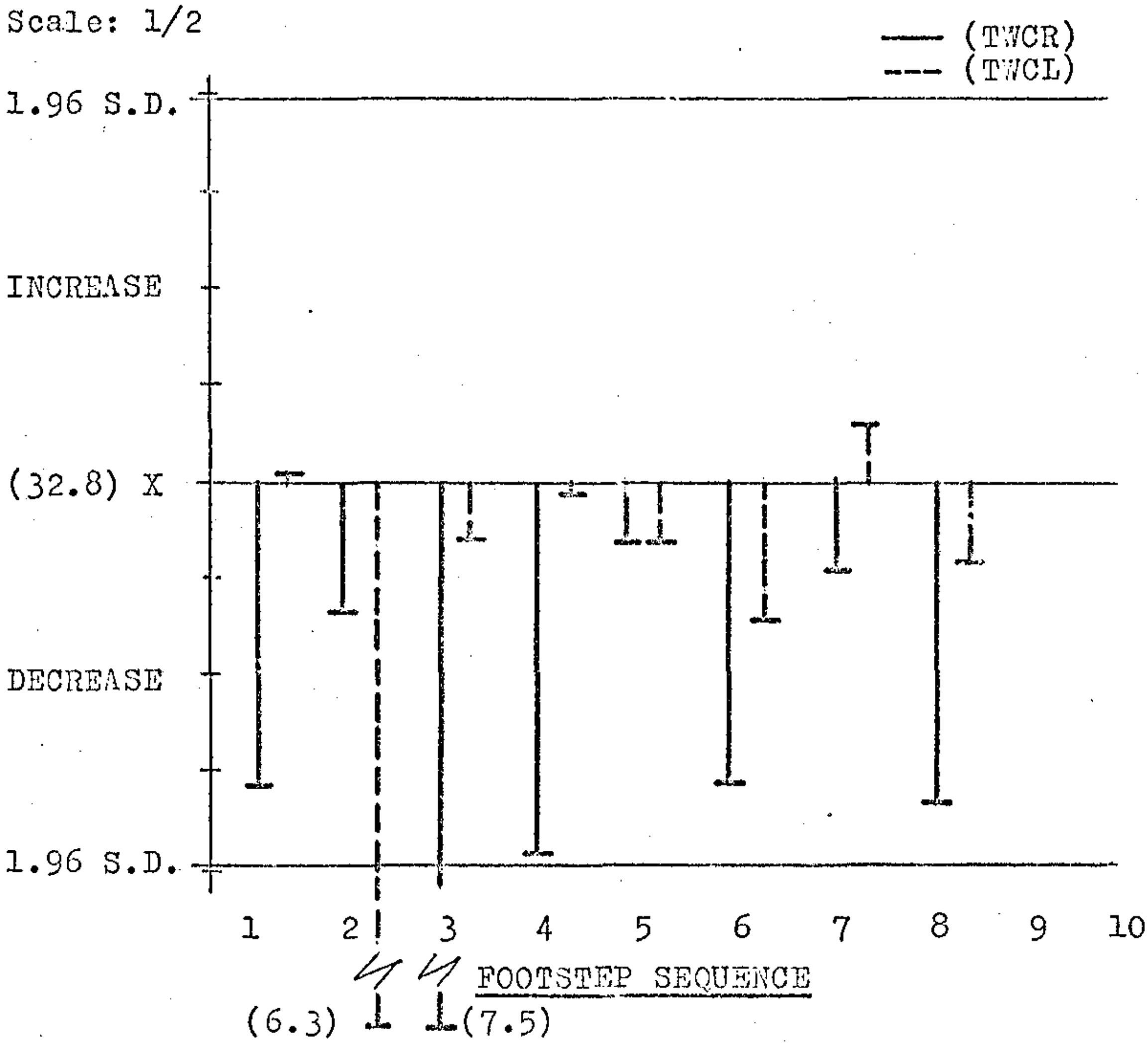
For data of diagram see APPENDIX 2 (TABLE 68).

FIG.(61) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (BNDR,BNDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (32.8 inches) of Subject (M.2) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

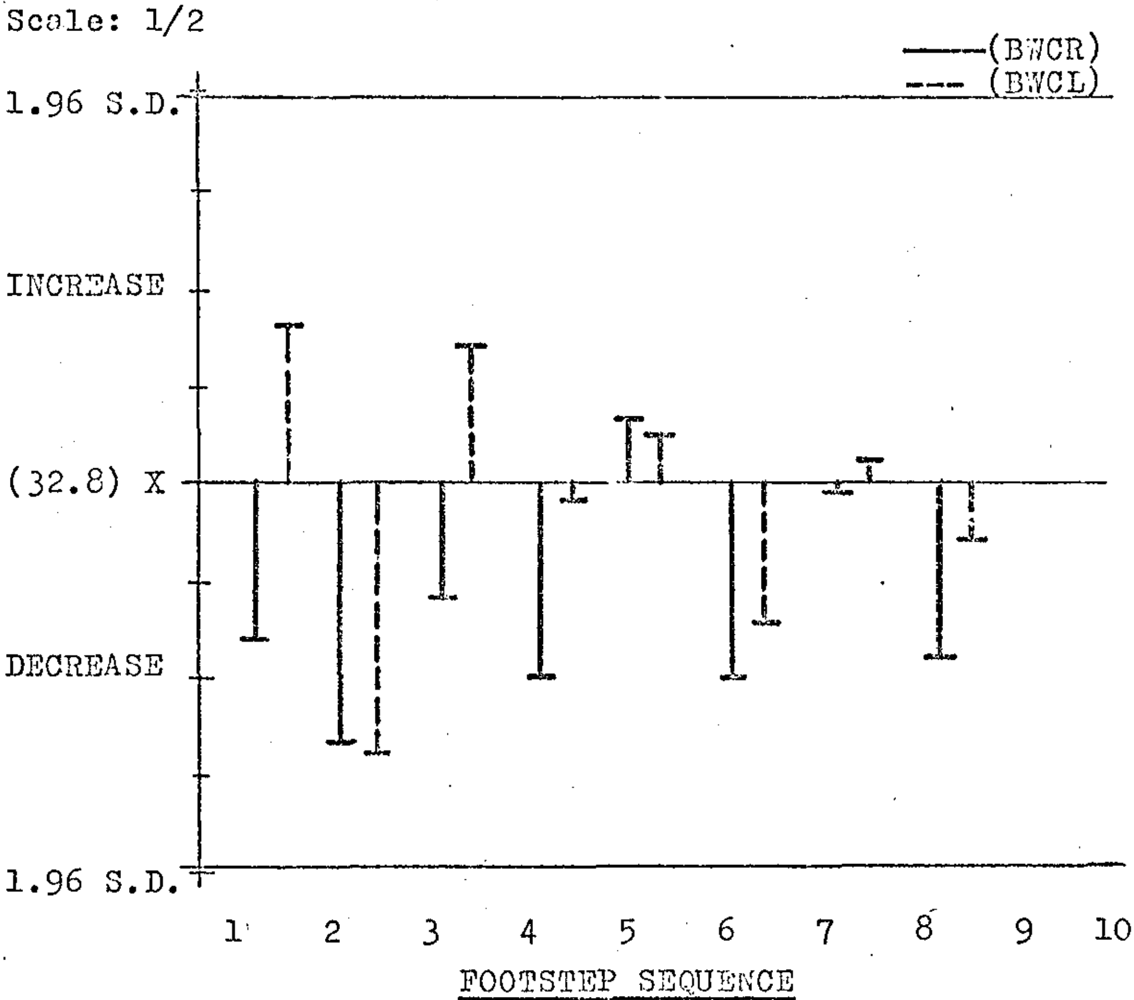
For data of diagram see APPENDIX 2 (TABLE 68).

FIG.(62) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWCR,TWCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY .(M.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (32.8 inches) of Subject (M.2) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

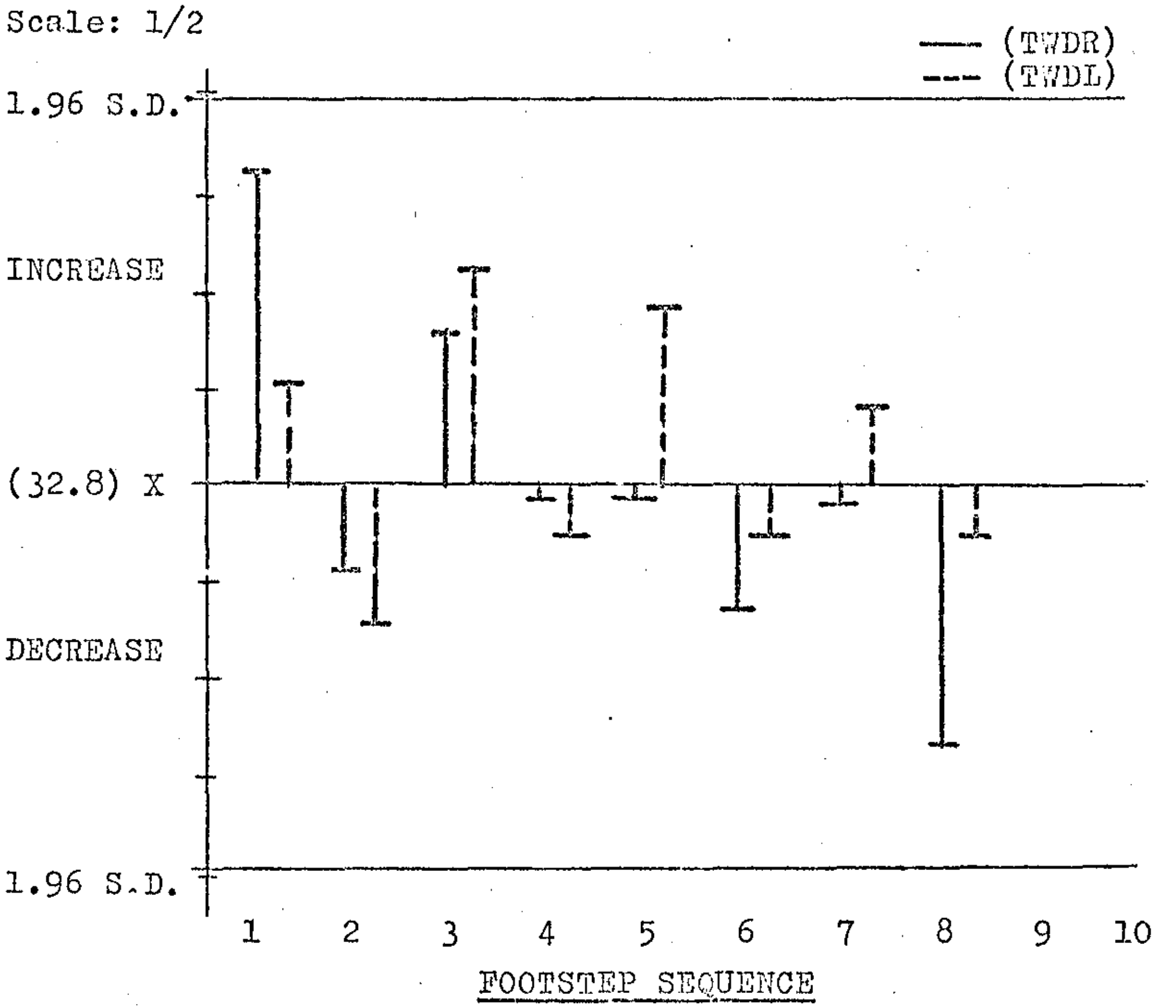
For data of diagram see APPENDIX 2 (TABLE 68).

FIG.(63) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (BWCR,BWCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (32.8 inches) of Subject (M.2) in Unobstructed Trials (6-10). (Number of strides n=40).

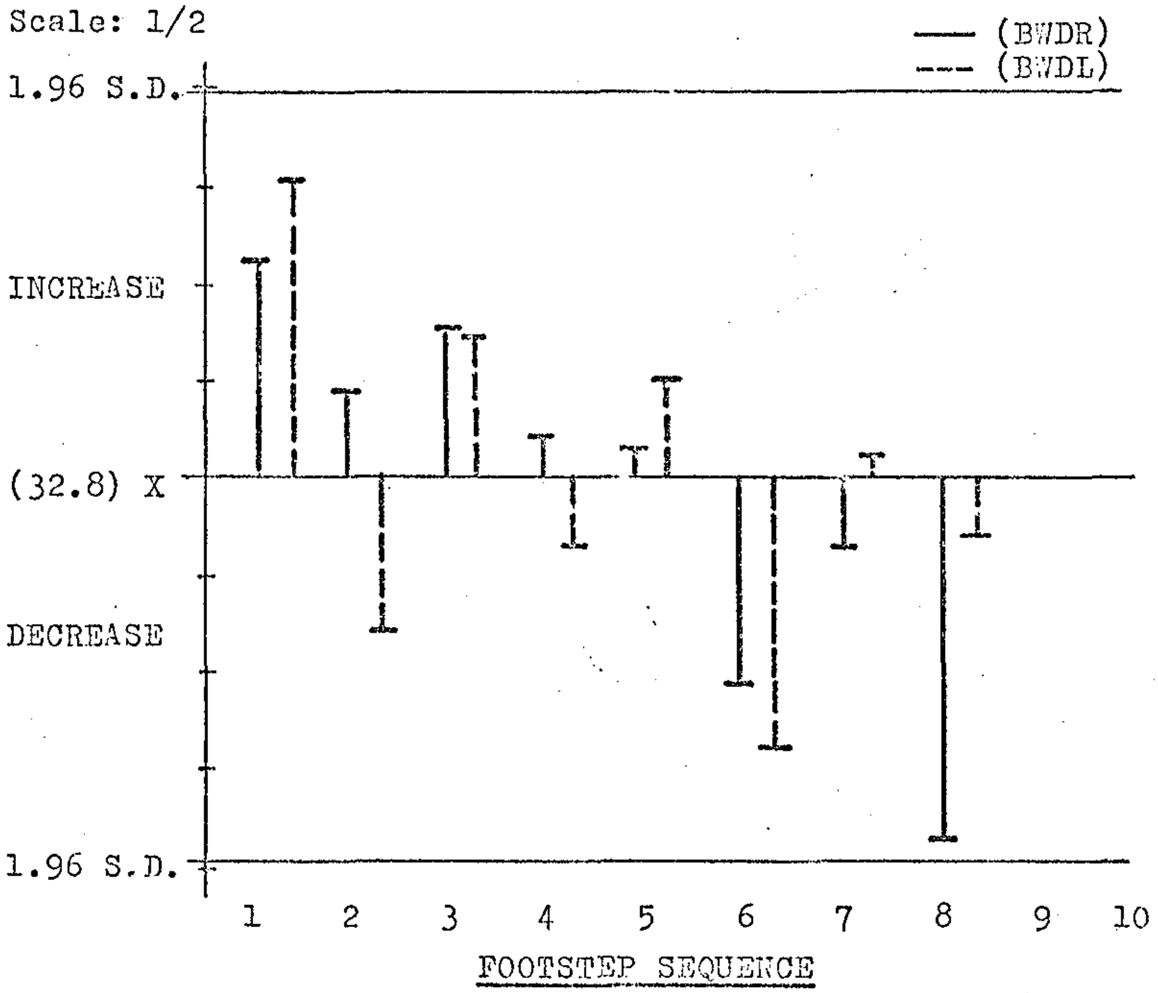
Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 68).

FIG.(64) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWDR,TWDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)



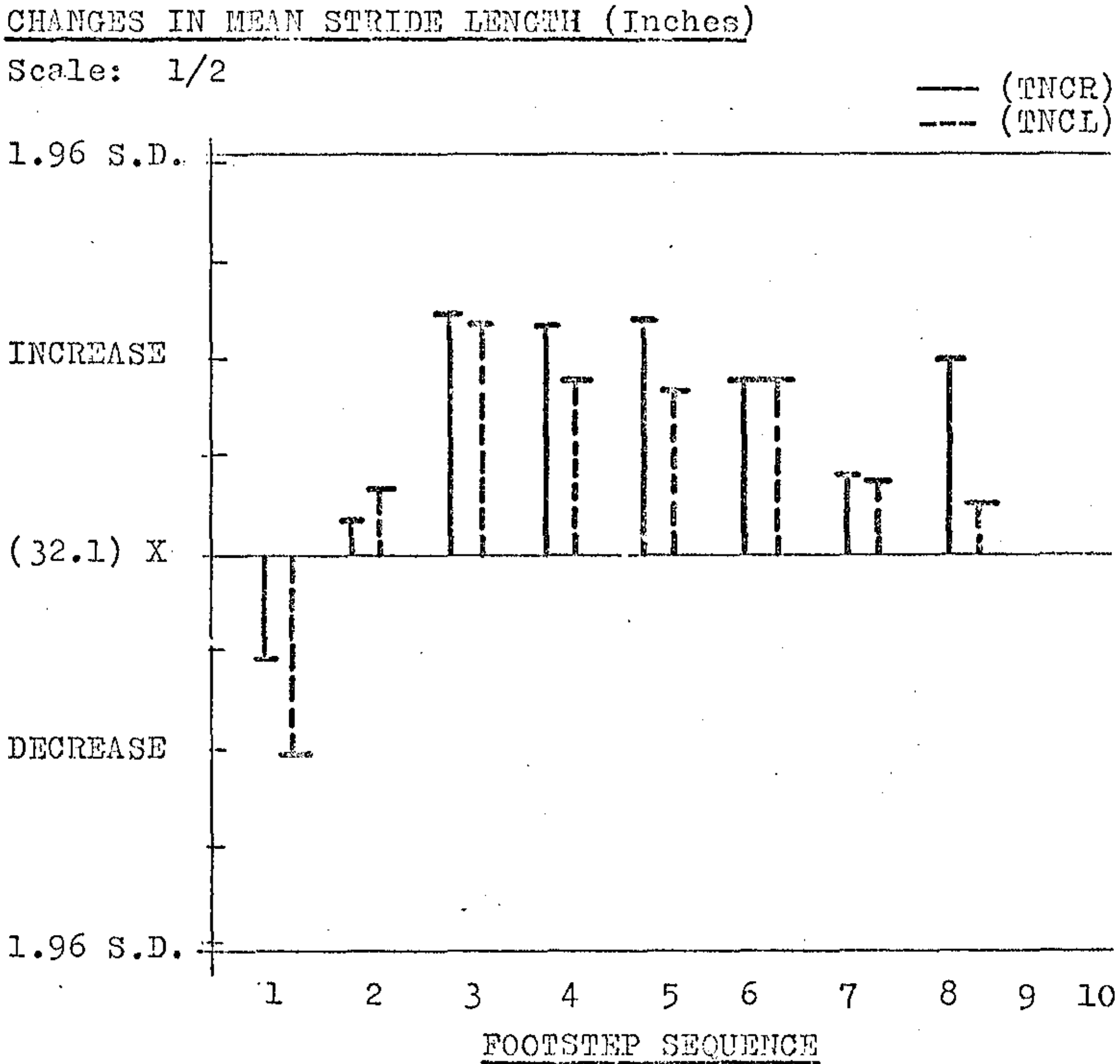
The (X) axis represents the overall mean stride length (32.8 inches) of Subject (M.2) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 68).

FIG.(65) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (BWDR,BWDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.2)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



The (X) axis represents the overall mean stride length (32.1 Inches) of Subject (M.3) in Unobstructed Trials (6-10). (Number of strides n=40).

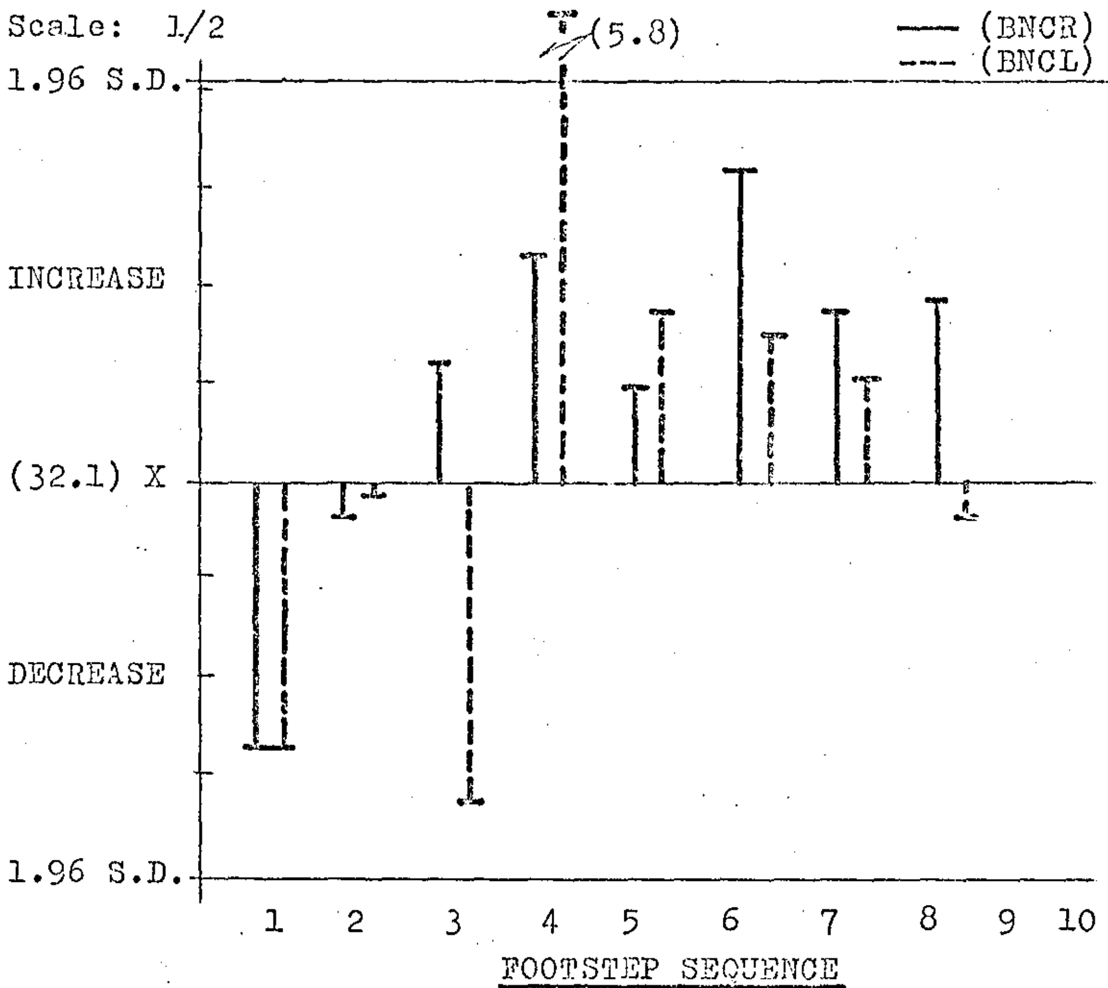
Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 69).

FIG.(66) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNCR,TNCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY.(M.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)



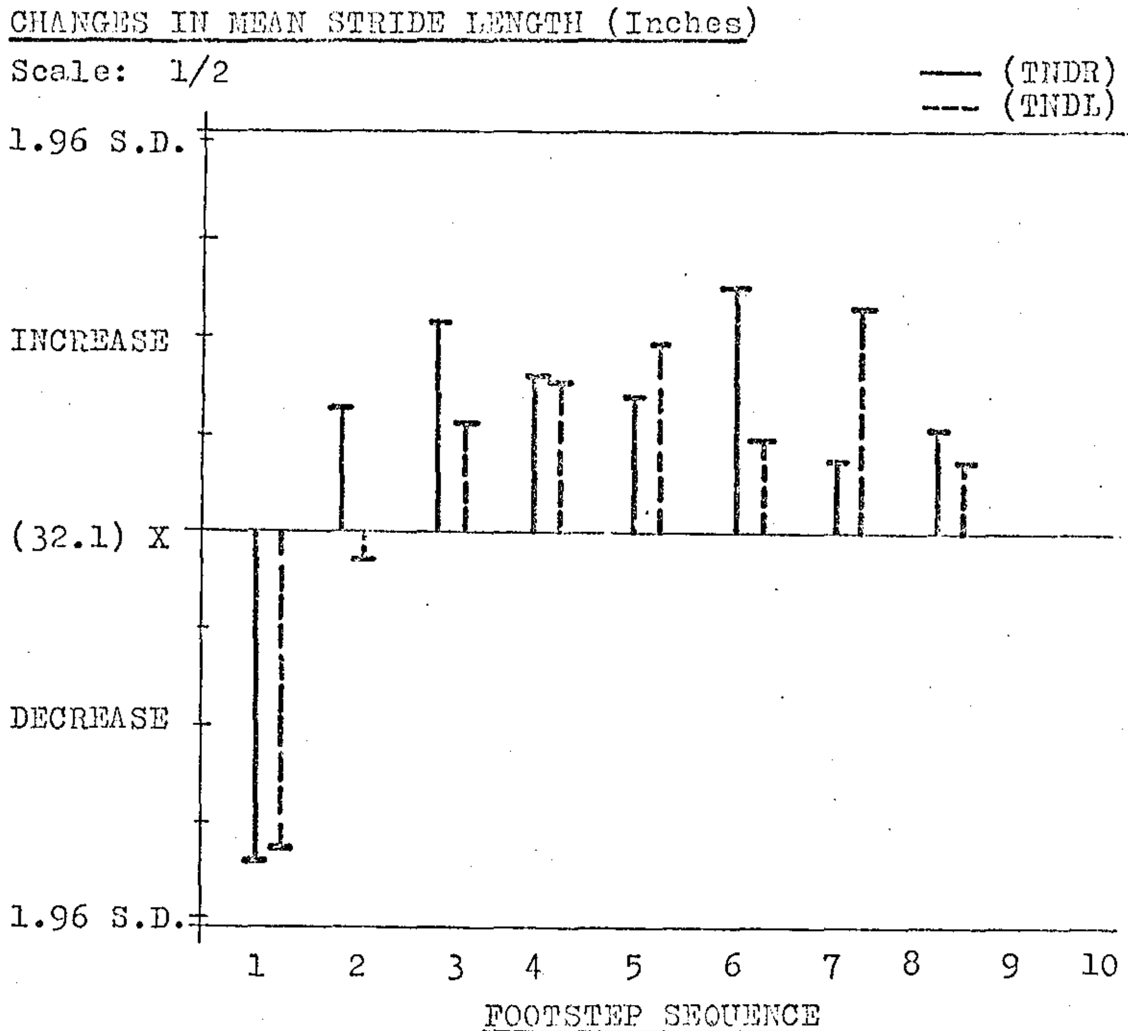
The (X) axis represents the overall mean stride length (32.1 Inches) of Subject (M.3) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 69).

FIG.(67) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (BNCR,BNCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



The (X) axis represents the overall mean stride length (32.1 Inches) of Subject (M.3) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

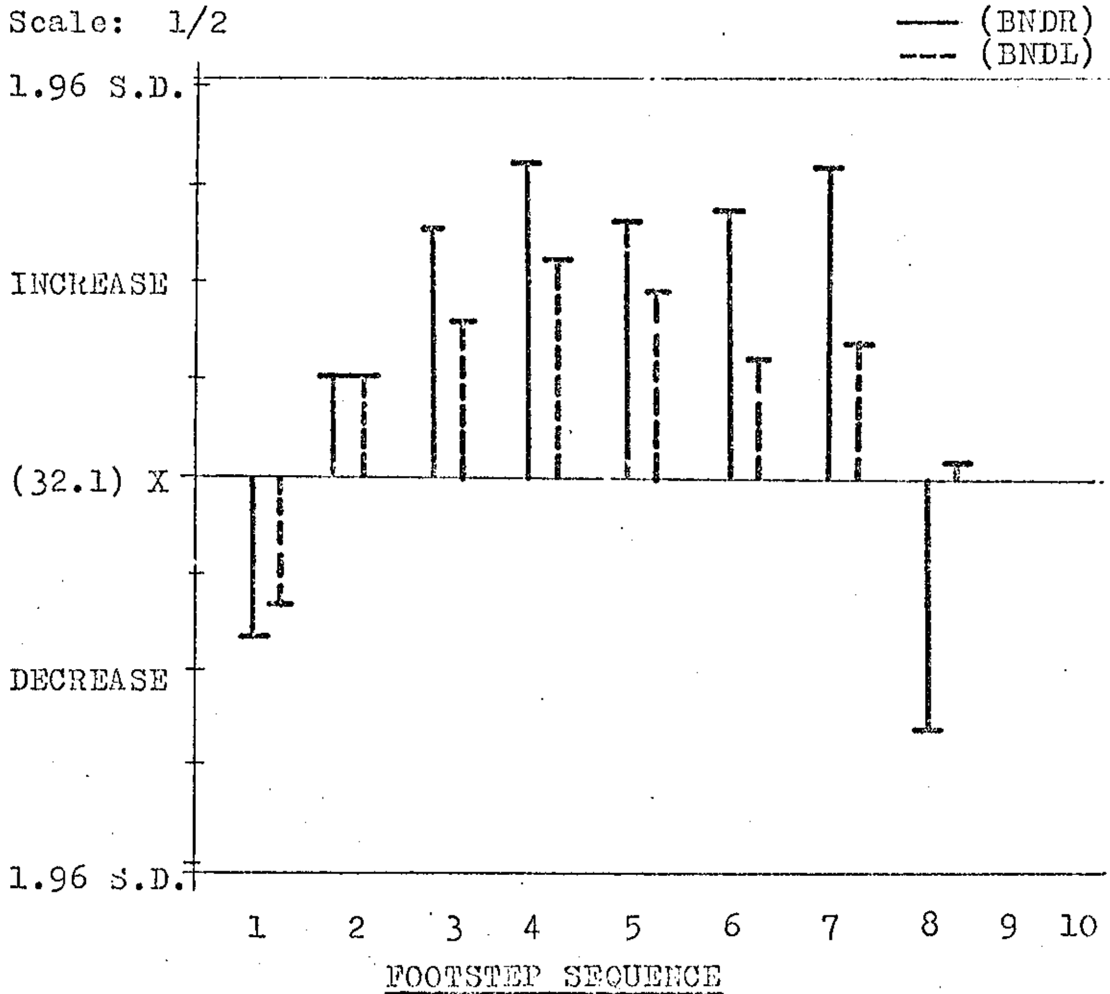
For data of diagram see APPENDIX 2 (TABLE 69).

FIG.(68) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TNDR,TNDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY.(M.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2

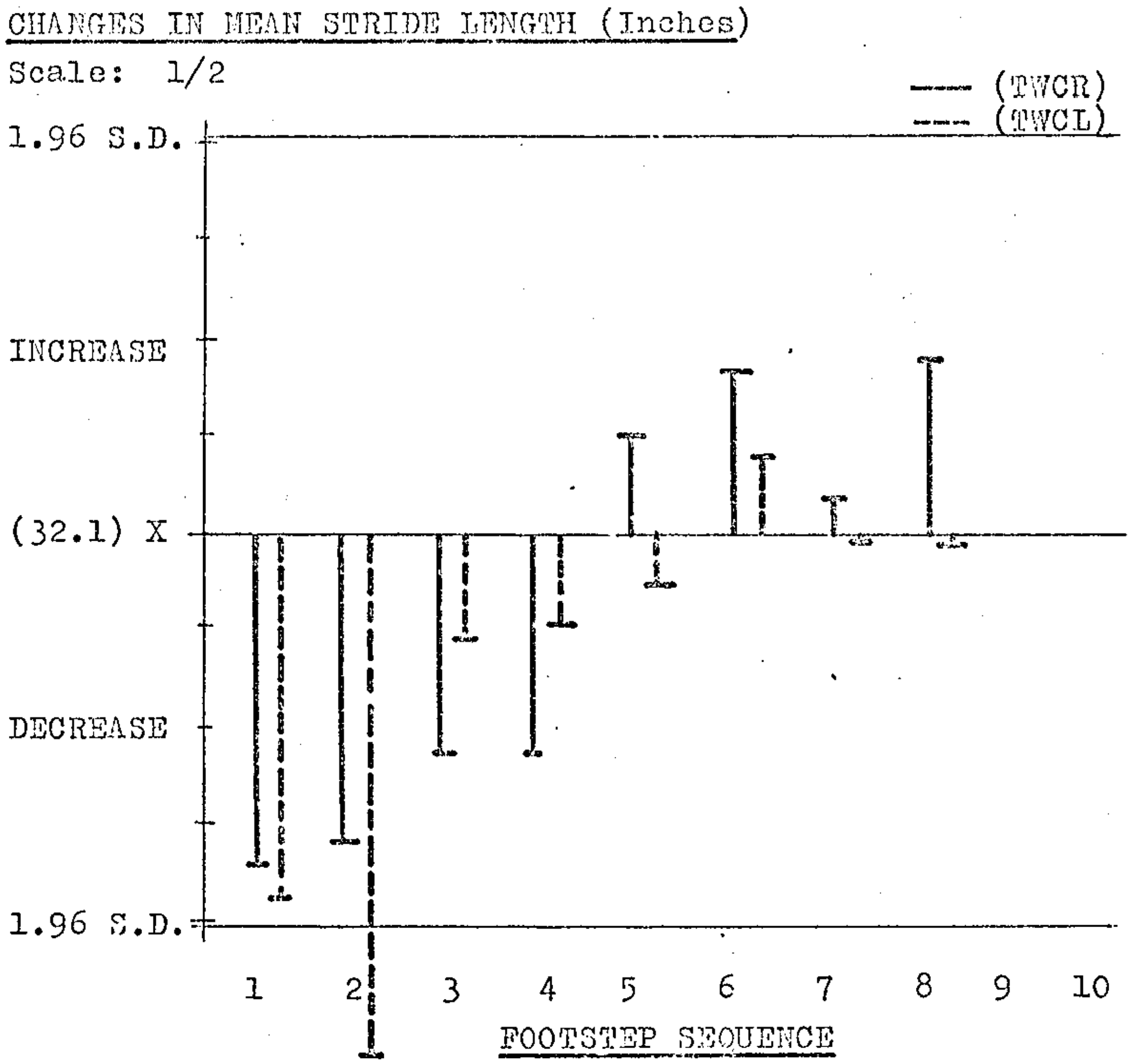


The (X) axis represents the overall mean stride length (32.1 Inches) of Subject (M.3) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 69).

FIG.(69) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (BNDR,BNDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.3)



The (X) axis represents the overall mean stride length (32.1 Inches) of Subject (M.3) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

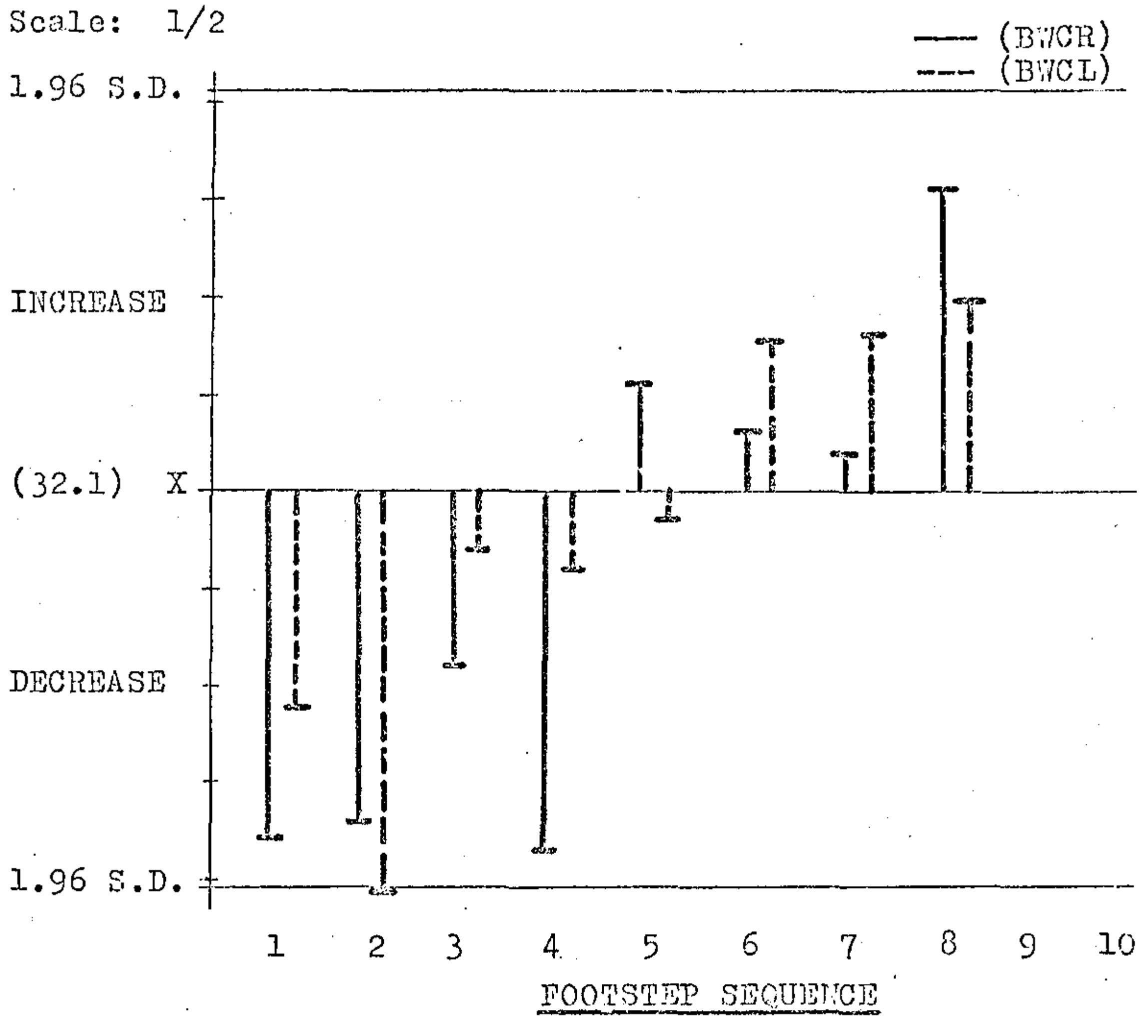
For data of diagram see APPENDIX 2 (TABLE 69).

FIG.(70) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWCR,TWCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)

Scale: 1/2



The (X) axis represents the overall mean stride length (32.1 Inches) of Subject (M.3) in Unobstructed Trials (6-10). (Number of strides n=40).

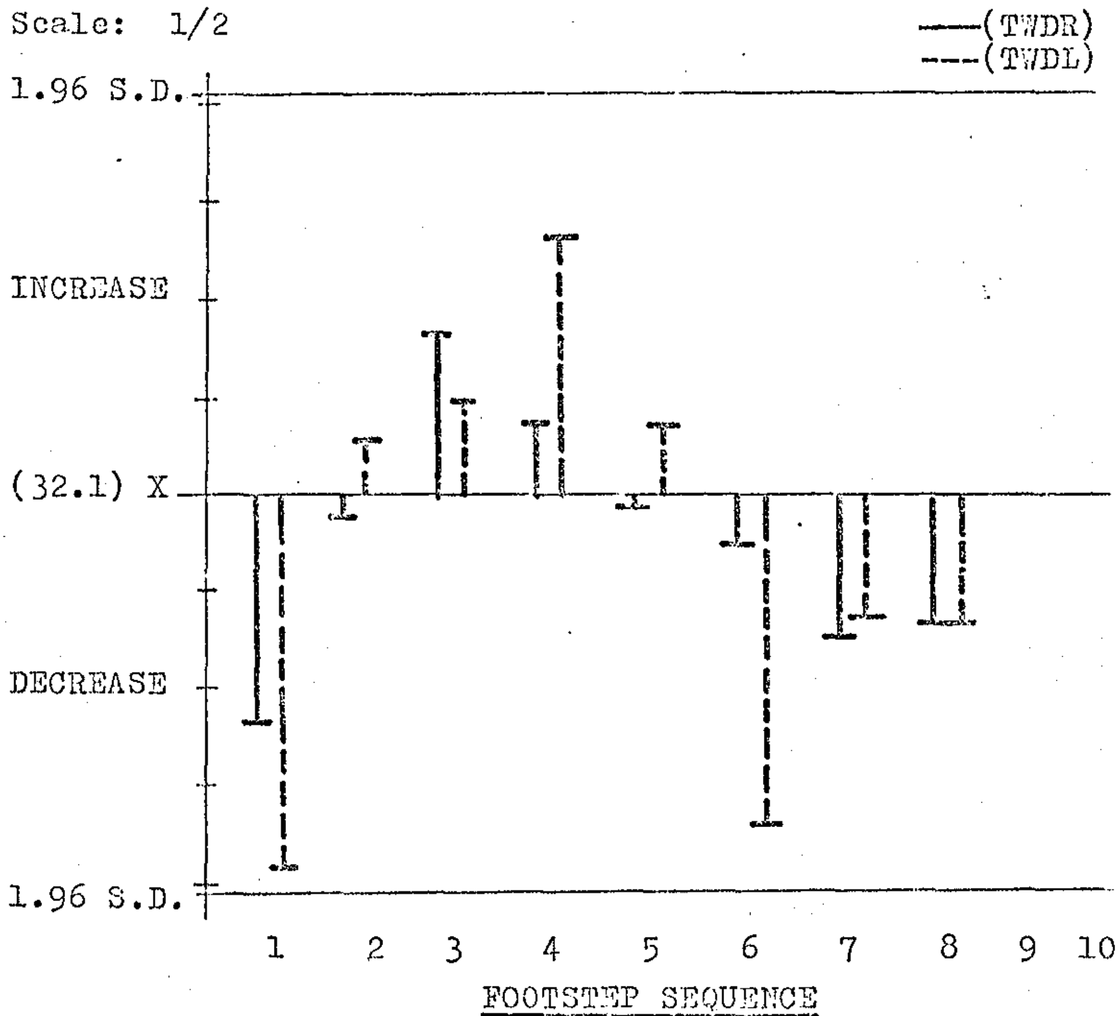
Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 69).

FIG.(71) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (BWCR,BWCL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY. (M.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

CHANGES IN MEAN STRIDE LENGTH (Inches)



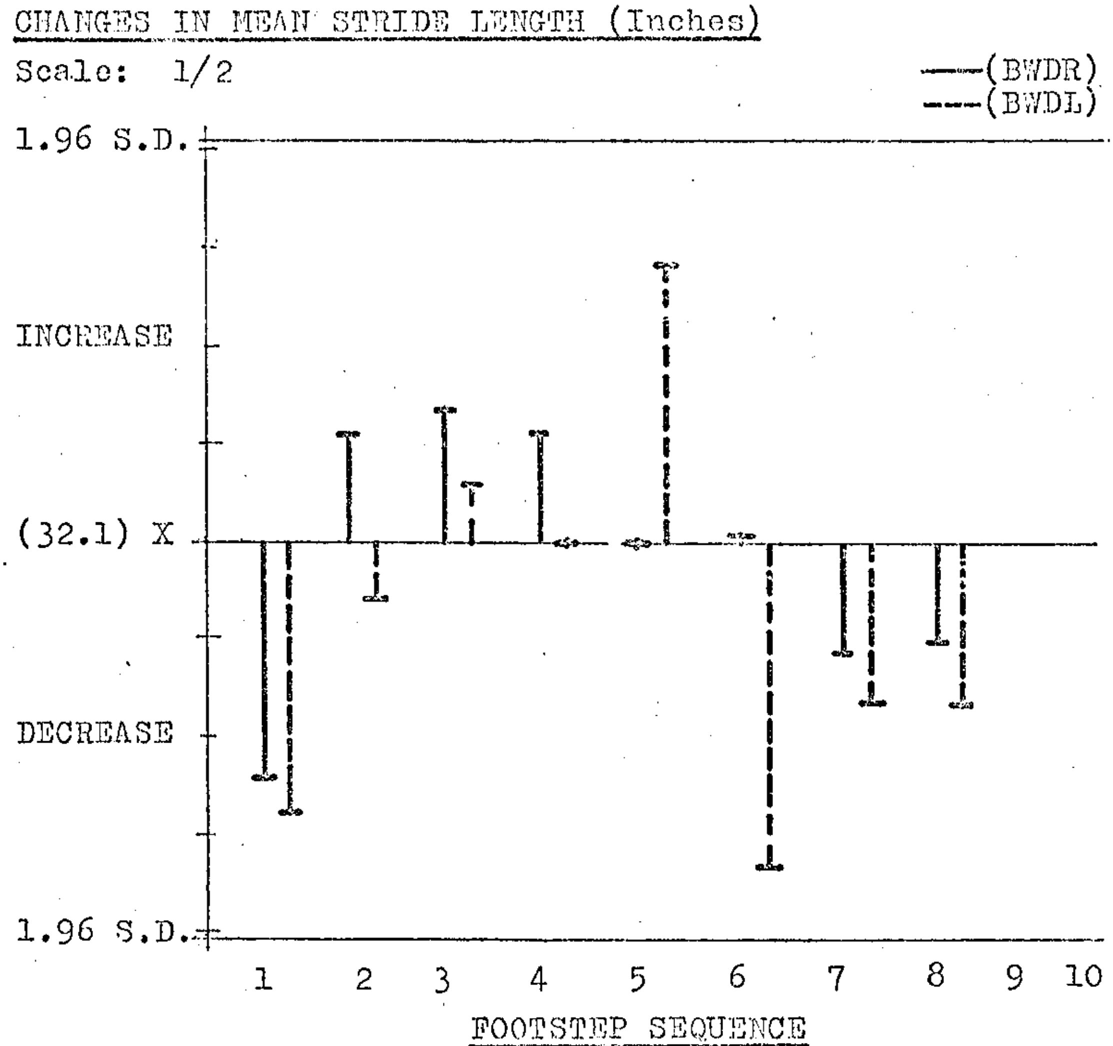
The (X) axis represents the overall mean stride length (32.1 inches) of Subject (M.3) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 69).

FIG.(72) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (TWDR,TWDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY.(M.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



The (X) axis represents the overall mean stride length (32.1 Inches) of Subject (M.3) in Unobstructed Trials (6-10). (Number of strides n=40).

Changes in stride length are obtained by subtracting (X) from the corresponding mean distances recorded for each footstep in trials with obstacles.

For data of diagram see APPENDIX 2 (TABLE 69).

FIG.(73) CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (BWDR,BWDL) COMPARED WITH OVERALL MEAN STRIDE LENGTH (X) IN UNOBSTRUCTED PASSAGEWAY.(M.3)

4.2(4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

DISCUSSION PART (1). The first part of this discussion is concerned with changes in Mean Stride Length.

The detours registered by Ss. confronted by an obstacle are examined later.

Changes in Mean Stride Length.

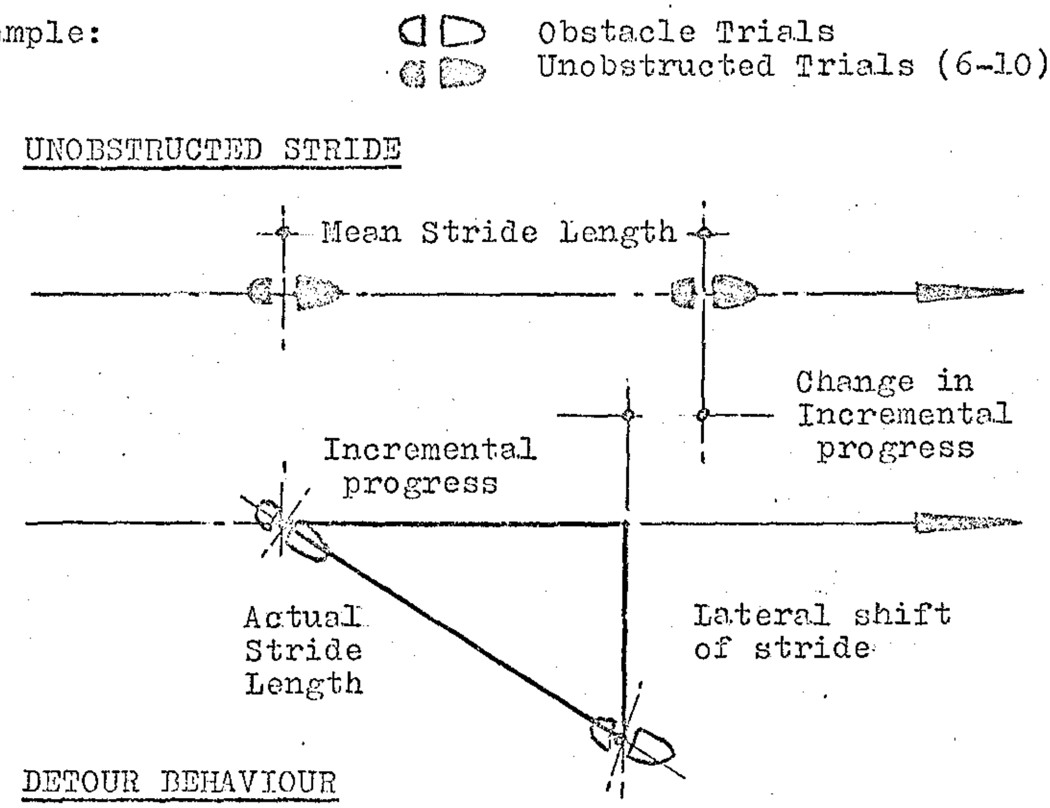
Data extracted from the bar charts RESULTS (FIGS.42-73) were consolidated in the TABLES (23 - 25) DISCUSSION to obtain an overall impression of the Ss.' performance. The Tables provide several kinds of information.

For a start, TABLE (23) records all changes in Mean Stride Length which were significantly different at the five per cent level from the Mean Stride Length returned in the appropriate Unobstructed Trials. The changes are listed irrespective of whether they can be definitely associated with avoidance behaviour. Changes in the prior vicinity of the obstacle positions (3 and 7) almost undoubtedly occurred in response to the presented obstacles, but elsewhere this is less sure. Some changes (e.g. BWCR, TNCL, BNCR, and BNCL) were almost certainly promoted by the S's. proximity to the end of the passageway, and one could posit that they occurred as a deliberate adjustment of pace. The frequency of changes at Step (1) when the obstacle was some distance ahead (i.e. TWDR, TWDL, BWDR, TNDL, BNDR) is more curious. Perhaps they were unconscious adjustments to the characteristics of the obstacle and its distance ahead? Whatever the cause, the occurrence demonstrates that changes in stride length are not invariable precursors to subsequent avoidance action although they might be indicative of precautionary action and of anticipated goal arrival.

As regards changes in Mean Stride Length which can be definitely associated with detour behaviour by reference to significant changes in lateral displacement of the foot, i.e. from FIGS.(75 —98), it will be realised that use of the phrase "change in Mean Stride Length" can be a misnomer.

For in those circumstances, the measure really relates to observed changes in incremental forward progress which differ from the corresponding Mean Stride Lengths in Unobstructed Trials.

Example:



The conceptual value of splitting detours into forward and lateral vector components is later shown in discussion of the gradients of detours.

In returning to the Tables of Mean Stride Length, it will be noticed that females were less consistent than males in maintaining their "stride length" in face of obstacles (TABLE 24). Both sexes found the greatest need to adjust their stride length on encountering close, wide obstacles (TWCR/L & BWCR/L). Do the recorded changes indicate that females were more circumspect than males? One might infer such a conclusion were the changes equally distributed among all Ss. However, a count reveals that S.(M.1) was alone responsible for sixteen of the nineteen male changes. The stature of this S. shown in TABLE (3) was the same as the mean female stature (range 64-68 inches). It is considered that leg length had more influence upon Ss.' performance than a possible sexual difference in attitude to the trials.

...continued

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

TRIAL	FOOTSTEP SEQUENCE 1	2	3	4	5	6	7	8	9	10
TWDR	F.1						F.3	F.3	F.3	
TWDL	F.1						F.3	F.2		
TWCR	F.1 F.3 M.1	F.1 F.2 F.3	F.3 M.2	F.3	F.2					
TWCL	F.2 F.3 M.1	F.1 F.3 M.2 M.3	F.2 F.3 M.1	F.4						
BWDR	F.3					F.1 F.3		F.3	F.1	
BWDL										
BWCR	F.1 F.3 M.1	F.1 F.2 F.3 M.1	F.3	F.3					M.1	
BWCL	F.2 F.3 M.1	F.1 F.3 M.1	F.3		F.3					
TNDR		M.1		M.1						M.1
TNDL	F.3			M.1						
TNCR	F.3									
TNCL	F.3	F.3						F.3	F.3	F.3 M.1
BNDR	F.1 F.3									
BNDL										M.1
BNCR	F.1 F.3									M.1
BNCL	F.1 F.3			M.3					F.2	F.2 M.1

TABLE (23). SIGNIFICANT CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (ALL SUBJECTS).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

FOOTSTEP SEQUENCE

TRIAL	1	2	3	4	5	6	7	8	9	10
TWDR	F						F	F	F	
TWDL	F						F	F		
TWCR	F	F	F	F	F					
TWCL	F	F	F	F						
BWDR	F					F		F	F	
BWDL										
BWCR	F	F	F	F						
BWCL	F	F	F		F					
TNDR										
TNDL	F									
TNCR	F									
TNCL	F	F						F	F	F
BNDR	F									
BNDL										
BNCR	F									
BNCL	F								F	F
TWDR										
TWDL										
TWCR	M		M							
TWCL	M	M	M							
BWDR										
BWDL										
BWCR	M	M							M	
BWCL	M	M								
TNDR		M		M						M
TNDL				M						
TNCR										
TNCL										M
BNDR										
BNDL										M
BNCR										M
BNCL				M						M

TABLE (24). SIGNIFICANT CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (ALL SUBJECTS: MALE DIFFERENTIATED FROM FEMALE).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

FOOTSTEP SEQUENCE

TRIAL	1	2	3	4	5	6	7	8	9	10
TWDR	1	.	.	.	.	.	1	1	1	.
TWDL	1	.	.	.	.	.	1	1	.	.
TWCR	3	3	2	1	1	.	.	.	.	.
TWCL	3	4	3	1	.	.	.	.	.	.
BWDR	1	.	.	.	.	1	.	1	1	.
BWDL	.	.	.	.	.	.	.	.	.	.
BWCR	3	4	1	1	.	.	.	.	1	.
BWCL	3	3	1	.	1	.	.	.	.	.
TNDR	.	1	.	1	.	.	.	.	.	1
TNDL	1	.	.	1	.	.	.	.	.	.
TNCR	1	.	.	.	.	.	.	.	.	.
TNCL	1	1	.	.	.	.	.	1	1	1
BNDR	2	.	.	.	.	.	.	.	.	.
BNDL	.	.	.	.	.	.	.	.	.	1
BNCR	2	.	.	.	.	.	.	.	.	1
BNCL	2	.	.	1	.	.	.	.	1	2
TWDR	I						I	I	I	
TWDL	I						I	I		
TWCR	D	D	D	D	D					
TWCL	D	D	D	D						
BWDR	D					D		D	D	
BWDL										
BWCR	D	D	D	D					I	
BWCL	D	D	D		Decrease					
TNDR		I		I						I
TNDL	D			Increase						
TNCR	D									
TNCL	D	D						I	I	D
BNDR	I/D									
BNDL										I
BNCR	I/D									D
BNCL	I/D			I					I	D

TABLE (25). SIGNIFICANT CHANGES IN MEAN STRIDE LENGTH IN TRIALS WITH OBSTACLES (ALL SUBJECTS: FREQUENCY AND DIRECTION OF OCCURRENCE).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

For ease of discernment, the obstacles which gave Ss. most cause for trepidation by the evidence of changes in their "Mean Stride Length" are rank ordered below:

OBSTACLE	FREQUENCY OF SIGNIFICANT CHANGE
TWCL	11
TWCR	10
BWCR	10
BWCL	8
BNCL	6
TNCL	5
TWDR	4
BWDR	4
TNDR	3
BNCR	3
TWDL	3
TNDL	2
TNCR	1
BNDL	1
BWDL	0

TABLE (25) identifies frequency of change with particular strides and with a statement as to whether the change was an increase or decrease in stride length as compared with Mean Stride Length in Unobstructed Trials. It can be observed that stride length changes at the beginning of Obstacle Trials tend to be shorter than their unobstructed counterparts whilst those at the close of trials tend to the reverse, but otherwise the direction of adjustments in step length by individuals or as revealed in the combined data has no predominant pattern.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

Example:

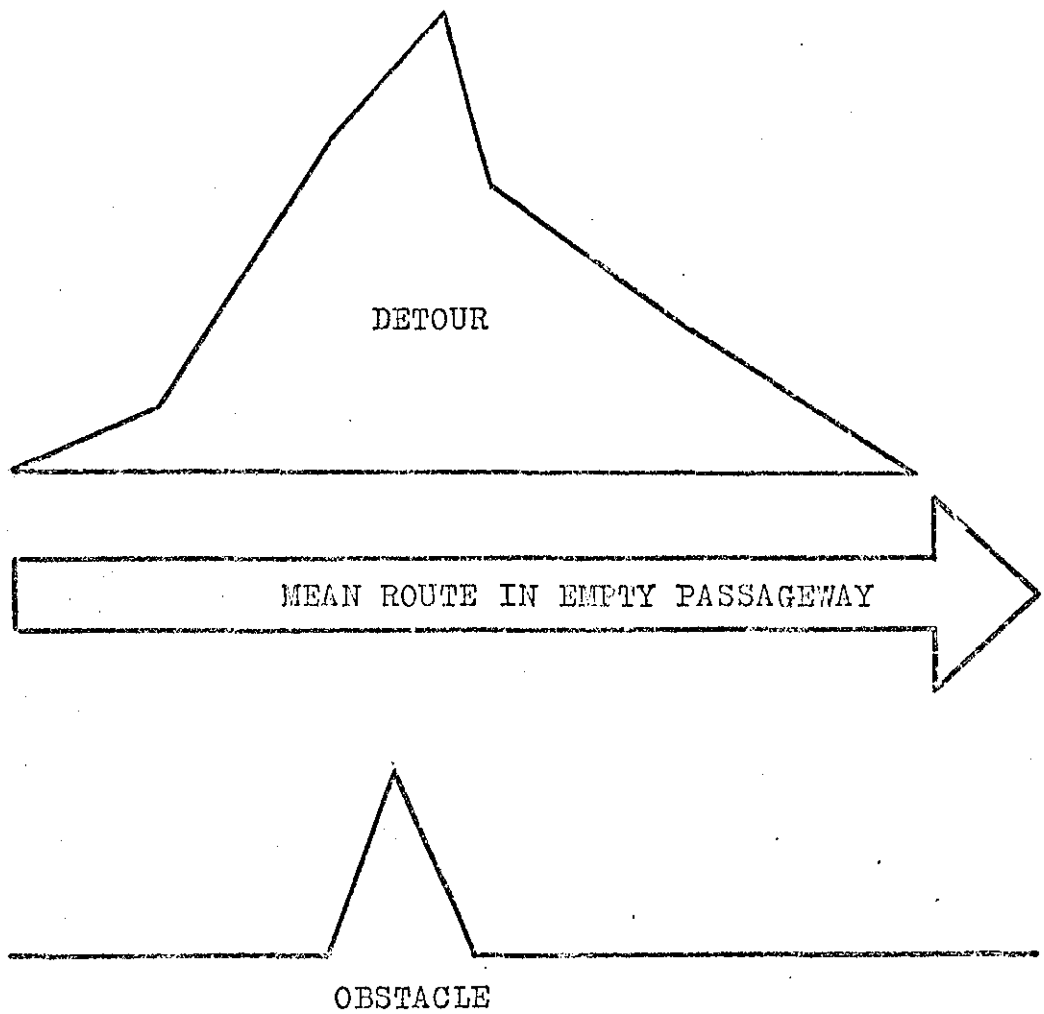
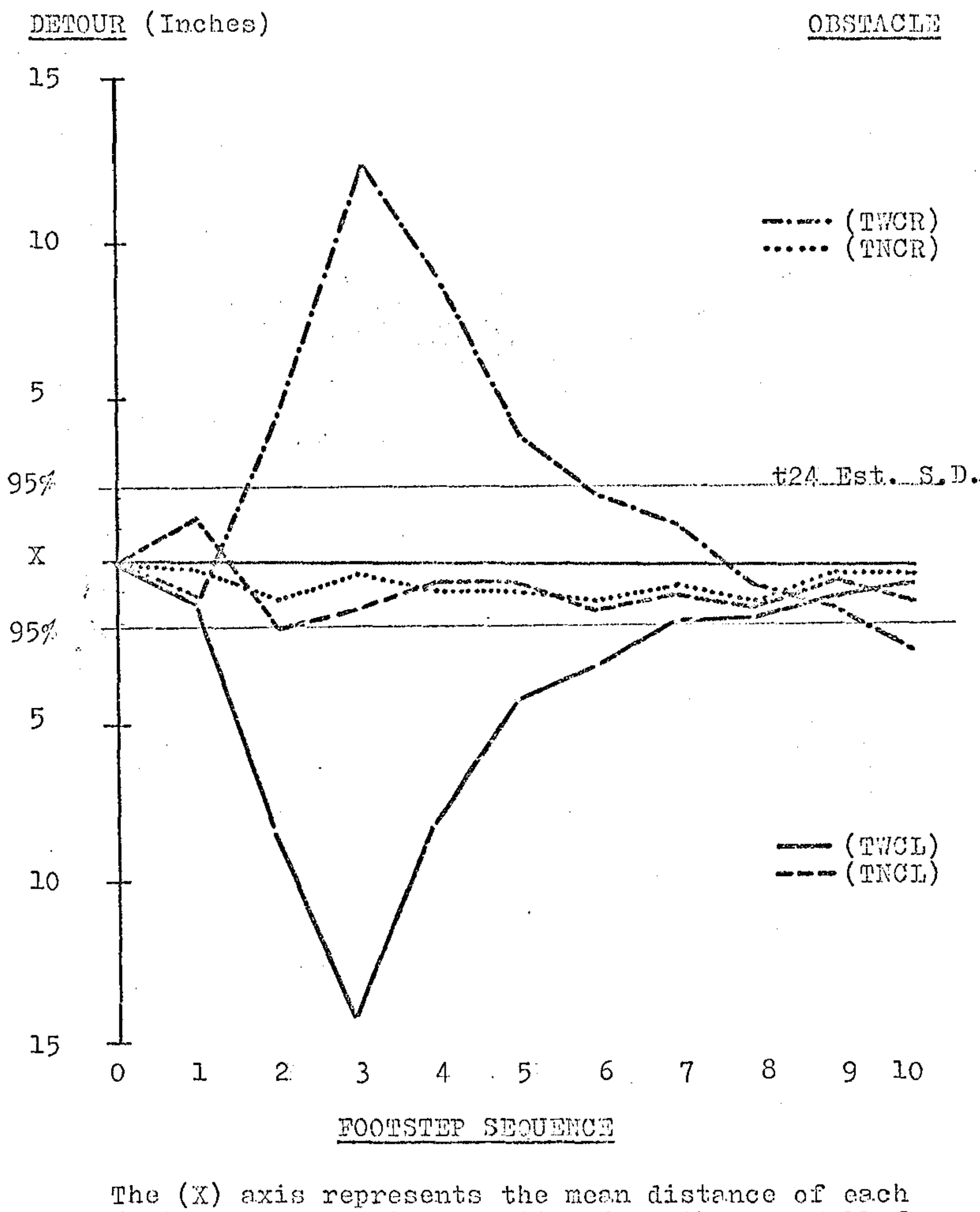


FIG.(74) FORMAT OF DIAGRAMS COMPARING MEAN ROUTE TAKEN IN UNOBSTRUCTED PASSAGEWAY WITH MEAN ROUTE TAKEN IN OBSTACLE TRIALS.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



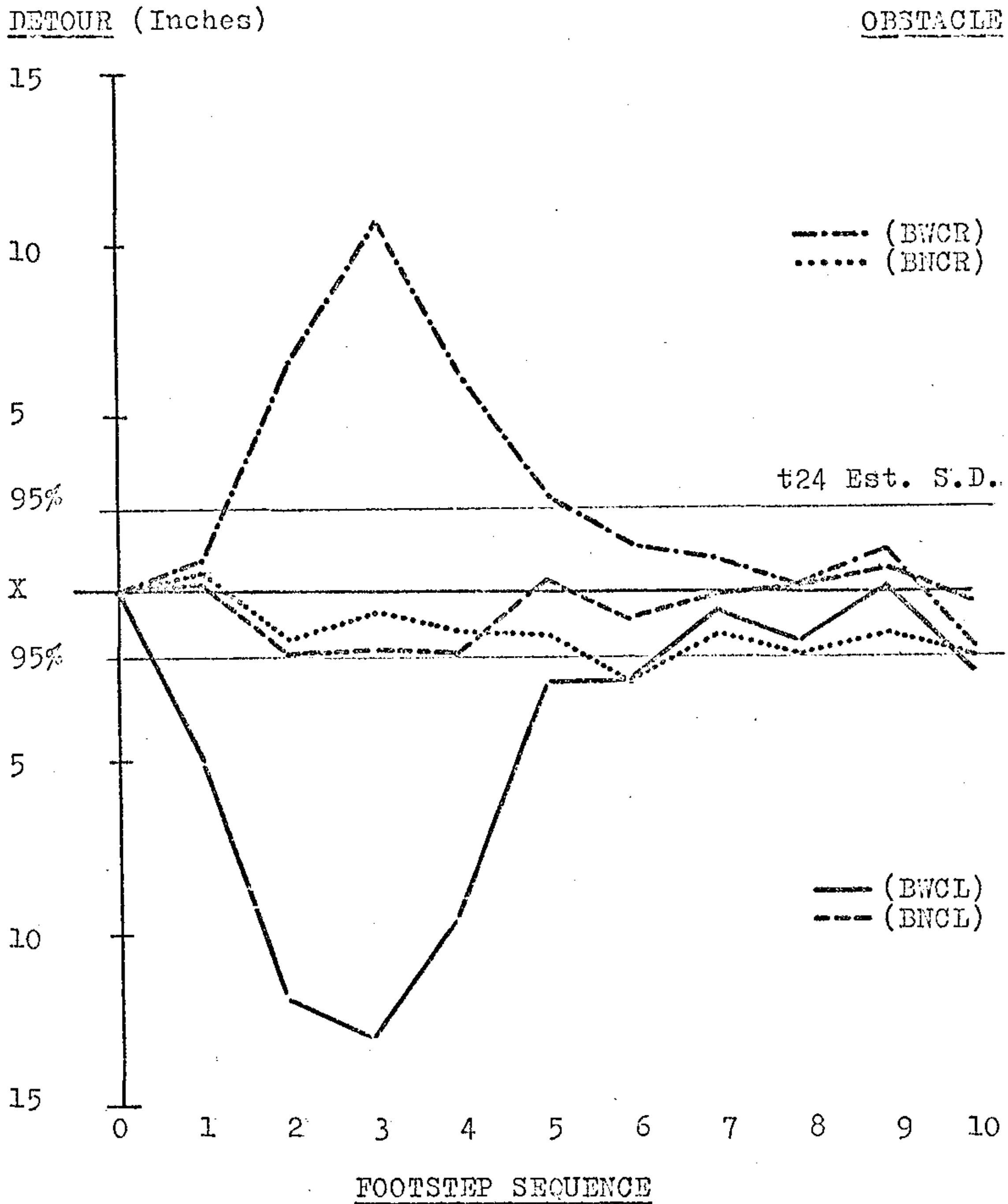
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.1) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distance represented by (X) from the corresponding mean distance recorded in Trials with Obstacles.

For data of diagram see APPENDIX 2 (TABLE 77).

FIG.(75) DETOURS IN RESPONSE TO CLOSE OBSTACLES (TWCR, TNCR) & (TWCL,TNCL). MEAN PERFORMANCE OF S.(F.1).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

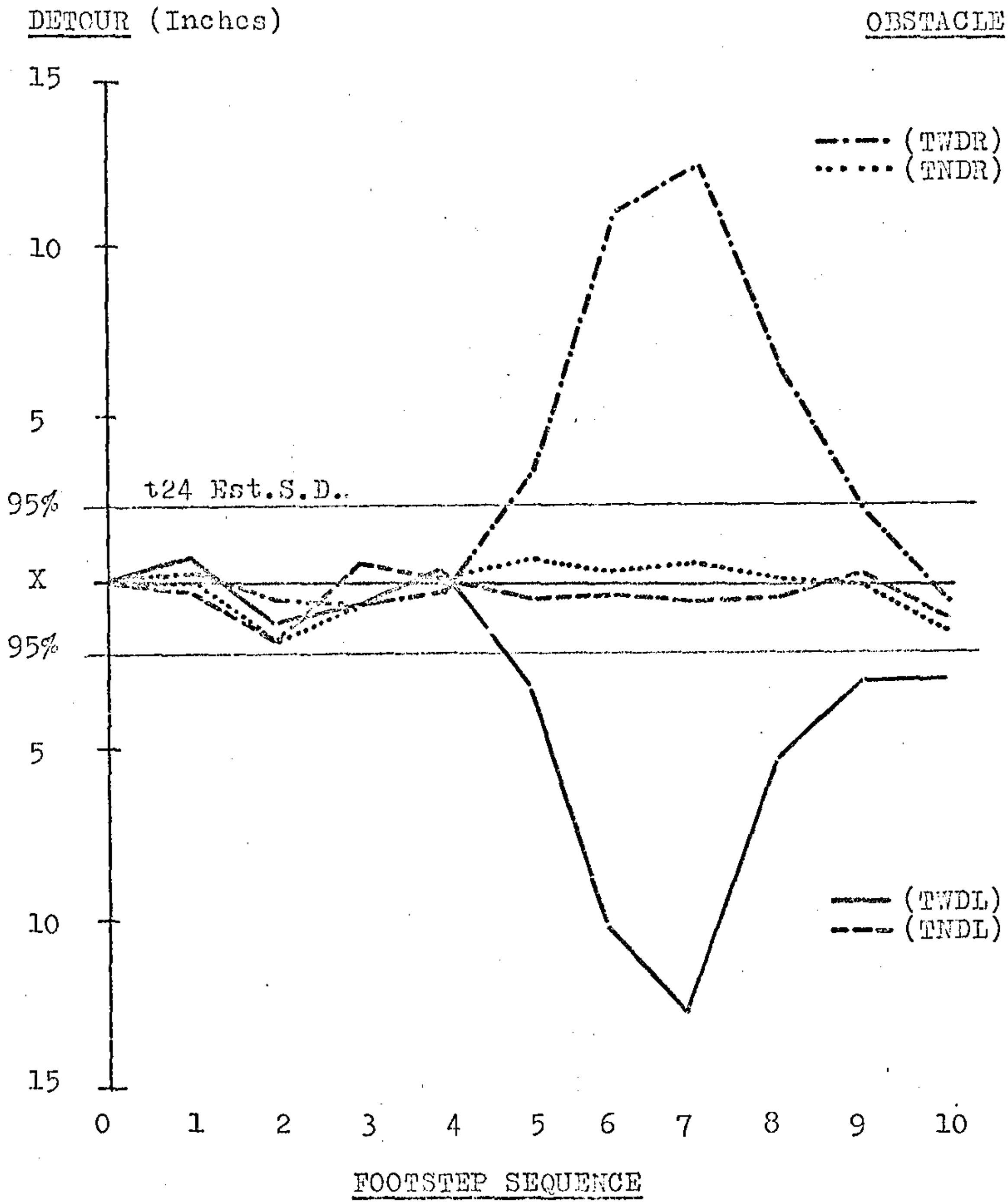


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.1) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distance represented by (X) from the corresponding mean distance recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 77).

FIG.(76) DETOURS IN RESPONSE TO CLOSE OBSTACLES (BWCR,BNCR) & (BWCL,BNCL). MEAN PERFORMANCE OF S.(F.1).

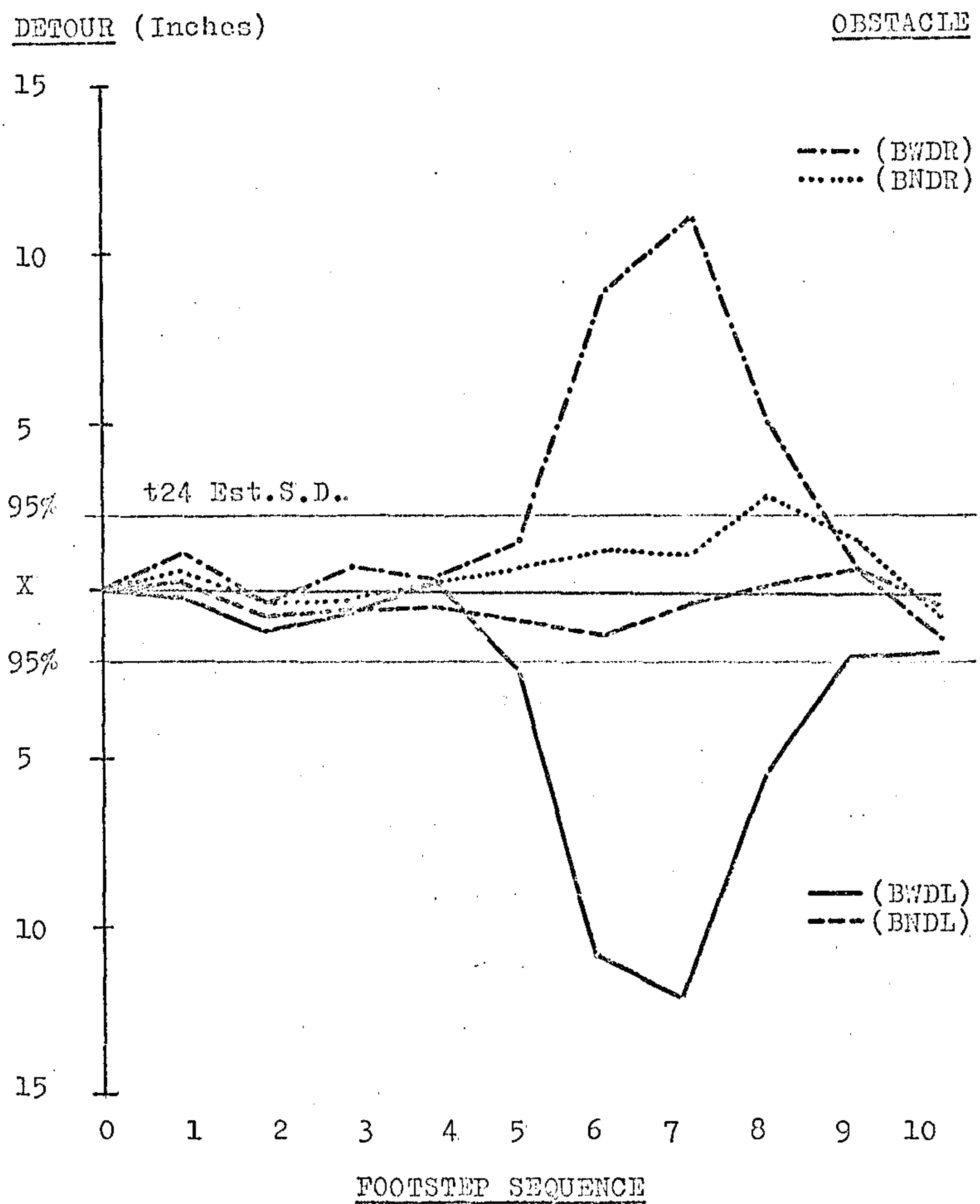


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.1) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distance represented by (X) from the corresponding mean distance recorded in Trials with Obstacles.

For data of diagram see APPENDIX 2 (TABLE 77).

FIG.(77) DETOURS IN RESPONSE TO DISTANT OBSTACLES (TWDR, TNDR) & (TWDL,TNDL). MEAN PERFORMANCE OF S.(F.1).



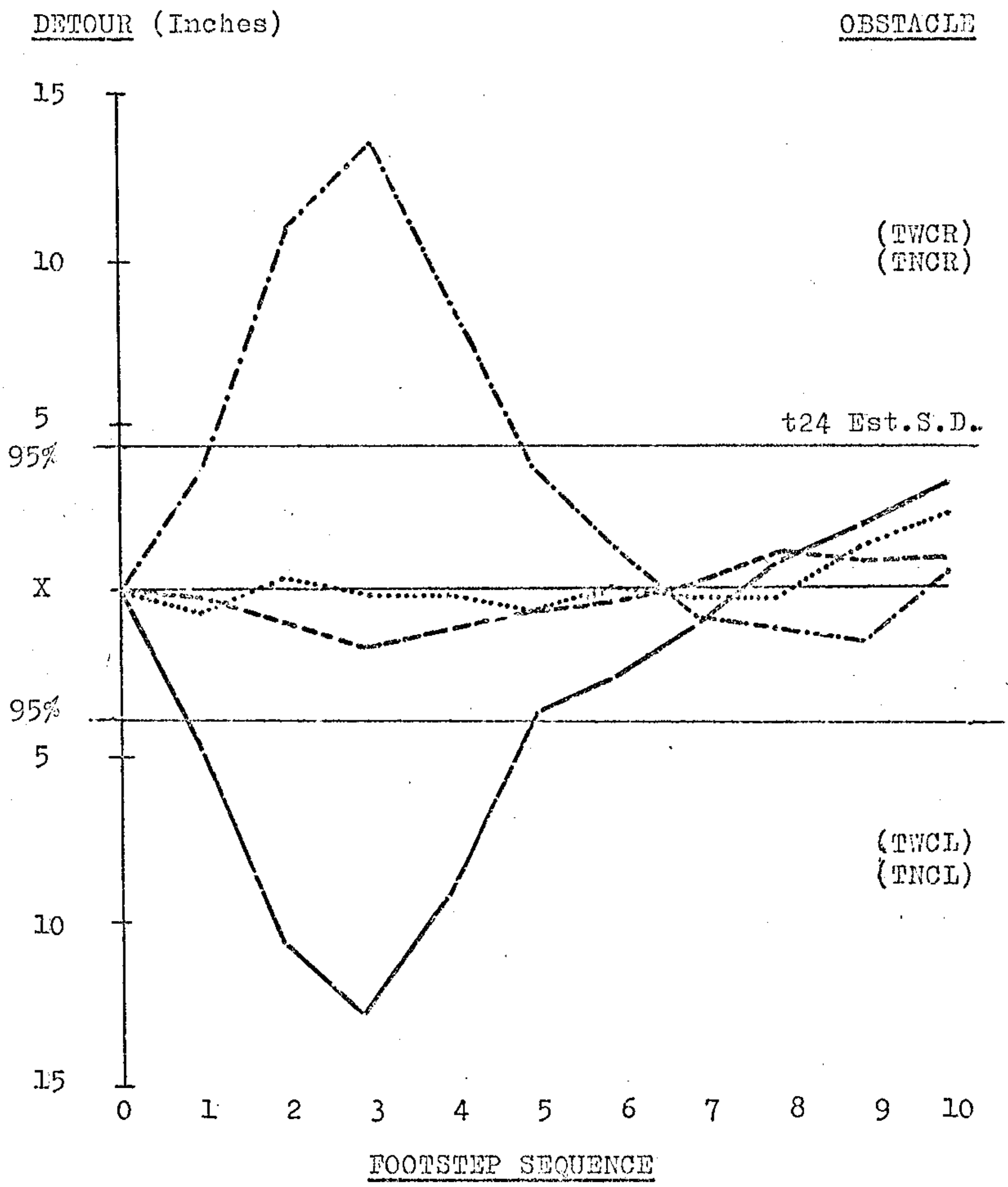
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.1) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distance represented by (X) from the corresponding mean distance recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 77).

FIG.(78) DETOURS IN RESPONSE TO DISTANT OBSTACLES (BWDR, BNDR) & (BWDL,BNDL). MEAN PERFORMANCE OF S.(F.1).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



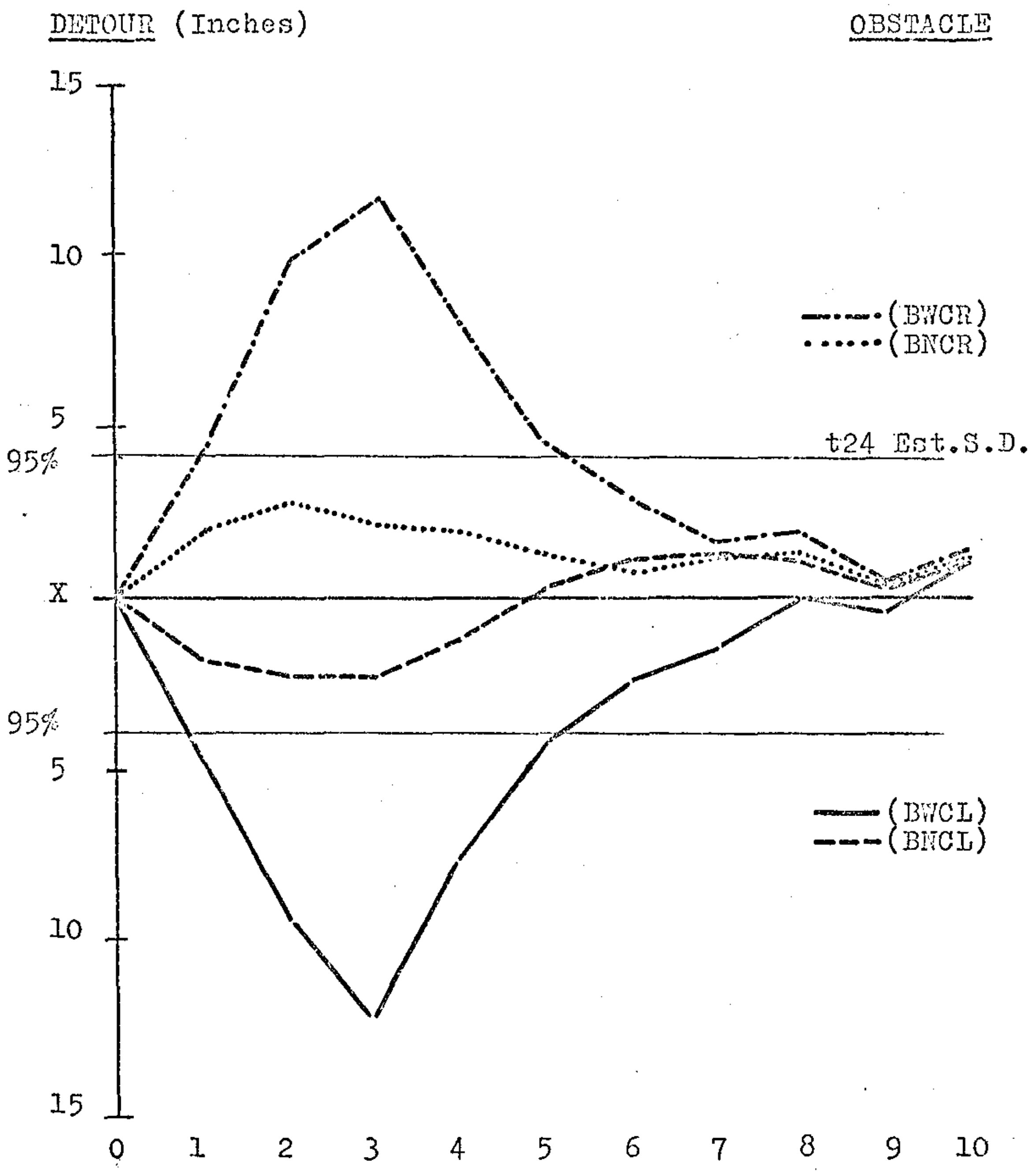
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.2) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 78).

FIG.(79) DETOURS IN RESPONSE TO CLOSE OBSTACLES (TWCR, TNCR) & (TWCL,TNCL).MEAN PERFORMANCE OF S.(F.2).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

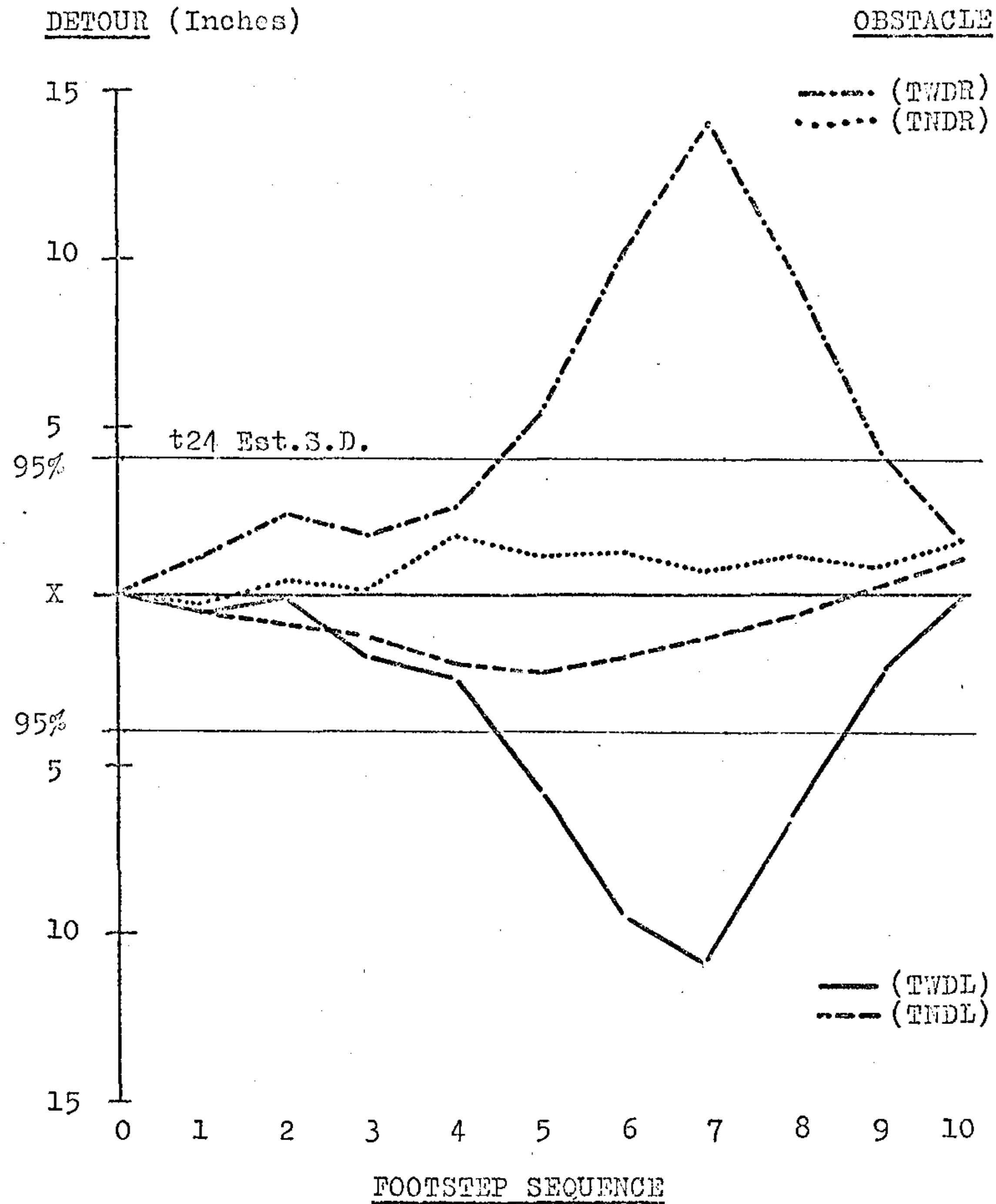


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.2) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distance represented by (X) from the corresponding mean distance recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 78).

FIG.(80) DETOURS IN RESPONSE TO CLOSE OBSTACLES (BWCR, BNCR) & BBWCL,BNCL).MEAN PERFORMANCE OF S.(F.2).

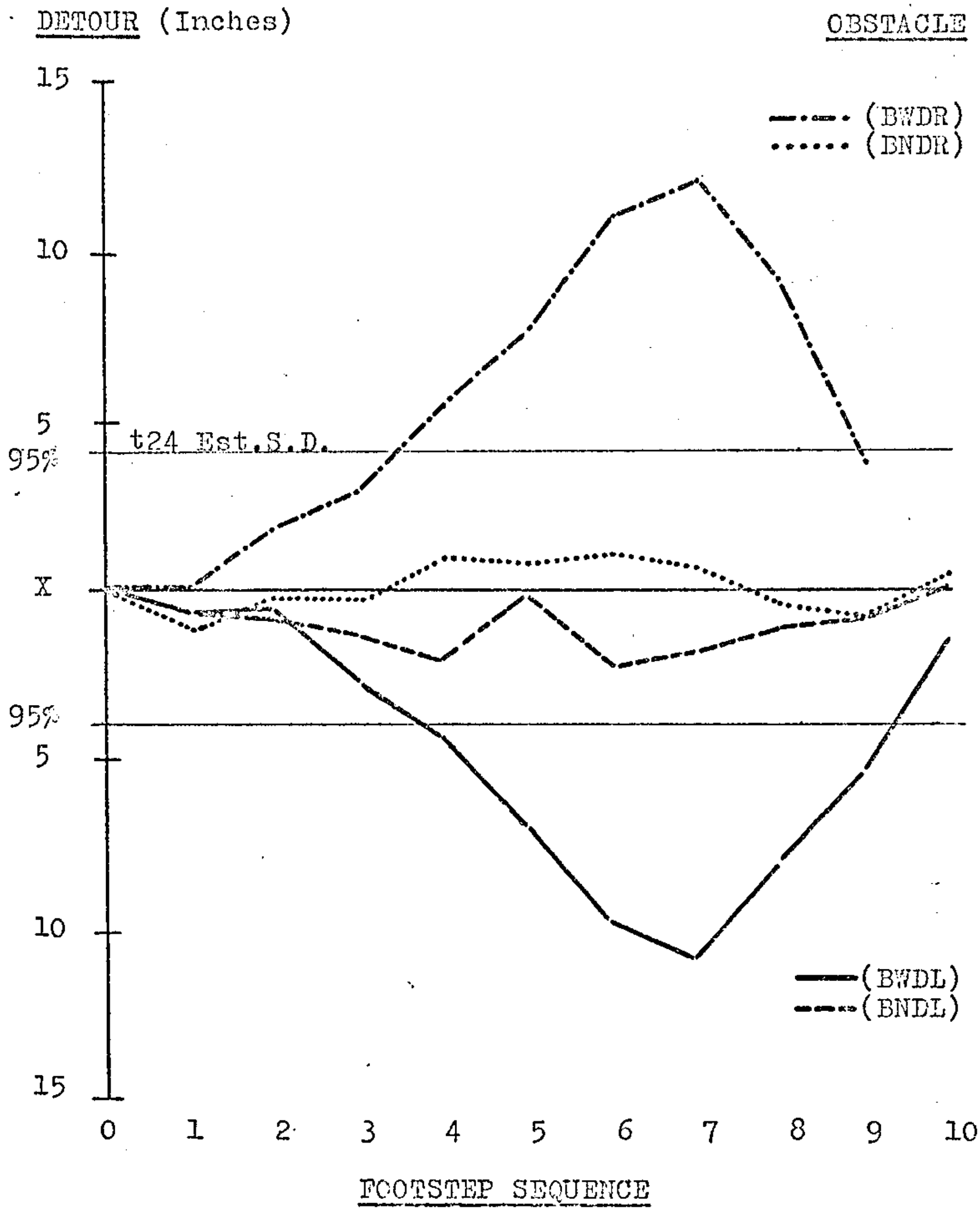


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.2) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 78).

FIG.(81) DETOURS IN RESPONSE TO DISTANT OBSTACLES (TWDR, TNDR) & (TWDL,TNDL).MEAN PERFORMANCE OF S.(F.2).

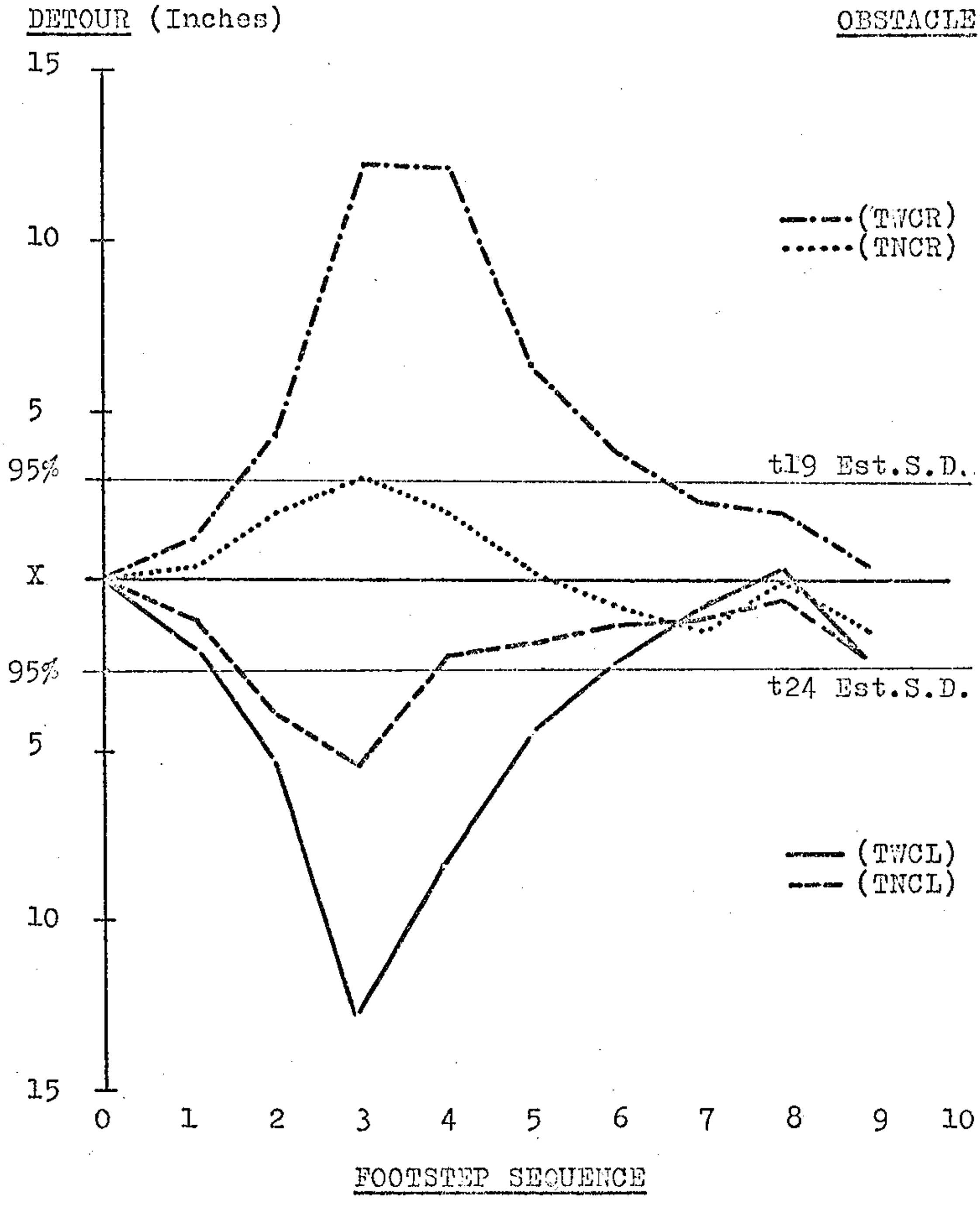


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.2) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 78).

FIG.(82) DETOURS IN RESPONSE TO DISTANT OBSTACLES (BWDR, BNDR) & (BWDL,BNDL).MEAN PERFORMANCE OF S.(F.2).



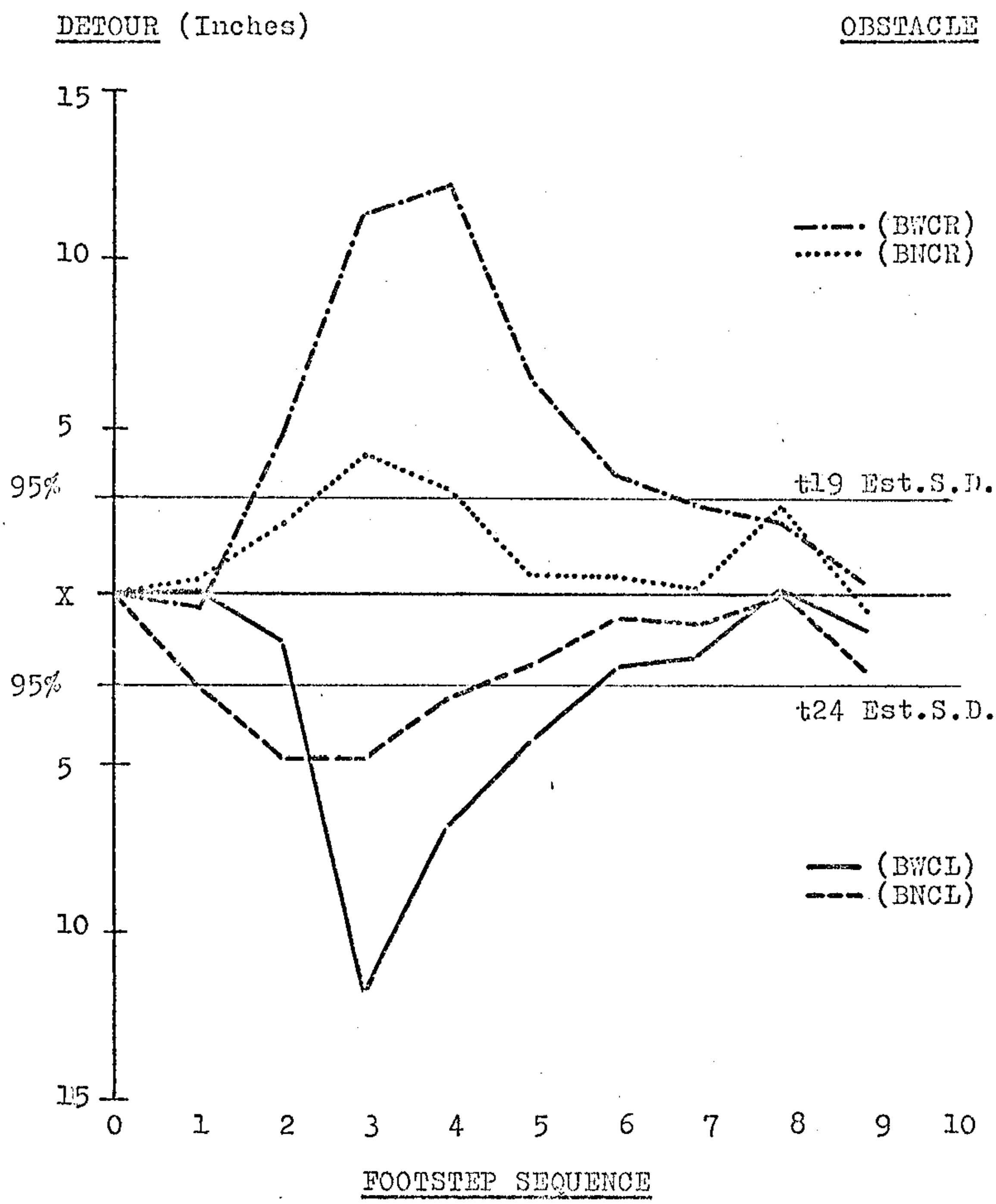
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.3) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 79).

FIG.(83) DETOURS IN RESPONSE TO CLOSE OBSTACLES (TWCR, TNCR) & (TWCL,TNCL).MEAN PERFORMANCE OF S.(F.3).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



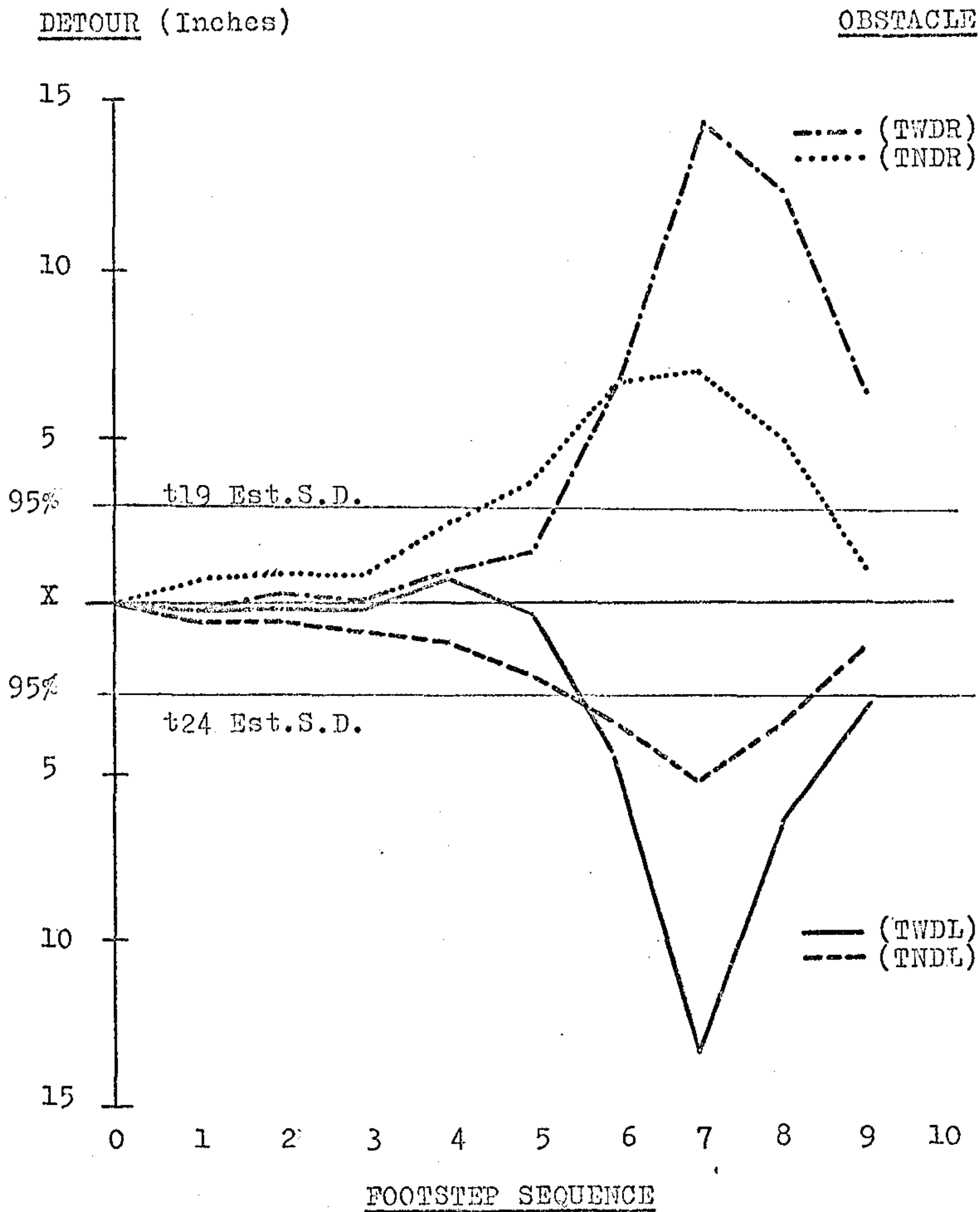
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(F.3) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 79).

FIG.(84) DETOURS IN RESPONSE TO CLOSE OBSTACLES (BWCR, BNCR) & (BWCL,BNCL).MEAN PERFORMANCE OF S.(F.3).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

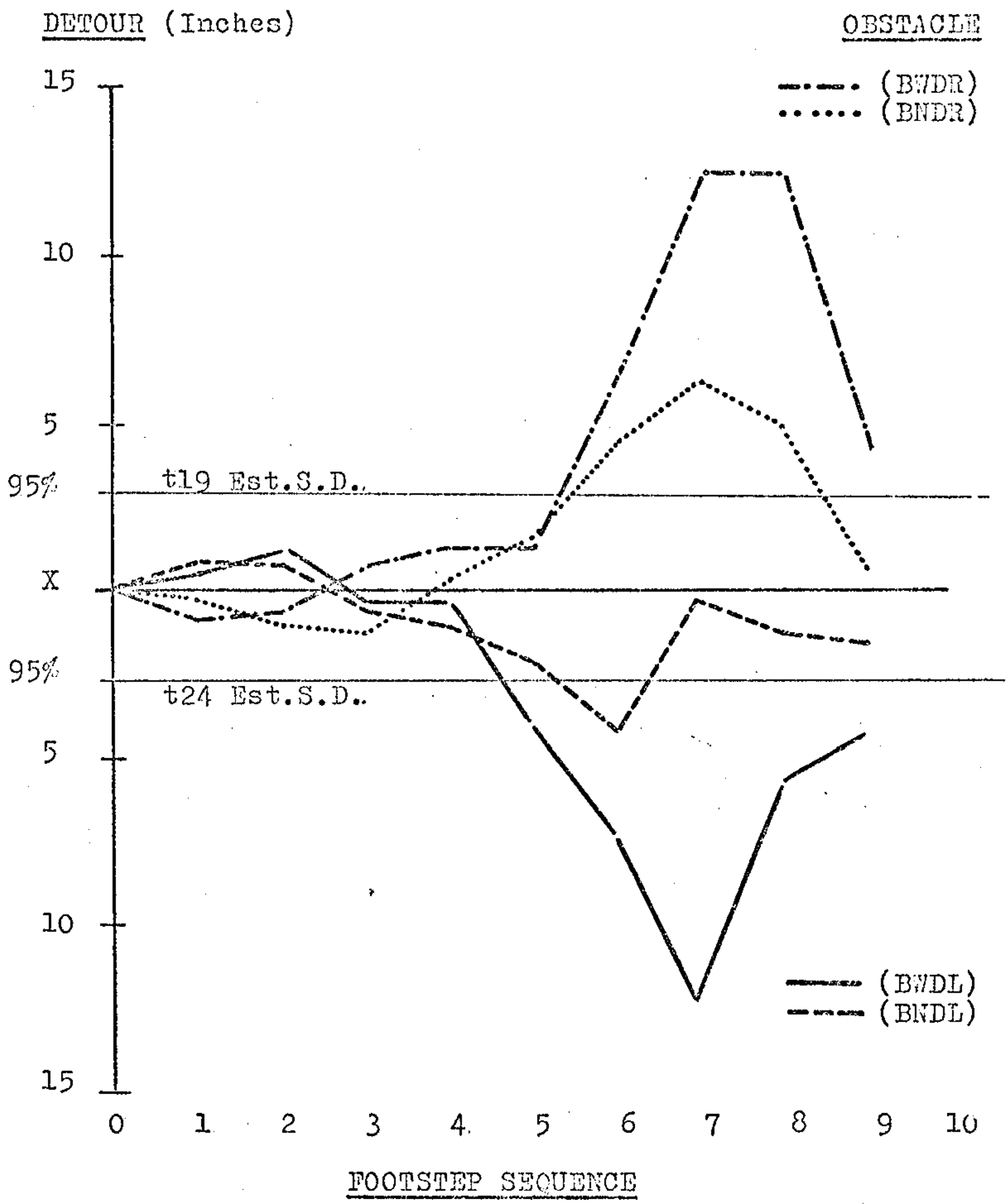


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wallfor S.(F.3) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 79).

FIG.(85) DETOURS IN RESPONSE TO DISTANT OBSTACLES (TWDR, TNDR) & (TWDL, TNDL). MEAN PERFORMANCE OF S.(F.3).



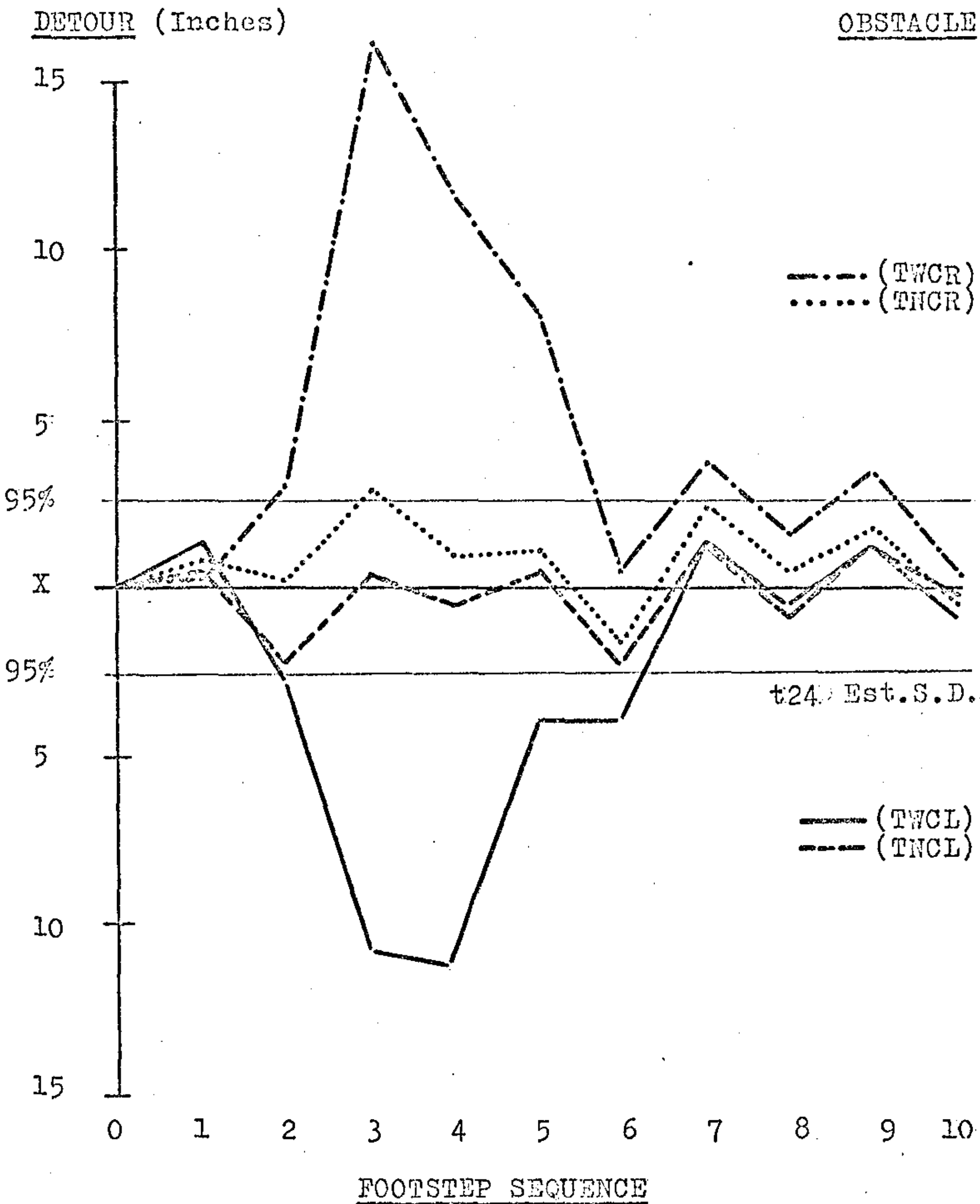
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.1) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 79).

FIG.(86) DETOURS IN RESPONSE TO DISTANT OBSTACLES (BWDR, BNDR) & (BWDL,BNDL).MEAN PERFORMANCE OF S.(F.3).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



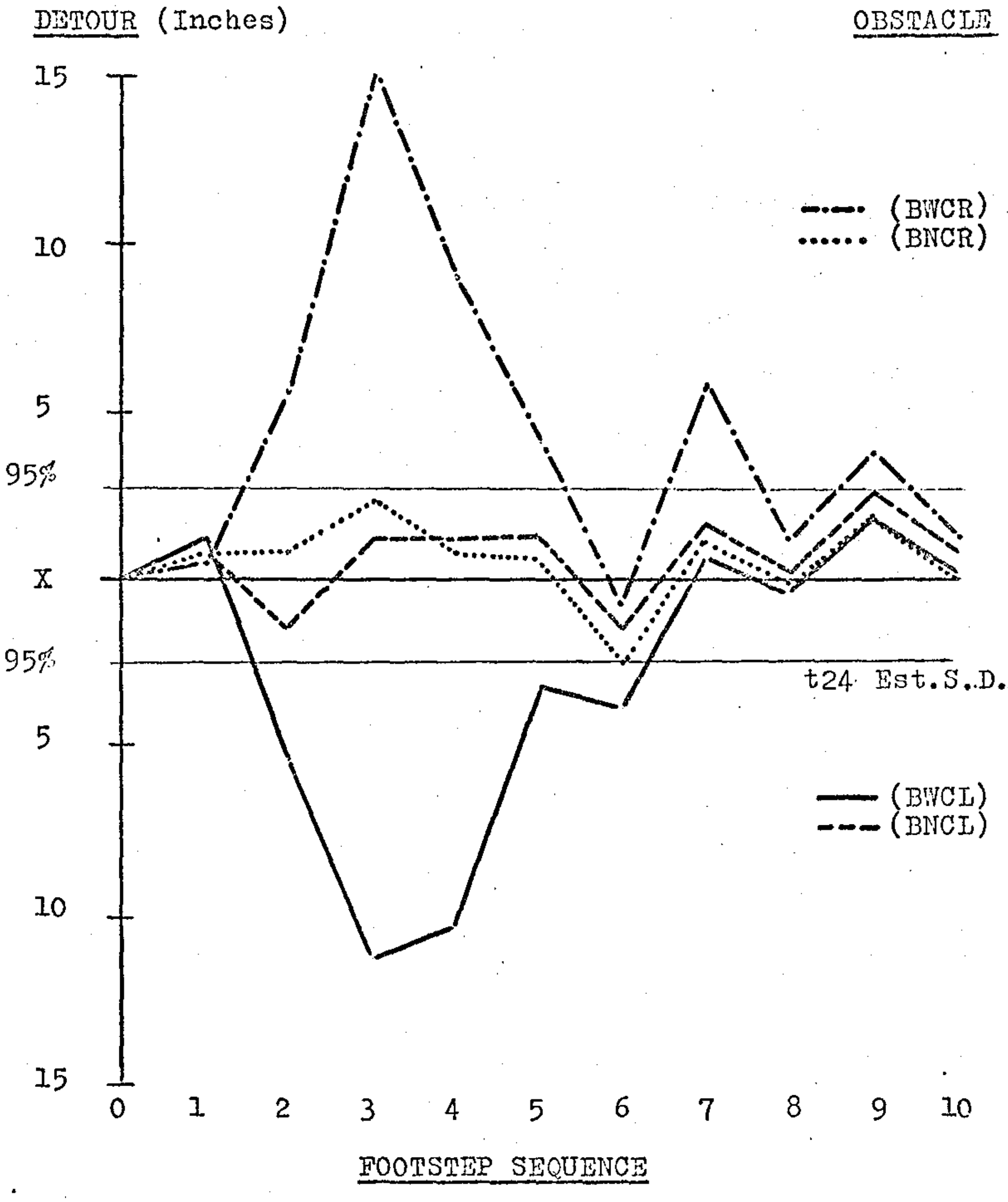
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.1) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 80).

FIG.(87) DETOURS IN RESPONSE TO CLOSE OBSTACLES (TWCR, TNCR) & (TWCL, TNCL).MEAN PERFORMANCE OF S.(M.1).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



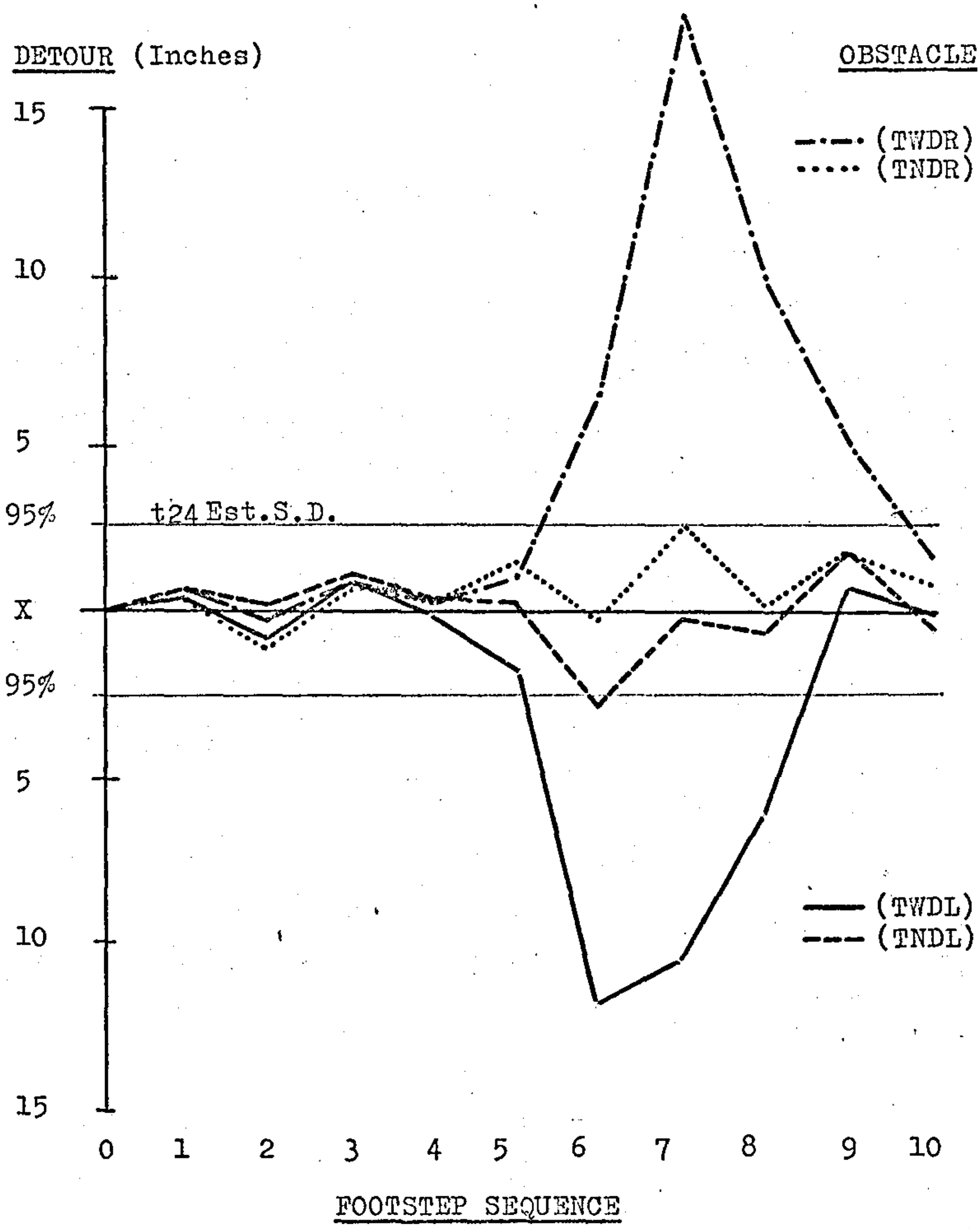
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.1) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 80).

FIG.(88) DETOURS IN RESPONSE TO CLOSE OBSTACLES (BWCR, BNCR) & (BWCL, BNCL).MEAN PERFORMANCE OF S.(M.1).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

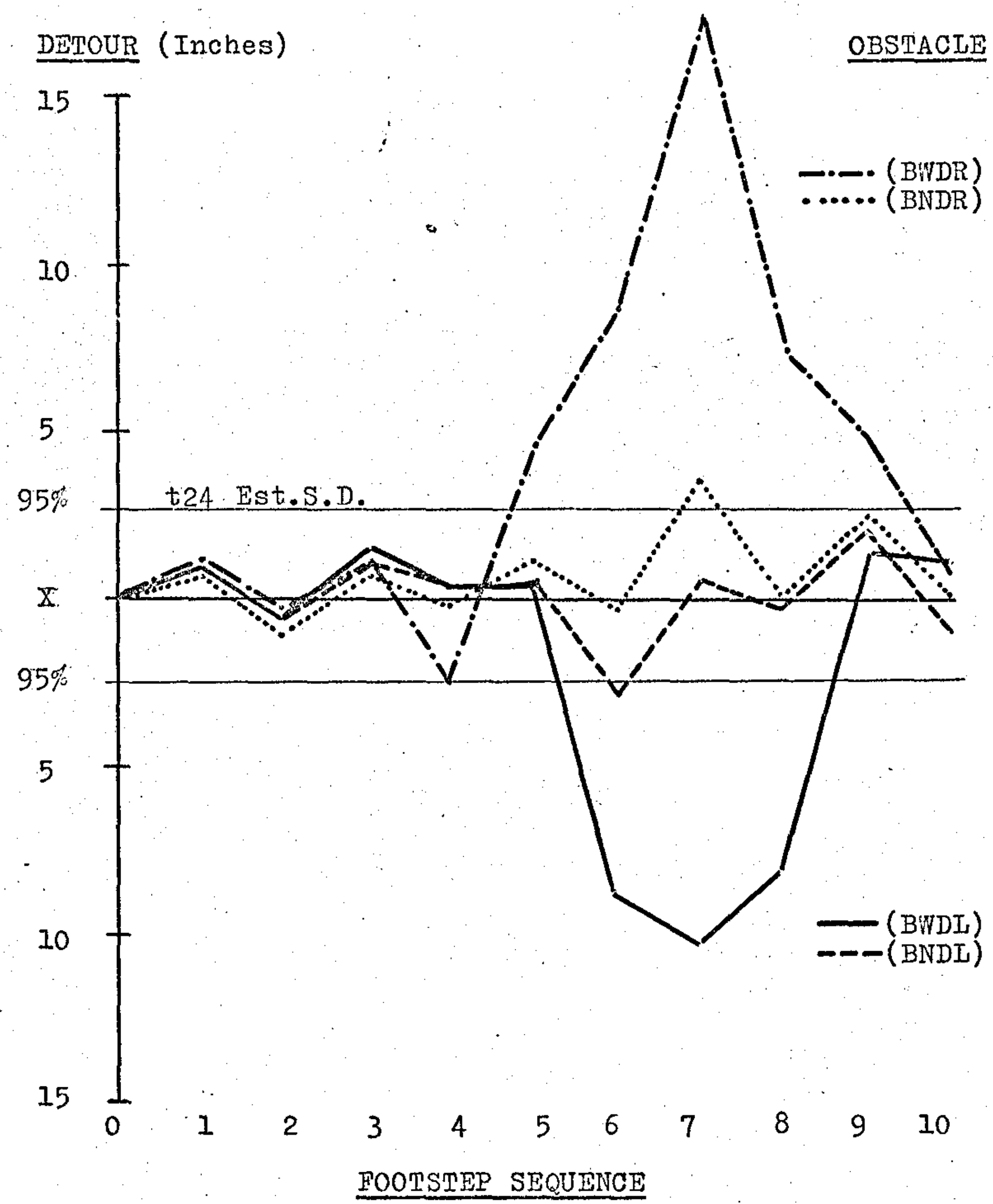


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.1) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 80).

FIG.(89) DETOURS IN RESPONSE TO DISTANT OBSTACLES (TWDR, TNDR) & (TWDL, TNDL).MEAN PERFORMANCE OF S.(M.1).



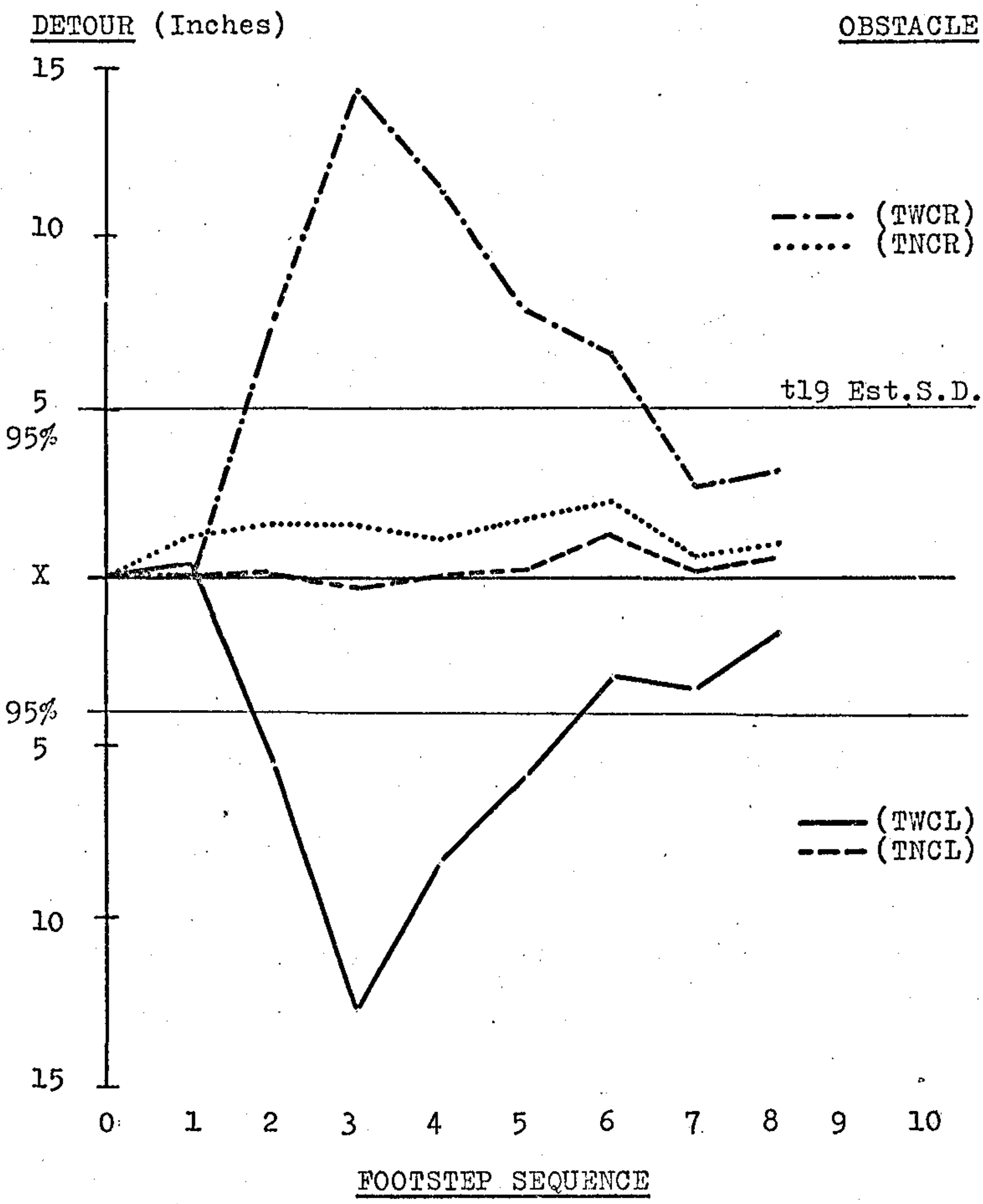
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.1) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 80).

FIG.(90) DETOURS IN RESPONSE TO DISTANT OBSTACLES (BWDR, BNDR) & (BWDL,BNDL).MEAN PERFORMANCE OF S.(M.1).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



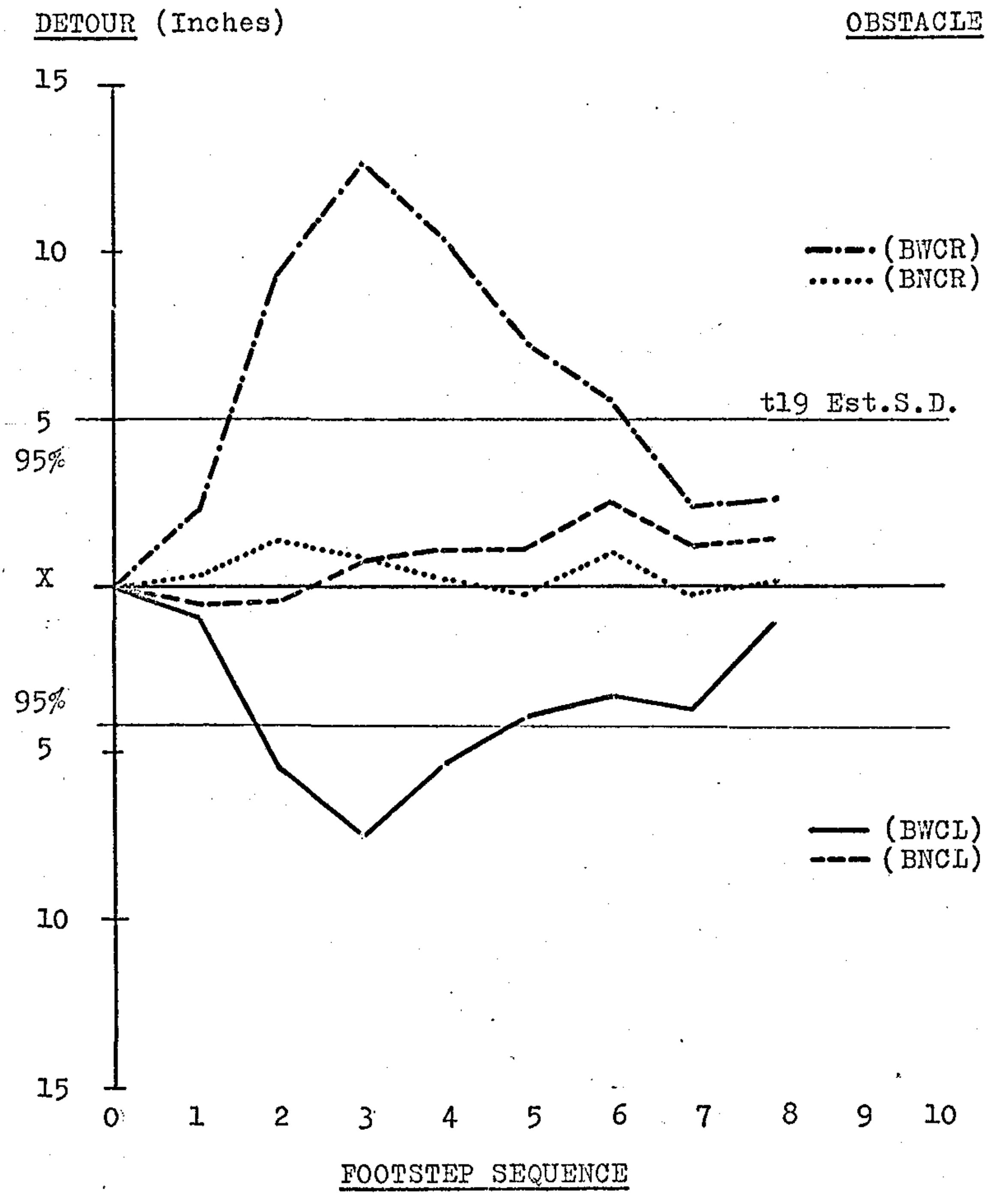
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.2) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 81).

FIG.(91) DETOURS IN RESPONSE TO CLOSE OBSTACLES (TWCR, TNCR) & (TWCL,TNCL).MEAN PERFORMANCE OF S.(M.2).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



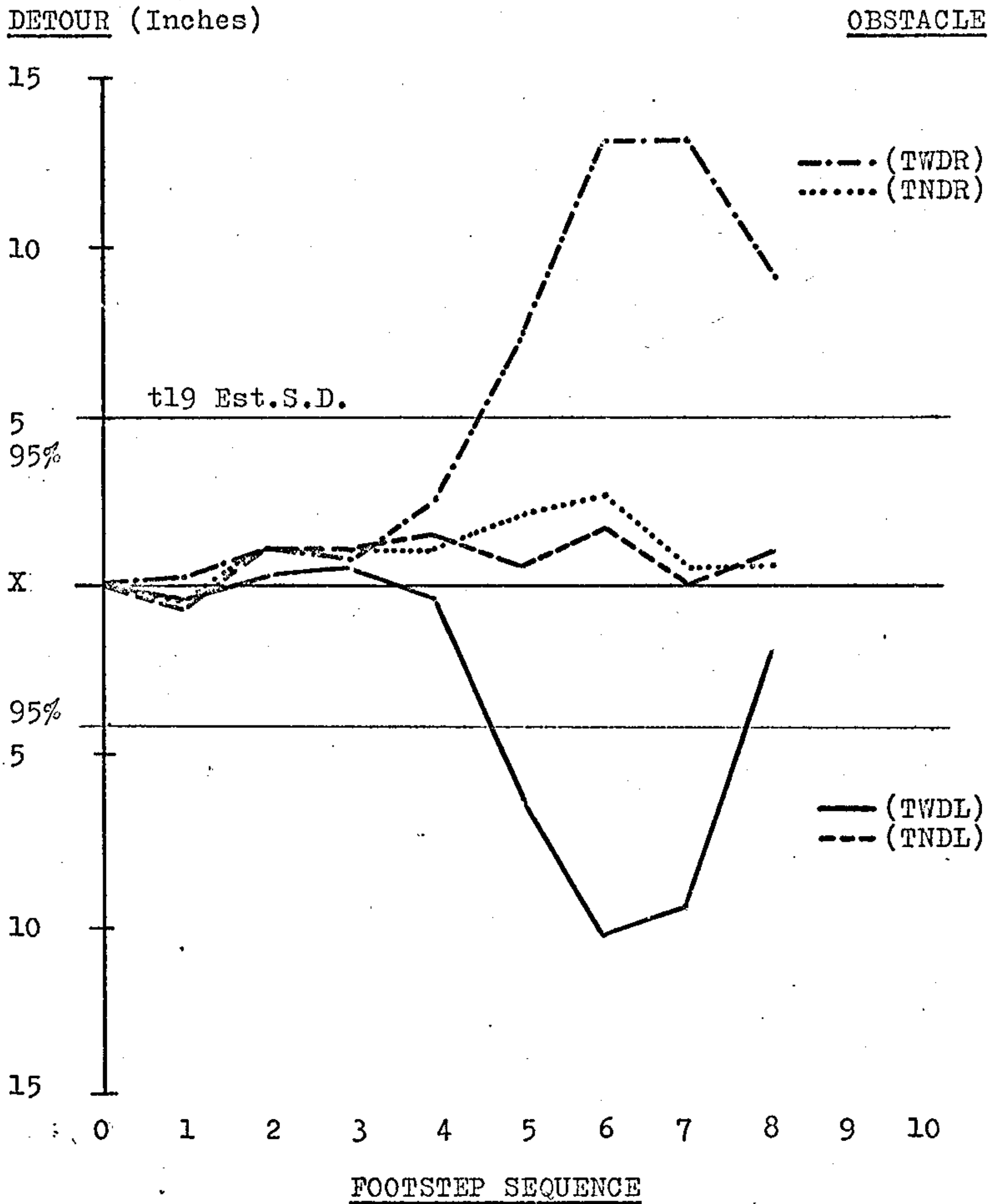
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.2) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 81).

FIG.(92) DETOURS IN RESPONSE TO CLOSE OBSTACLES (BWCR, BNCR) & (BWCL,BNCL).MEAN PERFORMANCE OF S.(M.2).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



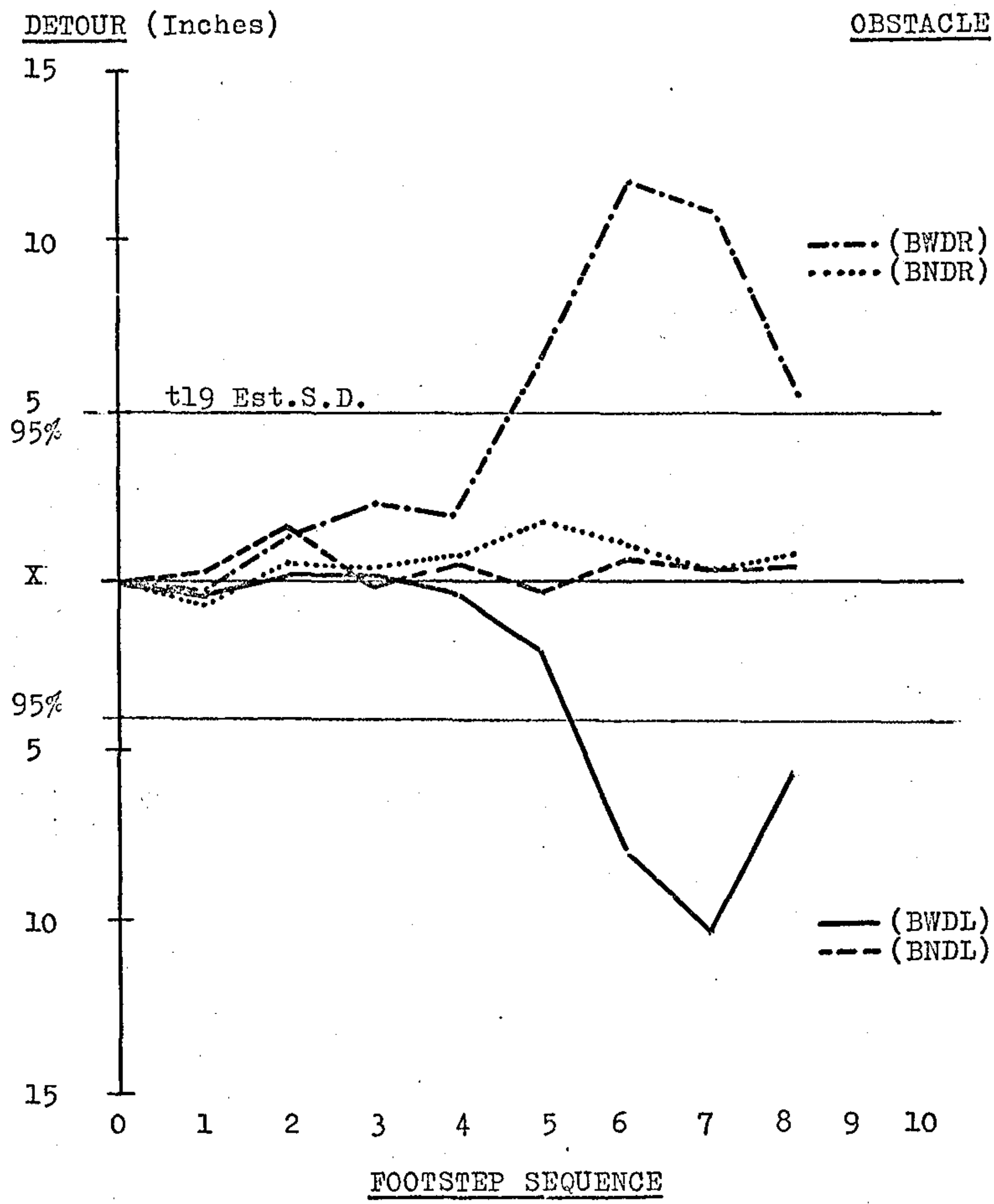
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.2) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 81).

FIG.(93) DETOURS IN RESPONSE TO DISTANT OBSTACLES (TWDR, TNDR) & (TWDL,TNDL).MEAN PERFORMANCE OF S.(M.2).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



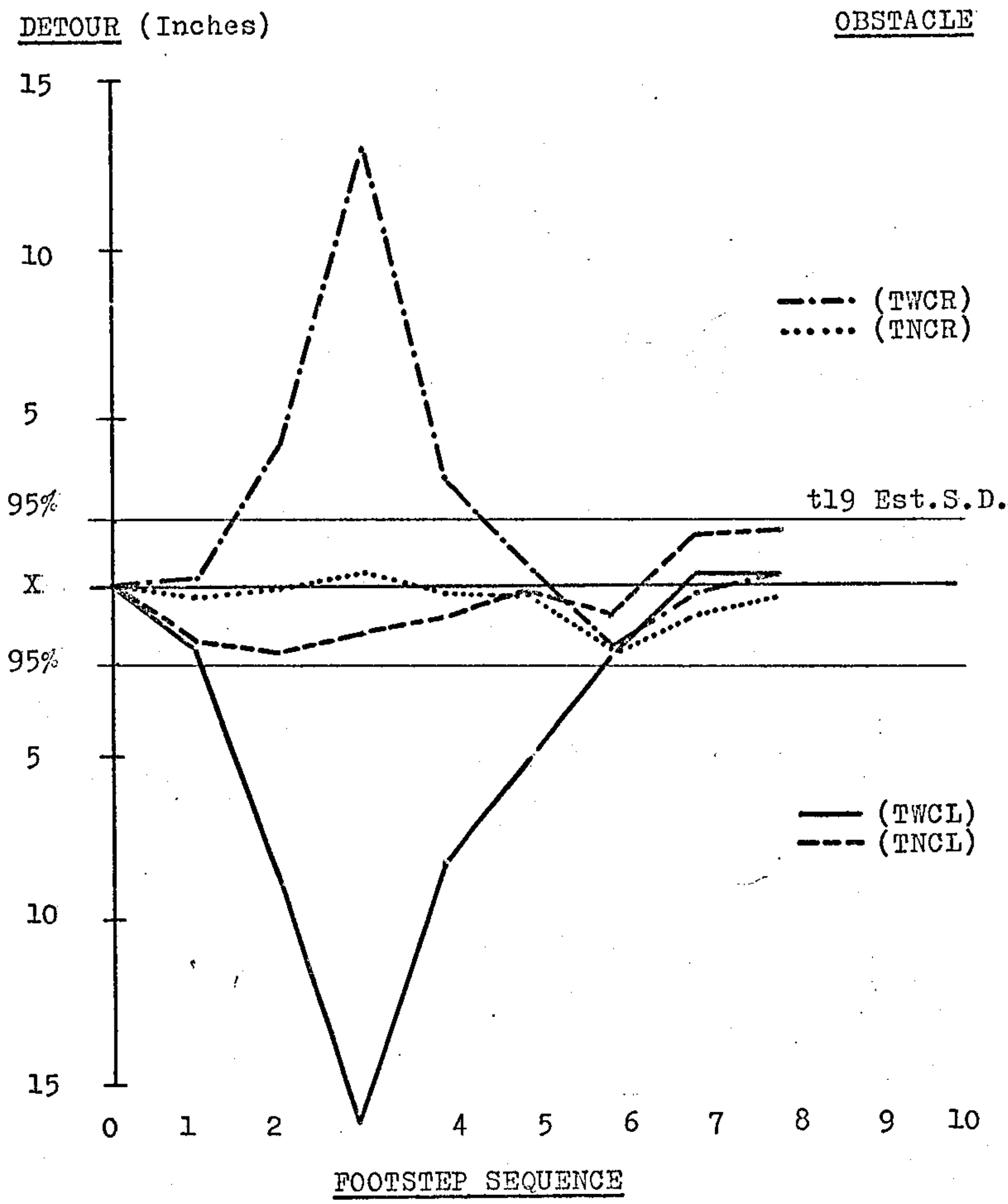
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.2) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 81).

FIG.(94) DETOURS IN RESPONSE TO DISTANT OBSTACLES (BWDR, BNDR) & (BWDL,BNDL). MEAN PERFORMANCE OF S.(M.2).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



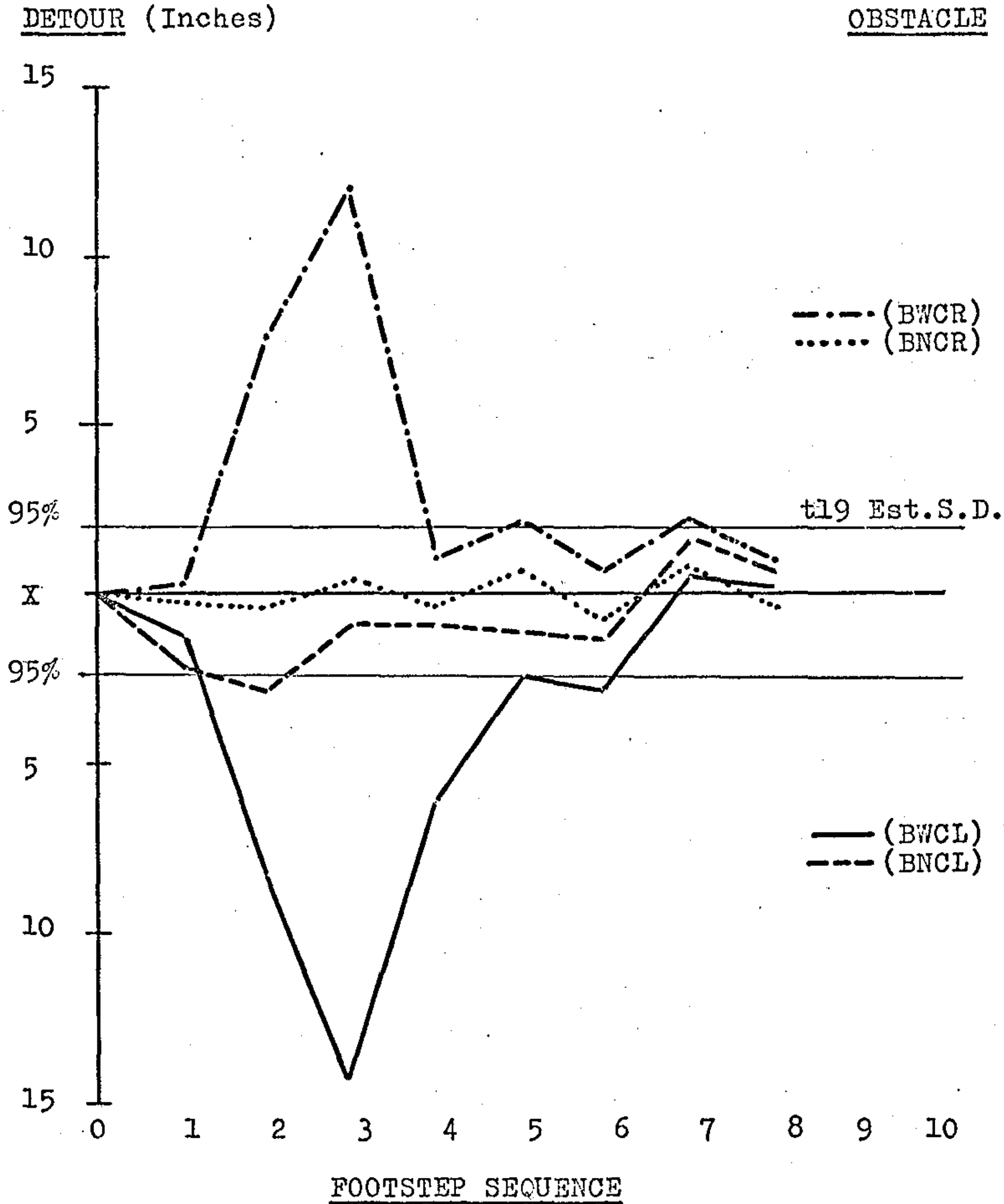
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.3) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 82).

FIG.(95) DETOURS IN RESPONSE TO CLOSE OBSTACLES (TWCR,TNCR) & (TWCL,TNCL). MEAN PERFORMANCE OF S.(M.3).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



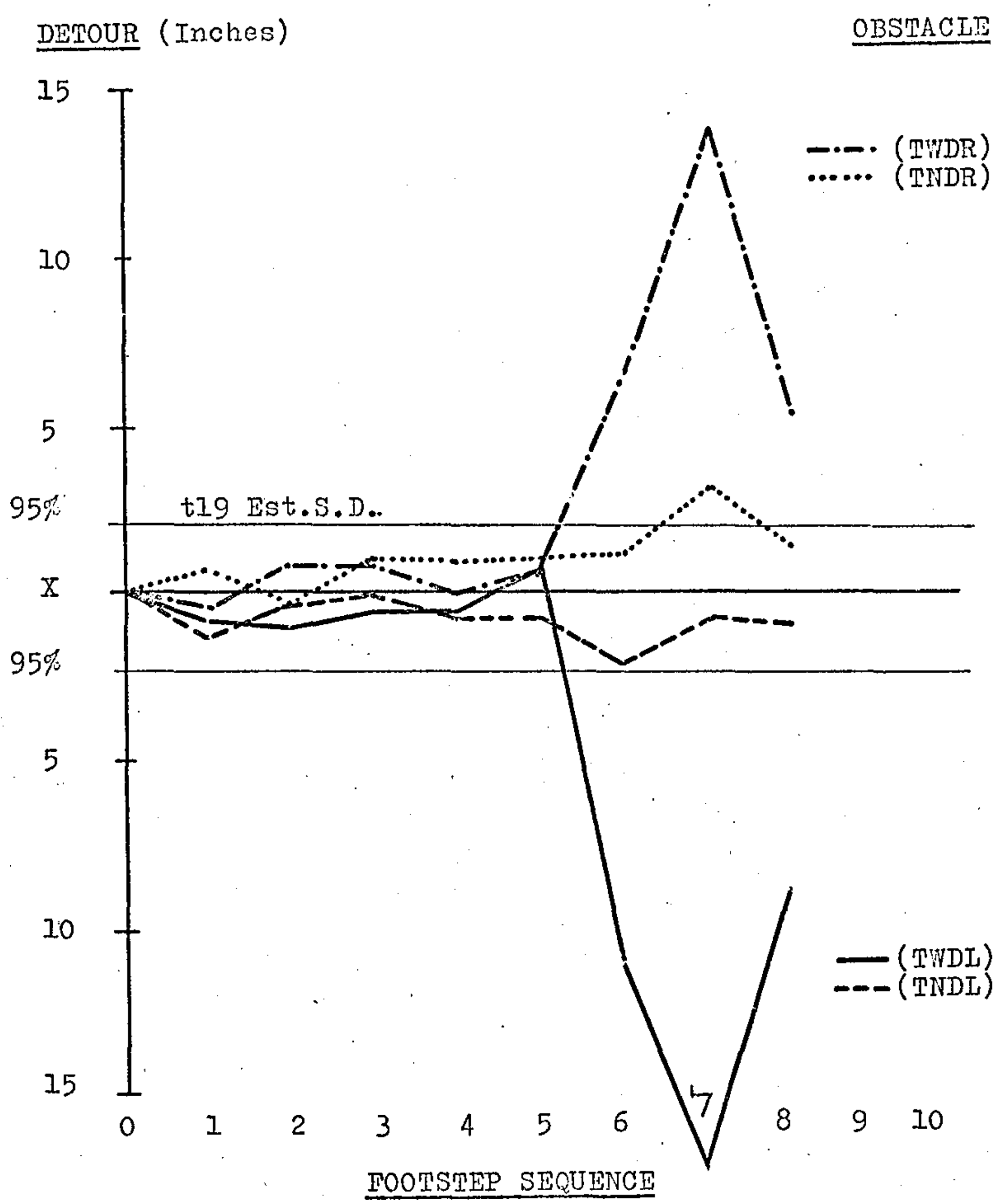
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.3) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 82).

FIG.(96) DETOURS IN RESPONSE TO CLOSE OBSTACLES (BWCR, BNCR) & (BWCL, BNCL). MEAN PERFORMANCE OF S.(M.3).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



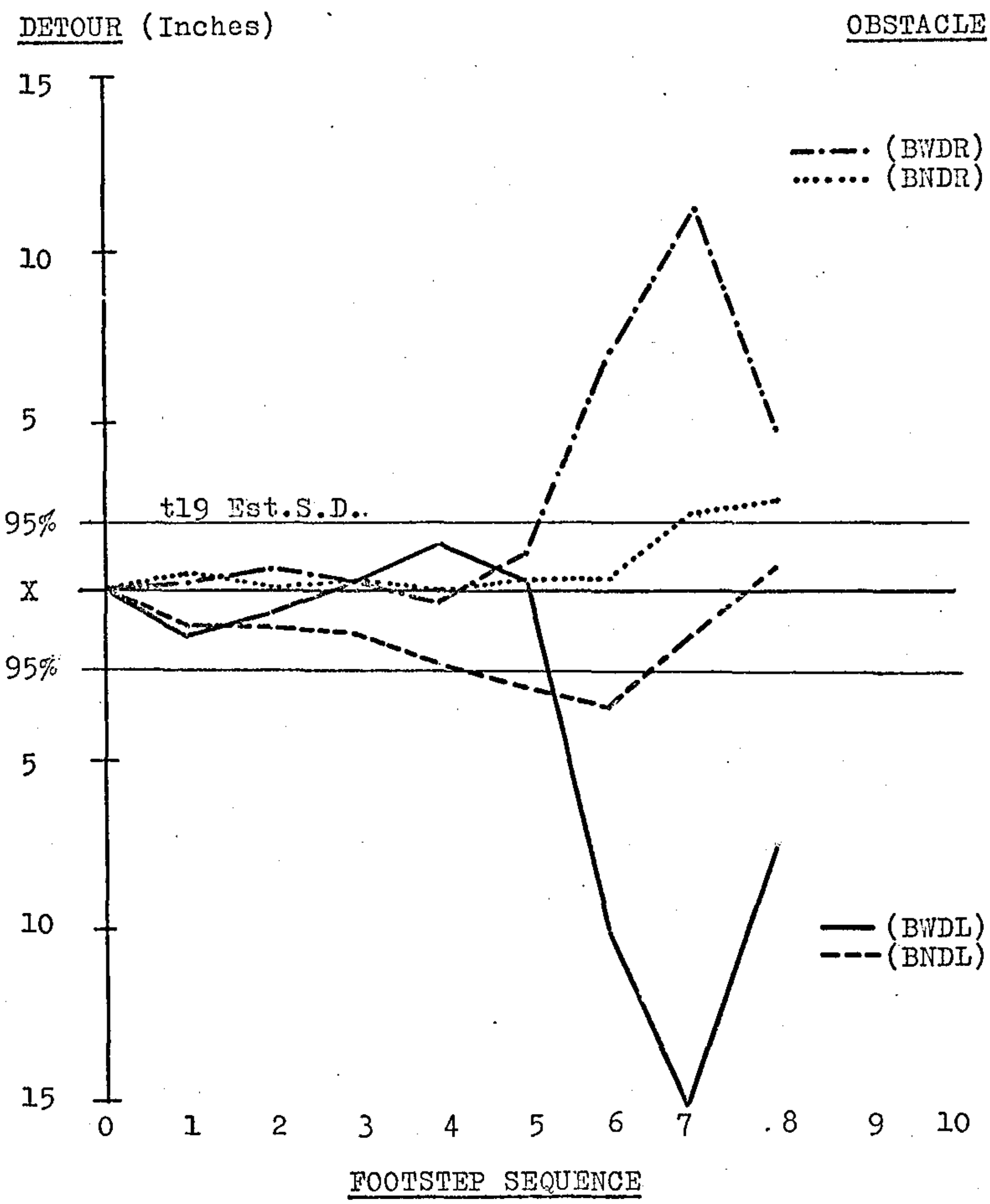
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.3) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 82).

FIG.(97) DETOURS IN RESPONSE TO DISTANT OBSTACLES (TWDR, TNDR) & (TWDL,TNDL). MEAN PERFORMANCE OF S.(M.3).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for S.(M.3) during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distance represented by (X) from the corresponding mean distance recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 82).

FIG.(98) DETOURS IN RESPONSE TO DISTANT OBSTACLES (BWDR, BNDR) & (BWDL,BNDL).MEAN PERFORMANCE OF S.(M.3).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

DISCUSSION PART (2).

Changes in distance maintained from L.H.Wall. Items discussed include:a).Individual response to NARROW obstacles.

b).Individual response to WIDE obstacles.

c).Aggregated response to WIDE obstacles.

The remaining matter for discussion relates to whether Ss.'s performance is indicative of their subjective experience of the risk incurred in Trials with Obstacles.

a). Individual response to NARROW obstacles.

The bar charts only referred to individual performance, whereas the diagrams of detour behaviour also include the combined mean performances for Ss. of the same sex. Aggregated performances, however, were plotted only in terms of response to WIDE obstacles. It was considered that no useful purpose would be served by aggregating Ss.'s response to NARROW obstacles because of the statistical bias obtaining from the wide variability in individual response to NARROW obstacles. In particular, S.(F.3) was inordinately cautious in her approach to NARROW obstacles by the standards of the other Ss. Perhaps this disparity arose from a misunderstanding of E.'s instructions for she was not of native English-speaking origin. Reference to TABLE (23) will reveal that S.(F.3) was responsible for nineteen of the twenty recorded changes statistically significant in female performance.

As regards male performance, it is noted that several recorded changes of statistical significance were so relatively small as to be of no practical significance. They fall within a possible range of experimental error. The margin by which statistically significant changes exceed the five per cent level is calculated below:

S.	Step No.	Foot	Trial Data (Appendix 2 Table 80)	Unobstructed Trials (6-10) 5% level (Appendix 1 Table 59)	Exceeds 5% level
M.1	3	Right	TNCR 2.90	2.56	0.34

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

S.	Step No.	Foot	Trial Data (Appendix 2 Table 80)		Unobstructed Trials (6-10) 5% level (Appendix 1 Table 59)	Exceeds 5% level
M.1	6	Left	TNDL	2.80	2.56 (Either foot)	0.24
M.1	7	Right	BNDR	3.60	2.56	1.04
M.1	6	Left	BNDL	2.90	2.56	0.34
			Trial Data (Appendix 2 Table 82)		Unobstructed Trials (6-10) 5% level (Appendix 1 Table 61)	
M.3	7	Left	TNDR	3.10	1.92 (Left foot)	1.18
M.3	7	Left	BNDR	2.30	1.92	0.38
M.3	8	Right	BNDR	2.80	2.35 (Right foot)	0.45
M.3	2	Right	BNCL	2.80	2.35	0.45
M.3	5	Left	BNDL	2.70	1.92	0.78
M.3	6	Right	BNDL	3.40	2.35	1.05

The overall influence of the obstacles on Ss.'s performance is readily detected by the regularity of the gap maintained between the plots for like obstacles of the opposite hand. Almost without exception this gap may be observed to widen at the footsteps coincident with the position of the obstacle even though in the majority of cases such response was statistically non-significant. It would appear from this that the width of the NARROW obstacle was sufficient to arouse Ss. to the possibility of their being harmed if they did not take care, but it was less than that width necessary to provide statistical confirmation of their evasive action.

b). <u>Individual response to WIDE obstacles.</u>

No such problem as described above occurred in identifying evasive action in response to WIDE obstacles. The performance of all Ss. was statistically significant as can be immediately seen from the diagrams. The fact is not surprising since the obstacles were exactly half the width of the passageway and Ss. had been instructed to walk down the centre of the passageway.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

FEMALES.

FOOTSTEP SEQUENCE

TRIAL	1	2	3	4	5	6	7	8	9	10
TNDR					F.3	F.3	F.3	F.3		
TNDL						F.3	F.3	F.3		
TNCR										
TNCL		F.3	F.3							
BNDR						F.3	F.3	F.3 F.1	F.3	
BNDL						F.3				
BNCR			F.3	F.3						
BNCL		F.3	F.3	F.3						

MALES.

FOOTSTEP SEQUENCE

TRIAL	1	2	3	4	5	6	7	8	9	10
TNDR							M.3			
TNDL						M.1				
TNCR			M.1							
TNCL										
BNDR							M.1 M.3	M.3		
BNDL					M.3	M.1 M.3				
BNCR										
BNCL		M.3								

TABLE (26). SIGNIFICANT CHANGES IN DISTANCE FROM L.H.WALL IN TRIALS WITH NARROW OBSTACLES (ALL SUBJECTS).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

The data were examined for evidence of constancy in individual response to the various obstacles. FIGURES (99 - 104) were prepared in order to compare response to like obstacles of opposite hand, to compare response to CLOSE obstacles with that to DISTANT obstacles, and to compare reponse to obstacles mounted in the passageway above waist-level (TOP) with those mounted below (BOTTOM). The FIGURES also consolidate in more accessible form the extent of differences in response between the sexes and between members of the same sex.

The measure of constancy of performance was judged by the coincidence obtaining between related detours as to their points of entry and exit and by the congruency of paired detours. In comparing the performance of different Ss. it should be noted that detour movements, as shown in the diagrams vertically, are affected by the value of the 5% level in the corresponding Unobstructed Trials (6-10). The wider the range of variation in those trials and hence the higher the 5% level, the smaller the recorded detour in Trials with Obstacles. Put another way, the diagrams show foot location beyond the 5% level in Unobstructed Trials (6-10) and represent movement behaviour which would occur by chance less than once in twenty times.

If the criteria of examination described above are applied to female performance, consider first the duration of avoidance behaviour. In the eight obtaining wide obstacle positions (TOP,BOTTOM,LEFT,RIGHT, at CLOSE and DISTANT) the data reveals that S.(F.1) entered avoidance two paces before the obstacle except for condition BWCL, and made her exit two paces beyond the obstacle except for conditions TWCR and TWCL. It is clear from this that she found CLOSE obstacles more disconcerting and she may have varied her entry and exit strides to allay her (assumed) apprehension. By contrast, S.(F.2) took an additional stride of avoidance on entering conditions BWDR and BWDL. (The small portions of strides originating or terminating in statistically non-significant areas are ignored for simplification).

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

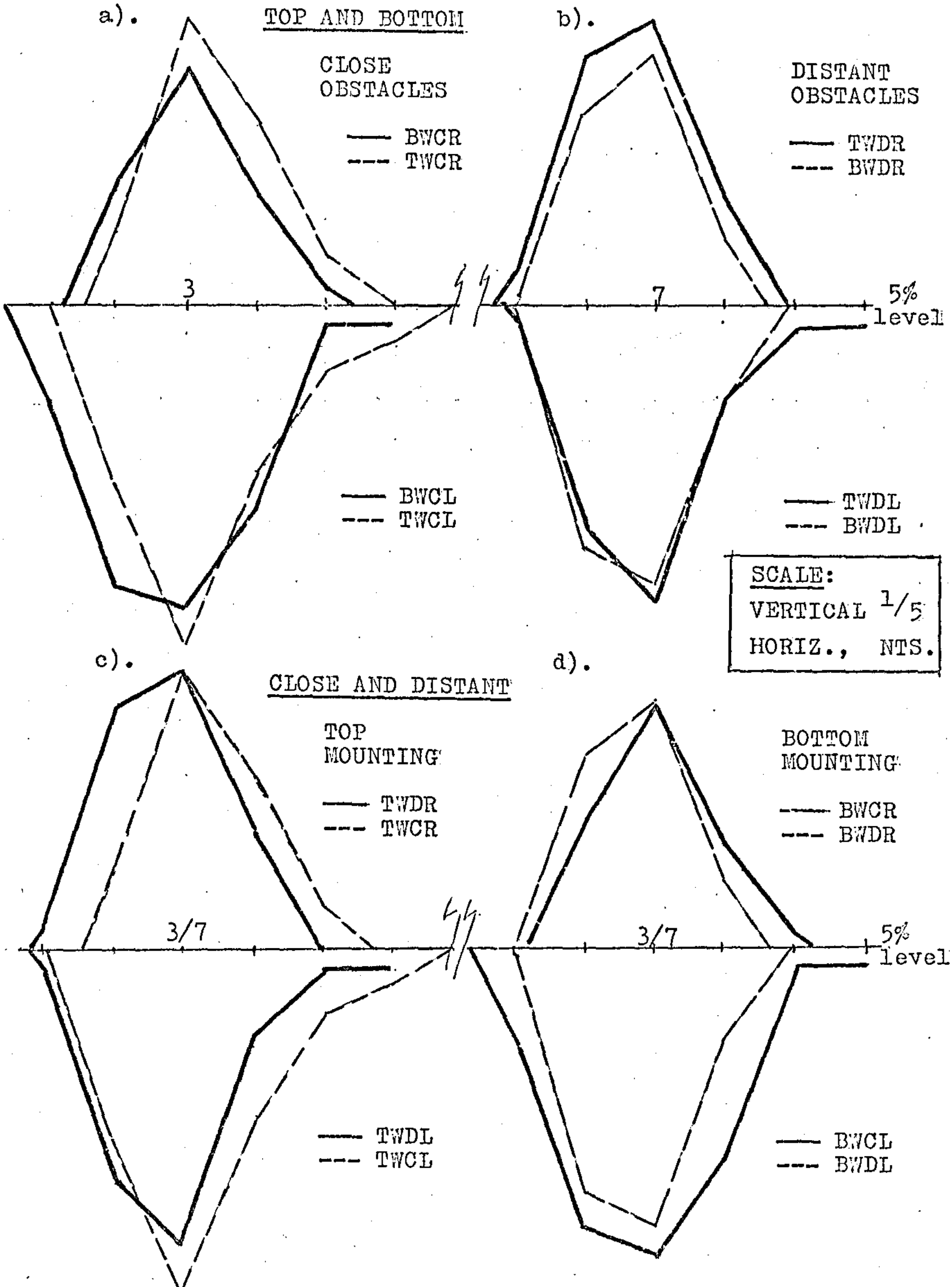
The performance of S.(F.3) displays the characteristic of a shorter entry into the obstacle situation than shown by her fellows except in the instance of condition BWDL, matched by a prolonged avoidance, except for condition TWDL, which extended to three paces and sometimes more. It can be recalled (TABLE 26) that this S. demonstrated greater variability in her "Mean Stride Length" than the other females Ss. Her prolonged avoidance of WIDE obstacles is possibly further evidence of her caution so dramatically portrayed by her response to NARROW obstacles.

As regards the width of the detours taken by female Ss. and in the matter of their congruency, it is noted that one inch vertical dimension on the diagrams represents five inches on the ground. Bearing in mind the few exceptional responses mentioned it is considered that the detours reveal a highly structured response to the permutations of a single class of situation, and that they provide useful evidence of constancy in risk assessment in conditions of subjective uncertainty. Moreover, the contrasting manner of negotiation of WIDE obstacles displayed by S.(F.3) emphasises the individualistic nature of the assessment of risk.

The measure of constancy as applied above is, of course, very much a value judgement. But nowhere better in S. performance is lack of constancy demonstrated than in the detours registered by male S.(M.2). Firstly, it may be seen that he began avoidance of DISTANT obstacles one pace earlier than for CLOSE obstacles. This is constancy: a one pace entry for CLOSE, a two pace entry for DISTANT obstacles. (Partial steps are again ignored). But his response to condition BWCL is inconsistent with his response to related CLOSE obstacles. By the terms above this is inconstancy although were he to repeat the same results on a future occasion that would be constancy. The performance of S.(M3), a person the same height as S.(M.2), provides an interesting contrast in constancy. Except for his prolonged avoidance of LEFT CLOSE obstacles and his wider avoidance of obstacles on the LEFT than on the RIGHT, the matching of his detours is exceptionally close.

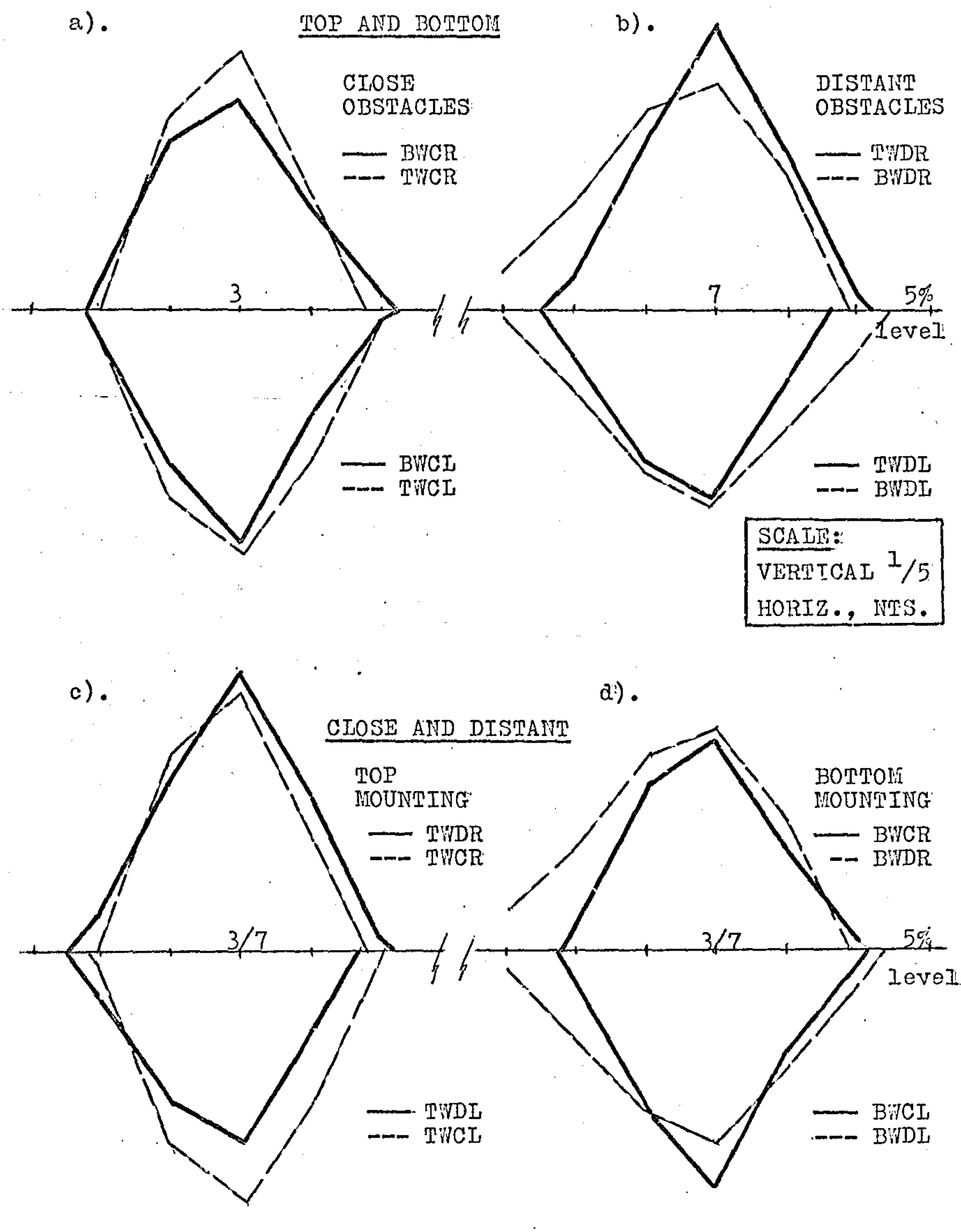
...continued.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



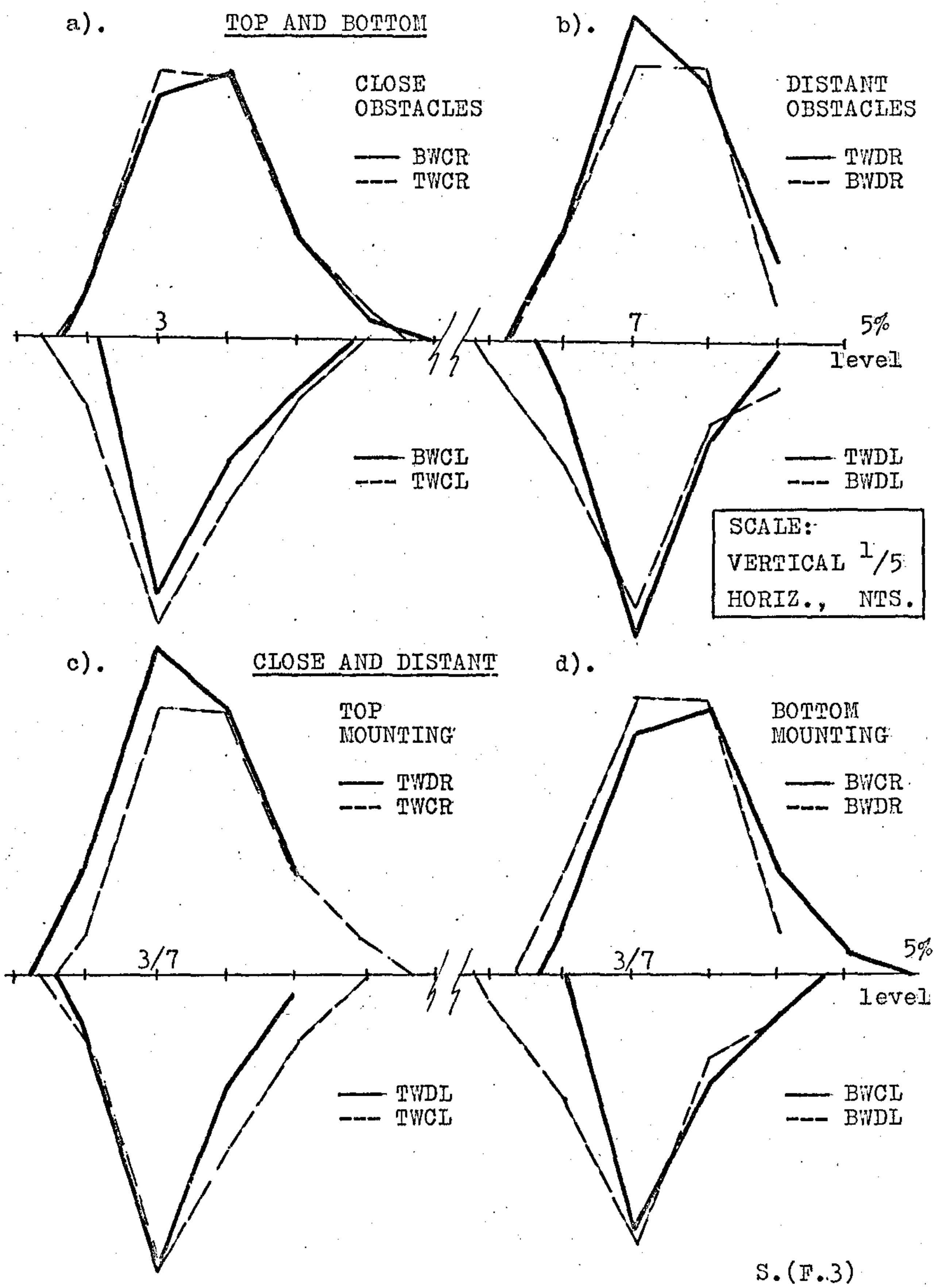
S.(F.1).

FIG.(99). CONGRUENCY OF DETOURS IN RESPONSE TO WIDE OBSTACLES.



S.(F.2)

FIG.(100). CONGRUENCY OF DETOURS IN RESPONSE TO WIDE OBSTACLES.



S.(F.3)

FIG.(101). CONGRUENCY OF DETOURS IN RESPONSE TO WIDE OBSTACLES.

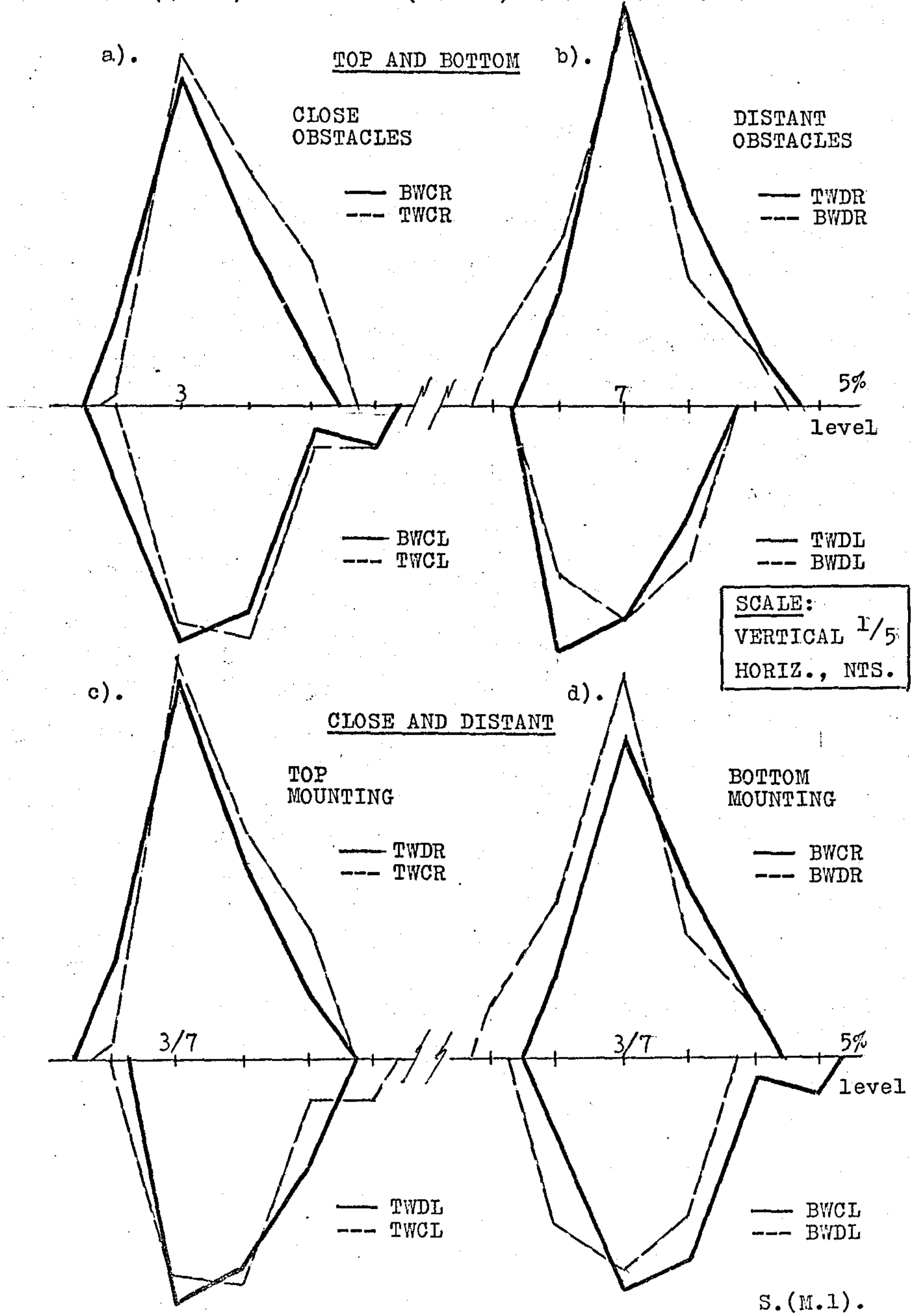
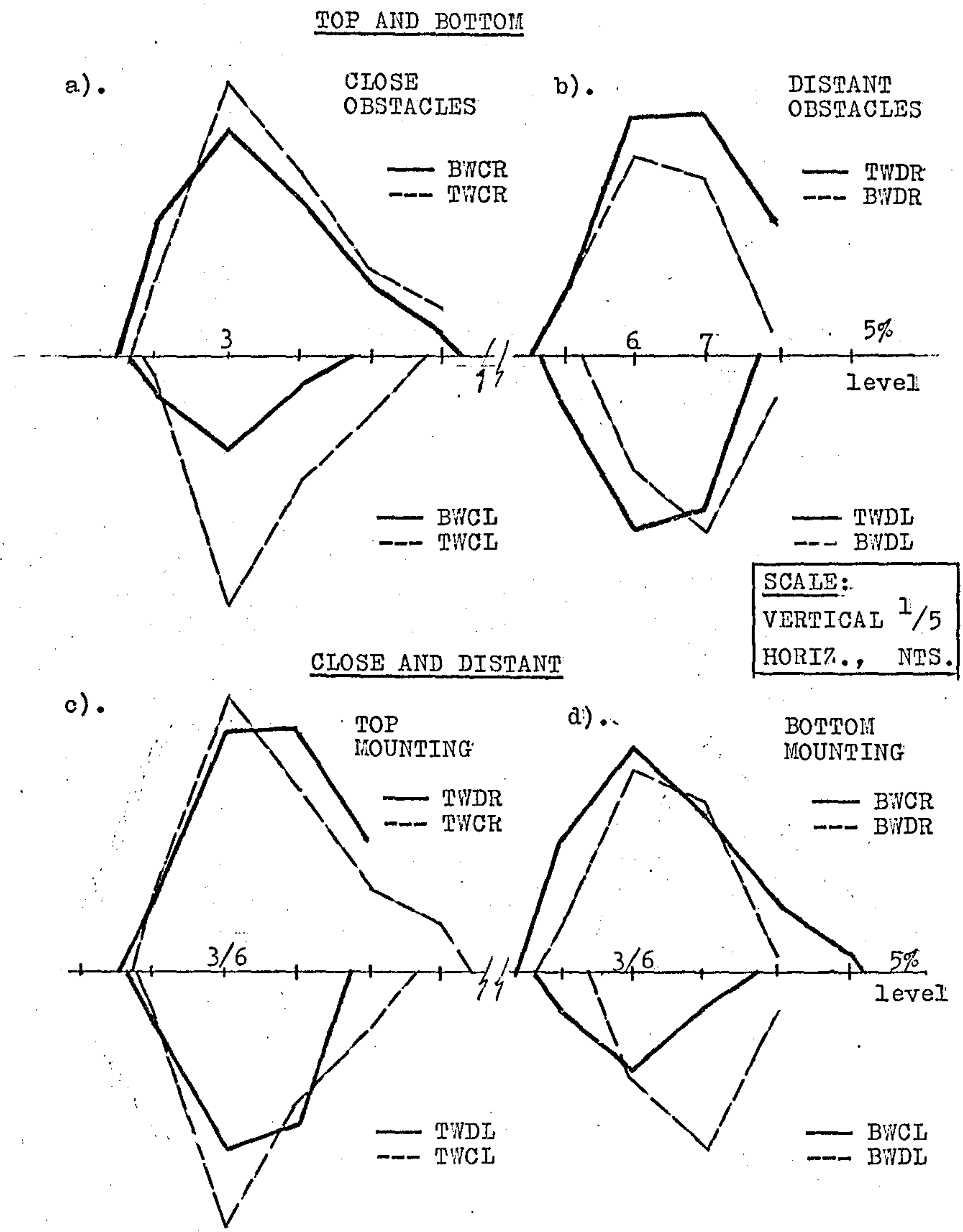
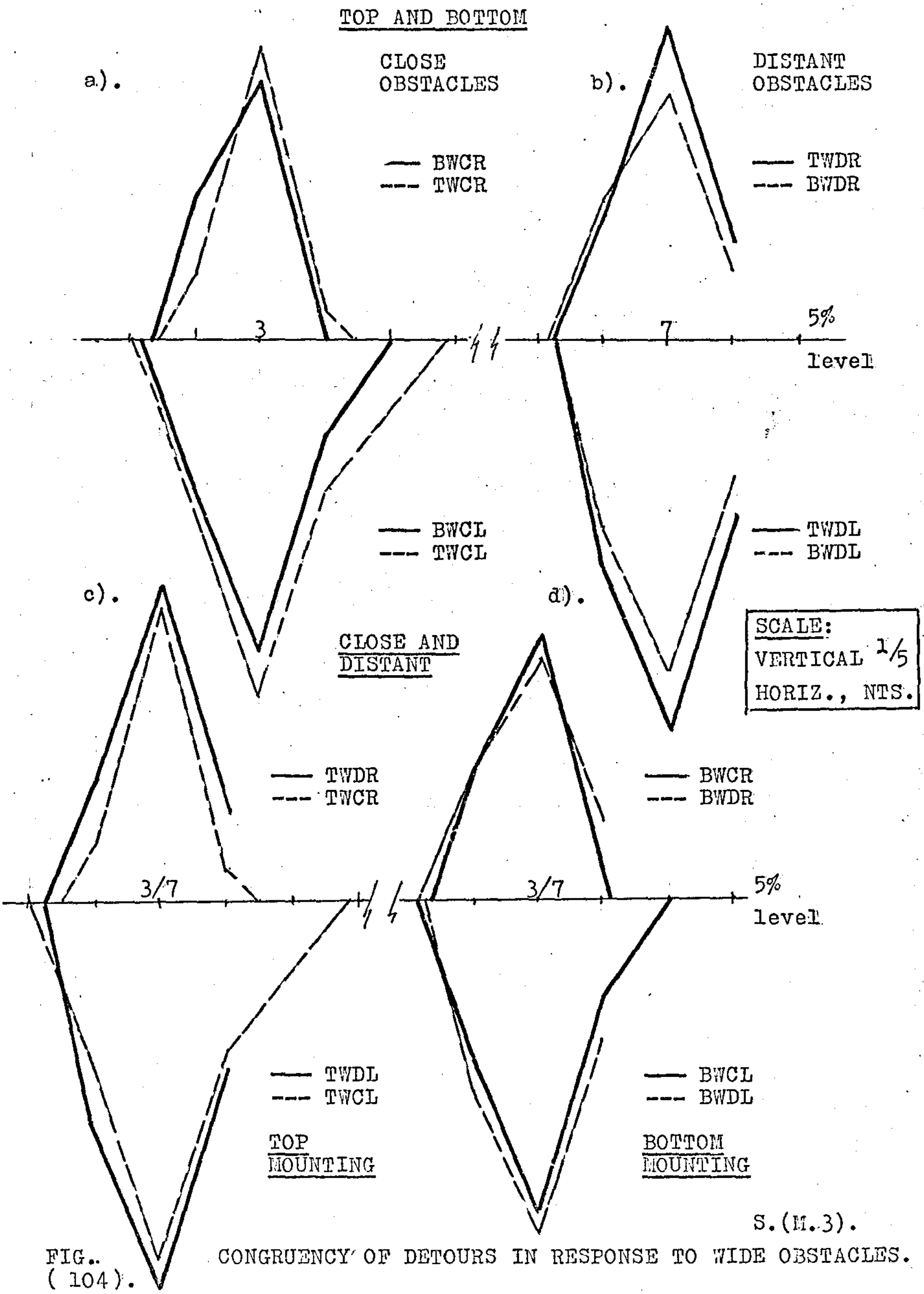


FIG.(102). CONGRUENCY OF DETOURS IN RESPONSE TO WIDE OBSTACLES.



S.(M.2).

FIG.(103).CONGRUENCY OF DETOURS IN RESPONSE TO WIDE OBSTACLES.



S.(M.3).

FIG.. (104). CONGRUENCY OF DETOURS IN RESPONSE TO WIDE OBSTACLES.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

A consistent wider avoidance of obstacles on the RIGHT than on the LEFT was shown by S.(M.1). A matter which again emphasises the individualistic nature of response. Apart from the fact that he entered avoidance of BOTTOM WIDE obstacles at the CLOSE and DISTANT positions earlier than for the equivalent TOP WIDE obstacles, there are no characteristics in his response behaviour which have not been dealt with illustratively in discussing the performance of other Ss.

Overall, the nature of male response to WIDE obstacles reinforces the claims made in respect of female performance. The more erratic performance of S.(M.2) is not thought to weaken this claim.

c). Aggregated response to WIDE obstacles.

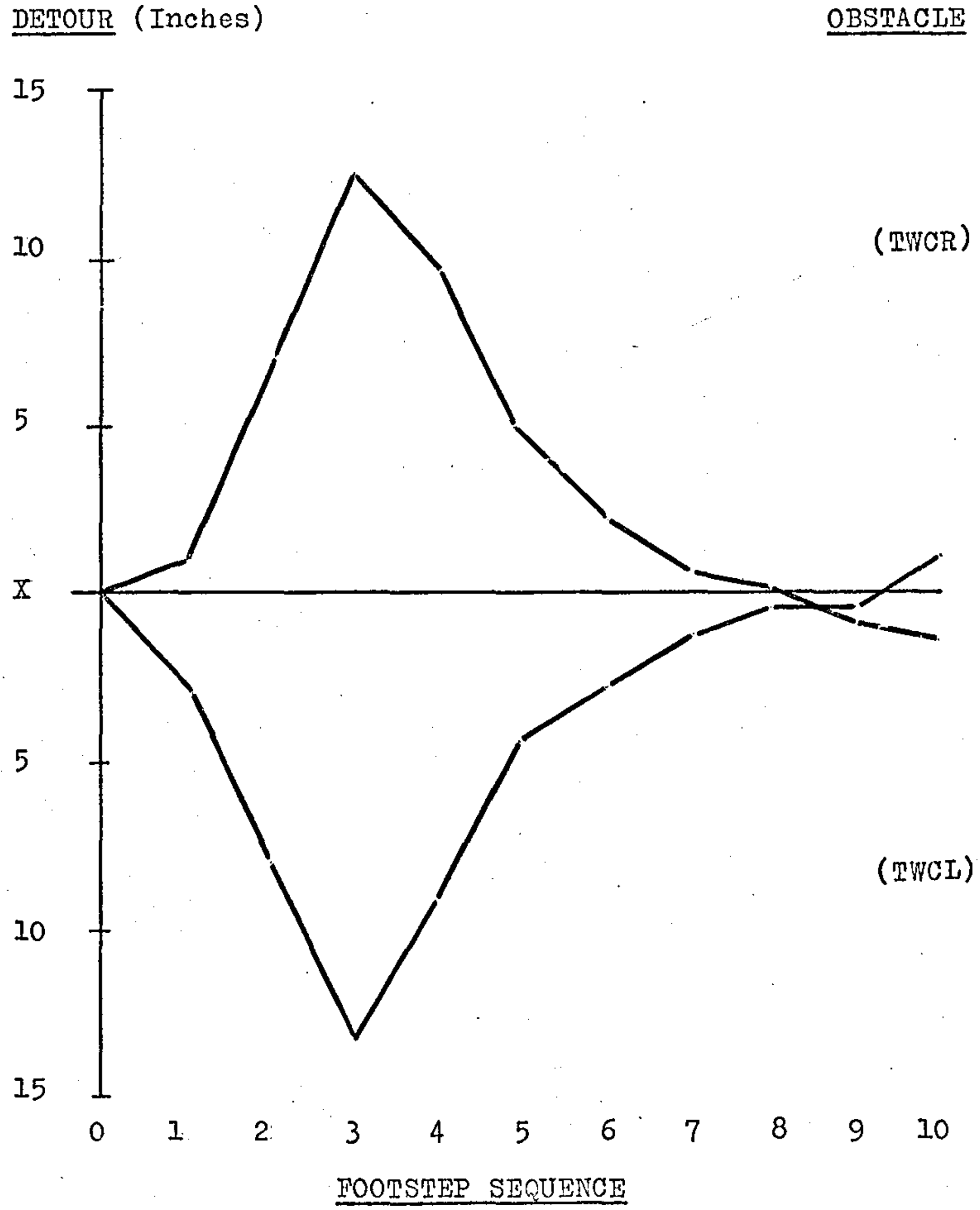
The data for the trials of individual Ss. were aggregated for members of the same sex and simple arithmetic means were derived for each Obstacle Trial (APPENDIX 2; TABLES 83 & 84). Statistical analysis was not attempted. The mean performance of each sex is plotted in FIGS.(105-120).

Although the data for independent trials was "smoothed" by averaging the aggregate of their arithmetic means, it is considered that the data retained its independence. The calculations surfaced the underlying trend to constancy in response not just to obstacles of opposite hand but also to those placed at CLOSE and DISTANT positions. The effect is more marked in female performance than in male.

FIGURES (121-124) were prepared in order to compare male and female avoidance behaviour. Seen here, the congruency between male and female response is quite remarkable.

One could hold the view that the experimental situation was constructed in such a way as to foster a stereotyped response. For example, the half-width of the passageway was only 27 inches such that when WIDE obstacles were presented this was the maximum gap for their negotiation. But whilst a gap of 27 inches might restrict the arm swing of some people, it is considerably less than the shoulder width of most individuals who are lightly clad (95th %tile male naked shoulder width is about 19 inches: Woodson, W.E. and D.W.Conover (1964) "Human engineering guide for equipment designers", Cambridge University Press).

The Ss. presumably had no doubts that they had room to pass WIDE obstacles, but was the 27 inch gap sufficiently large to accept their body-image, i.e. their imaginal body size? It is suggested that the point of entry to detour behaviour indicates their questioning of that proposition and their active institution of a Safe Distance judgement.

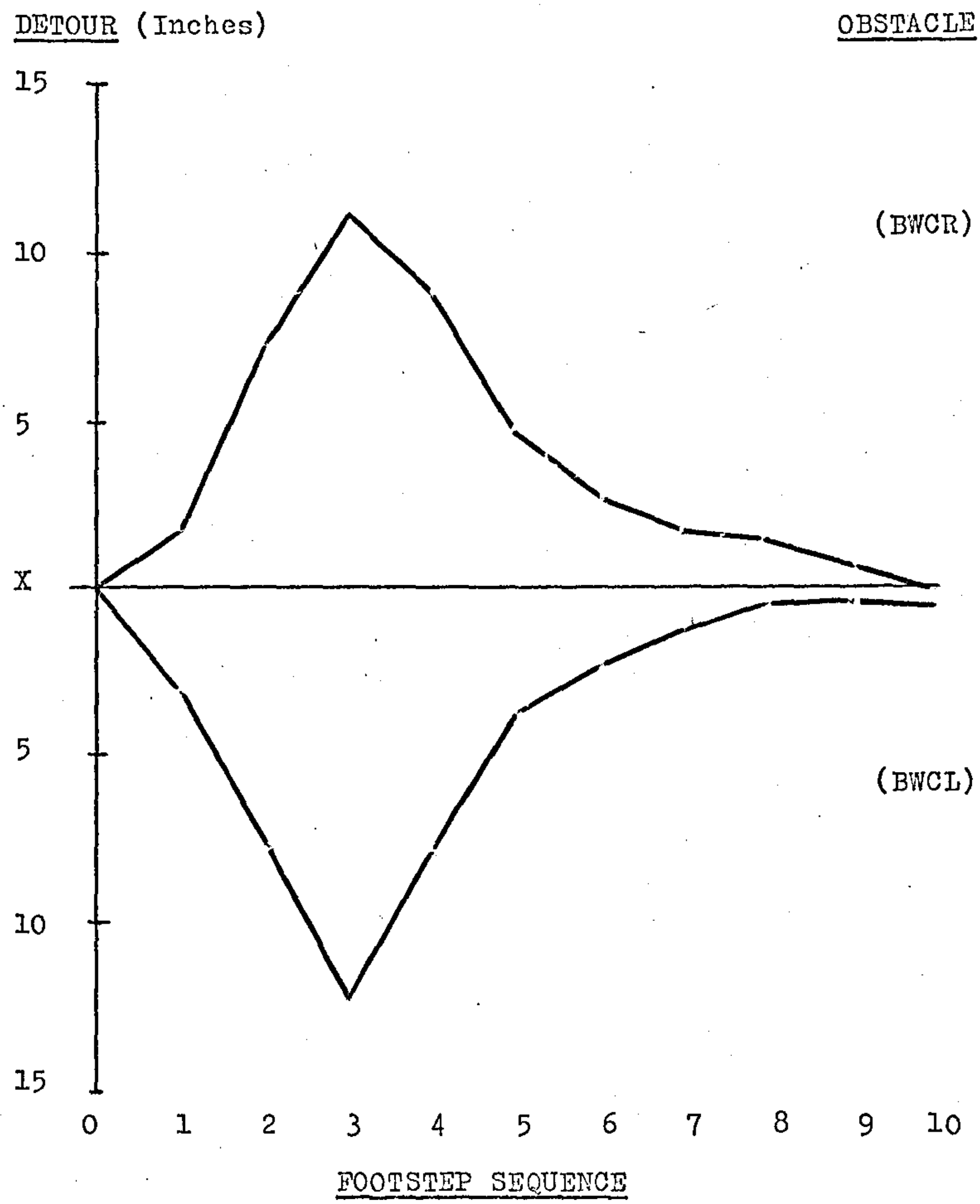


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 83).

FIG.(105) DETOURS IN RESPONSE TO OBSTACLES (TWCR & TWCL). MEAN PERFORMANCE OF ALL FEMALE Ss.



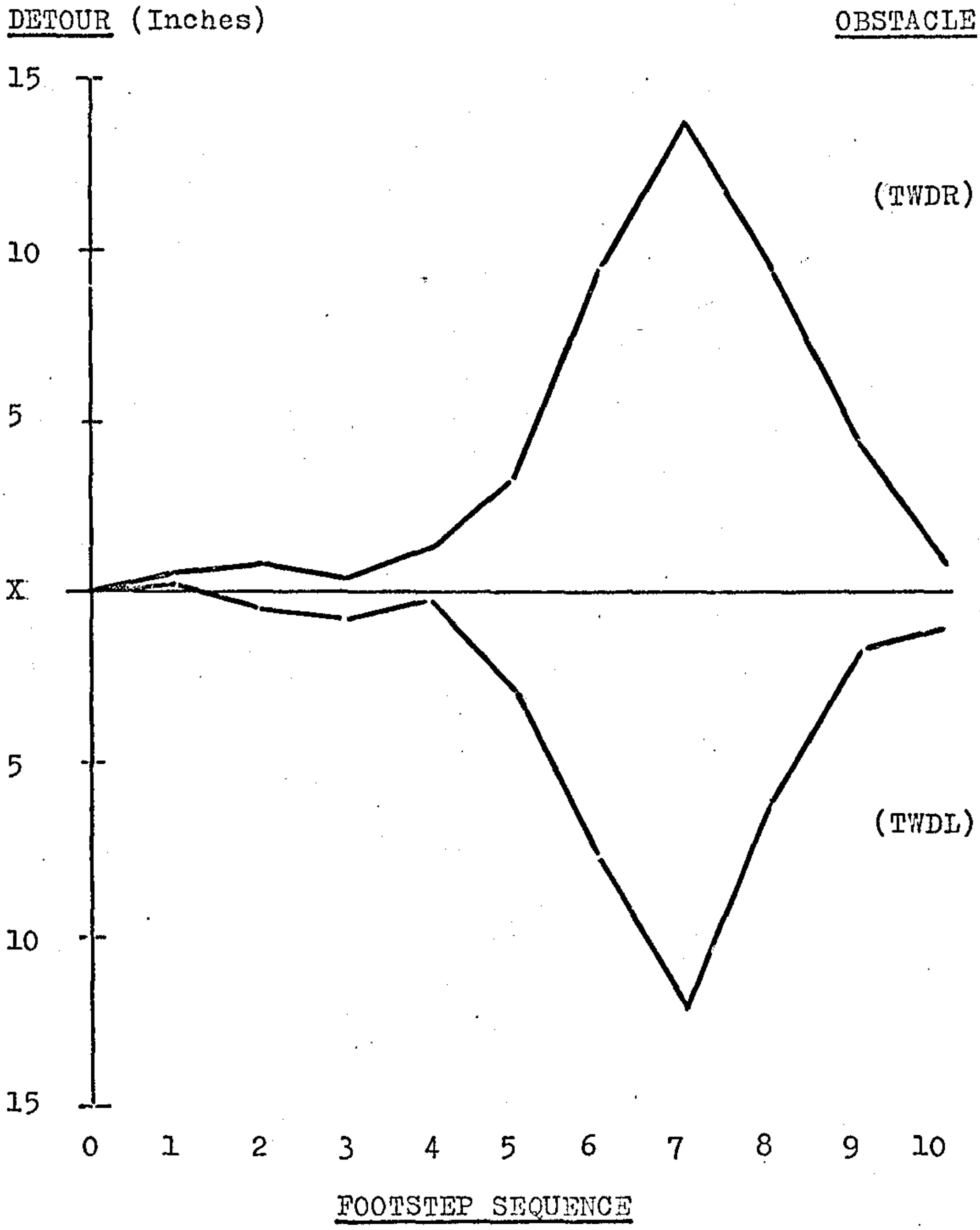
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 83).

FIG.(106) DETOURS IN RESPONSE TO OBSTACLES (BWCR & BWCL). MEAN PERFORMANCE OF ALL FEMALE Ss.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

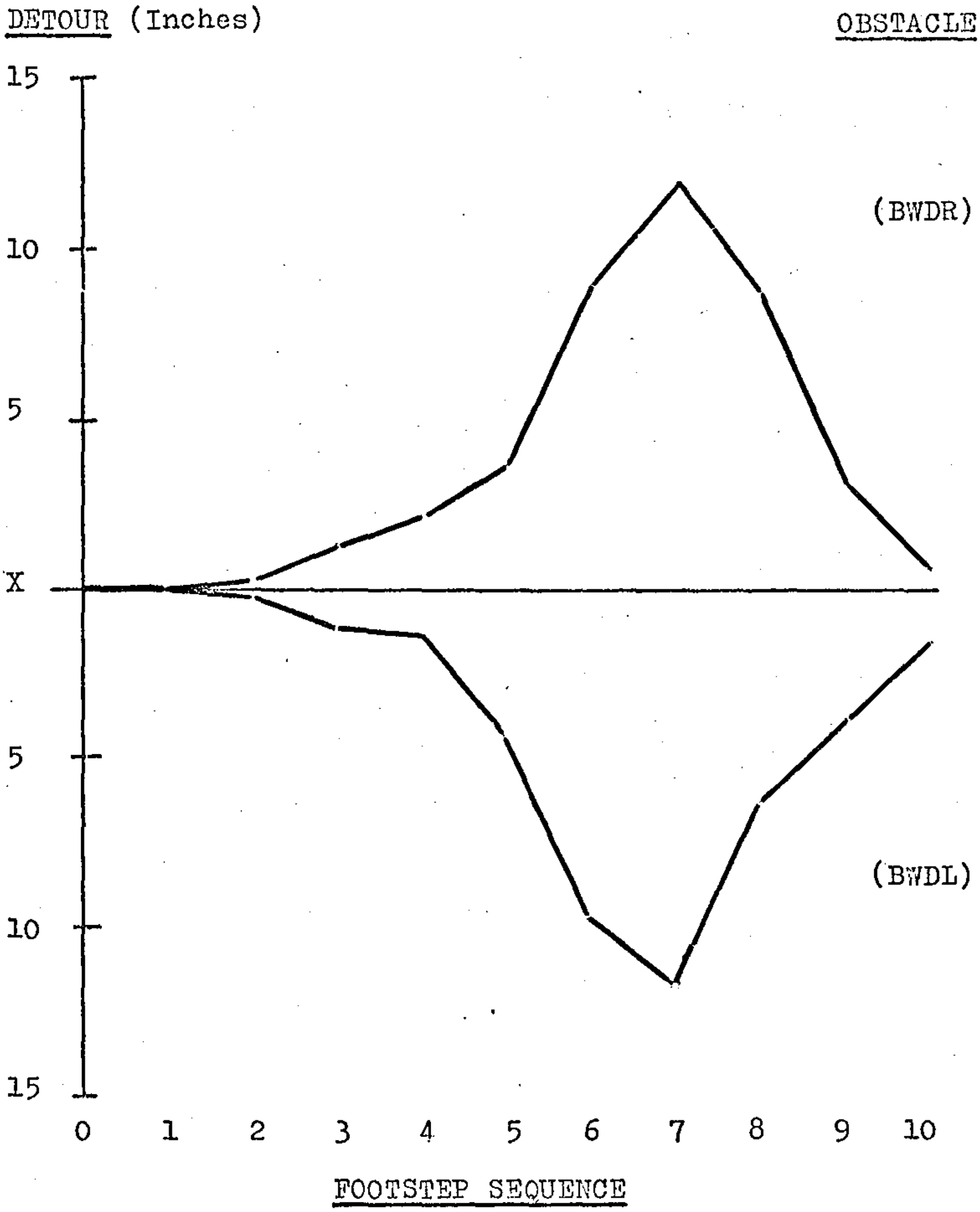


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 83).

FIG.(107) DETOURS IN RESPONSE TO OBSTACLES (TWDR & TWDL). MEAN PERFORMANCE OF ALL FEMALE Ss.

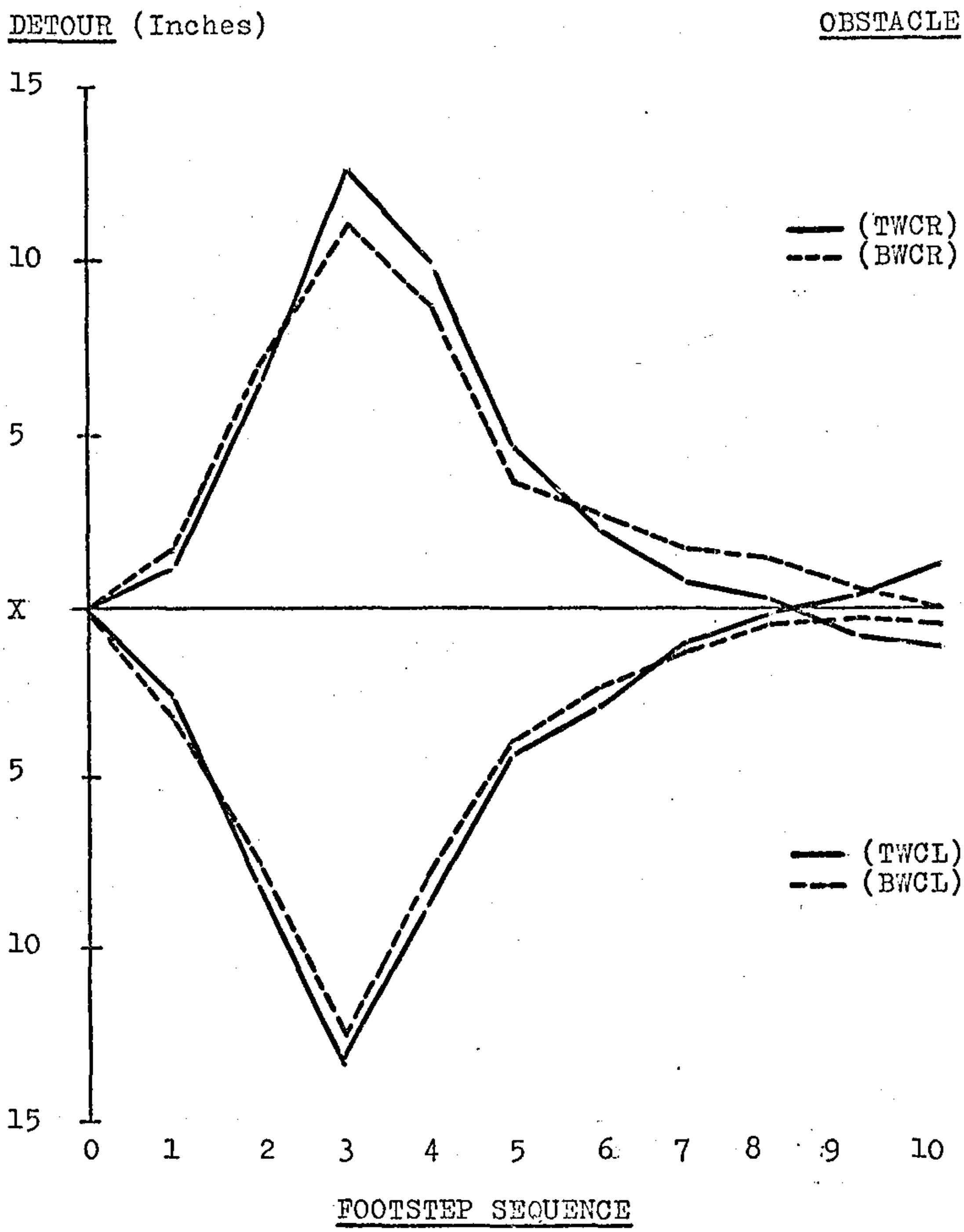


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 83).

FIG. (108) DETOURS IN RESPONSE TO OBSTACLES (BWDR & BWDL). MEAN PERFORMANCE OF ALL FEMALE Ss.



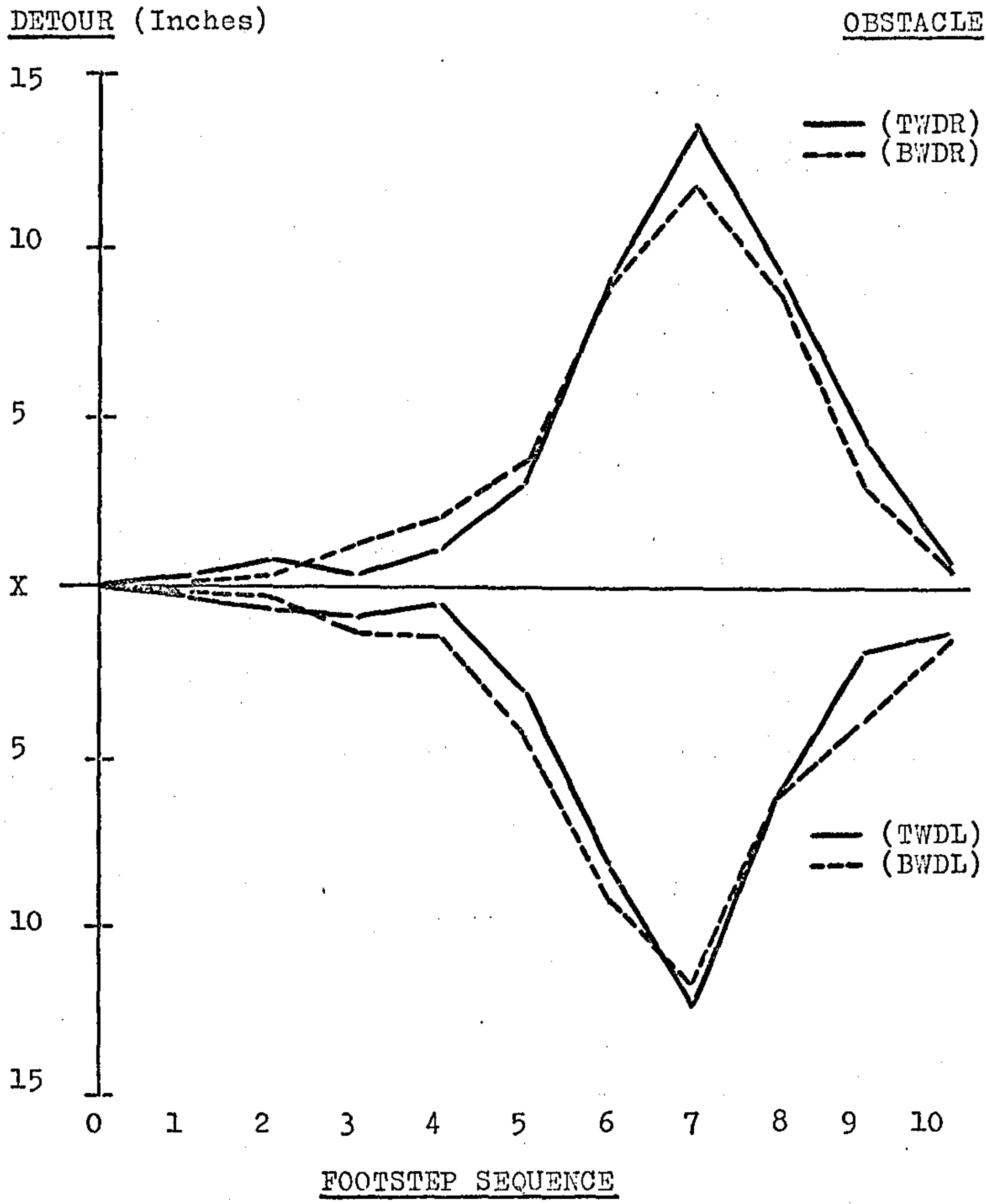
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 83).

FIG.(109) DETOURS IN RESPONSE TO OBSTACLES (TWCR & TWCL), (BWCR & BWCL). MEAN PERFORMANCE OF ALL FEMALE Ss.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



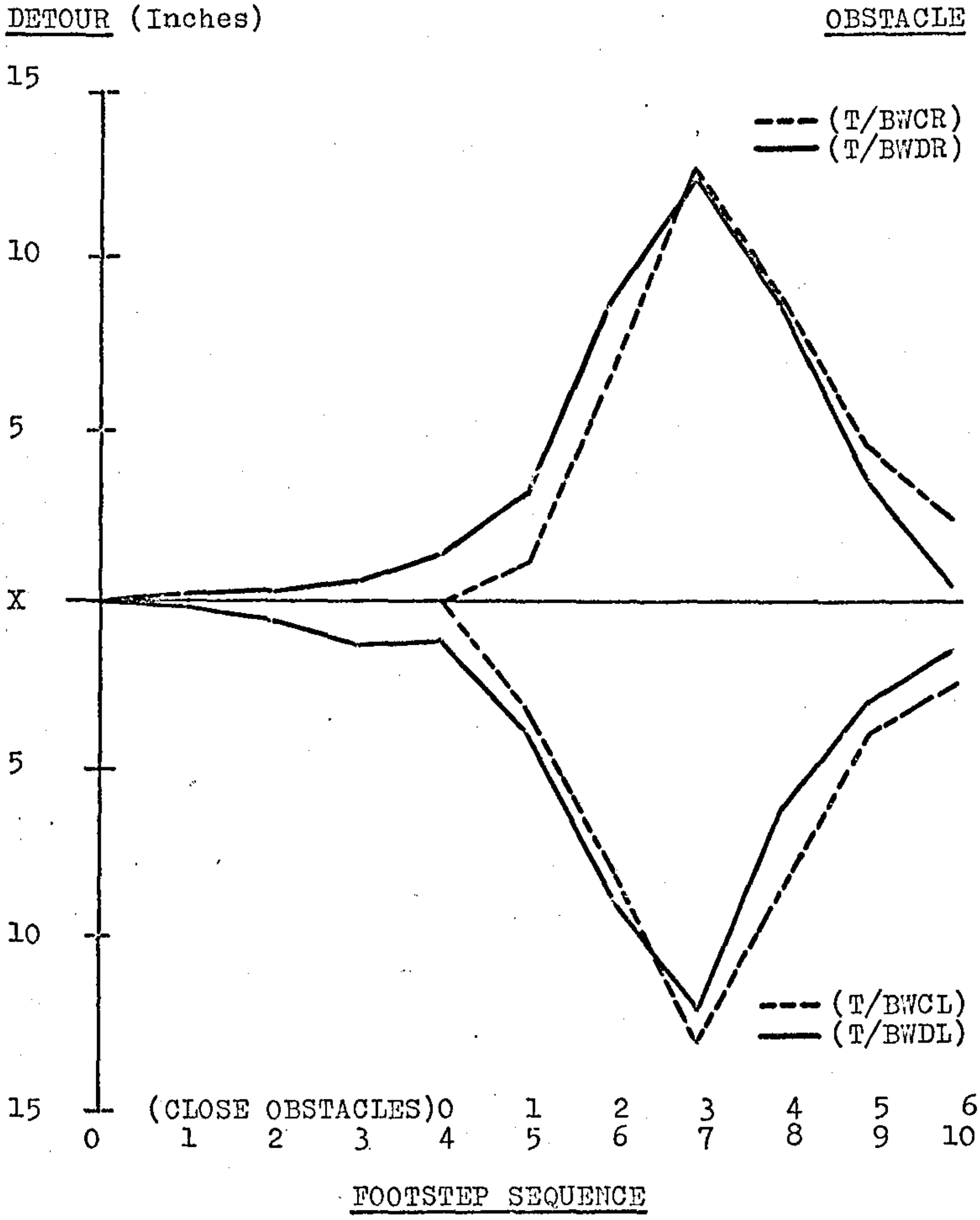
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 83).

FIG.(110) DETOURS IN RESPONSE TO OBSTACLES (TWDR & TWDL), (BWDR & BWDL).MEAN PERFORMANCE OF ALL FEMALE Ss.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

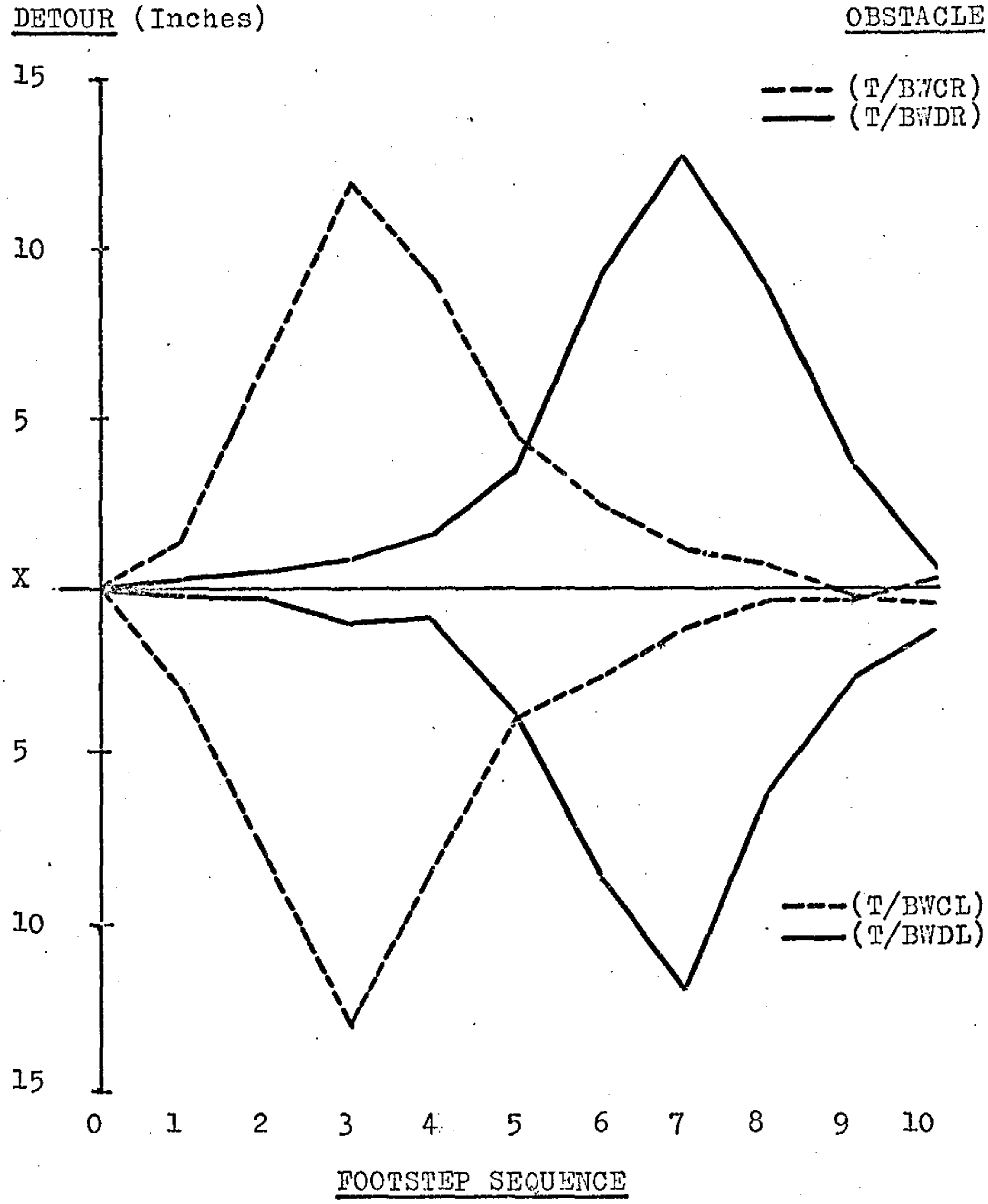


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 76).

FIG.(111) DETOURS IN RESPONSE TO OBSTACLES (T/BWCR & T/BWCL), (T/BWDR & T/BWDL) SUPERIMPOSED. MEAN PERFORMANCE OF ALL FEMALE Ss.



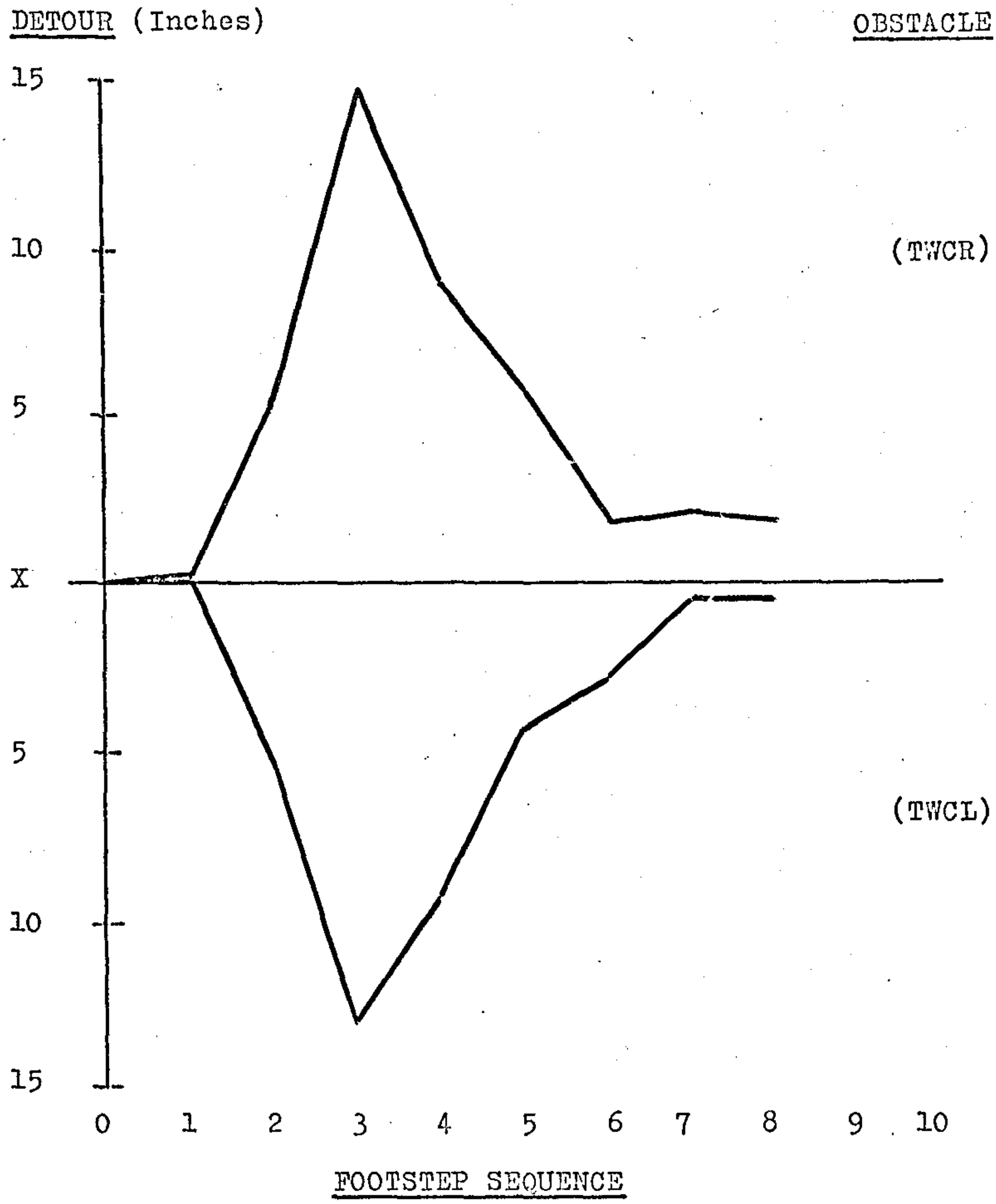
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 76).

FIG.(112) DETOURS IN RESPONSE TO OBSTACLES (T/BWCR & T/BWCL), (T/BWDR & T/BWDL). MEAN PERFORMANCE OF ALL FEMALE Ss.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

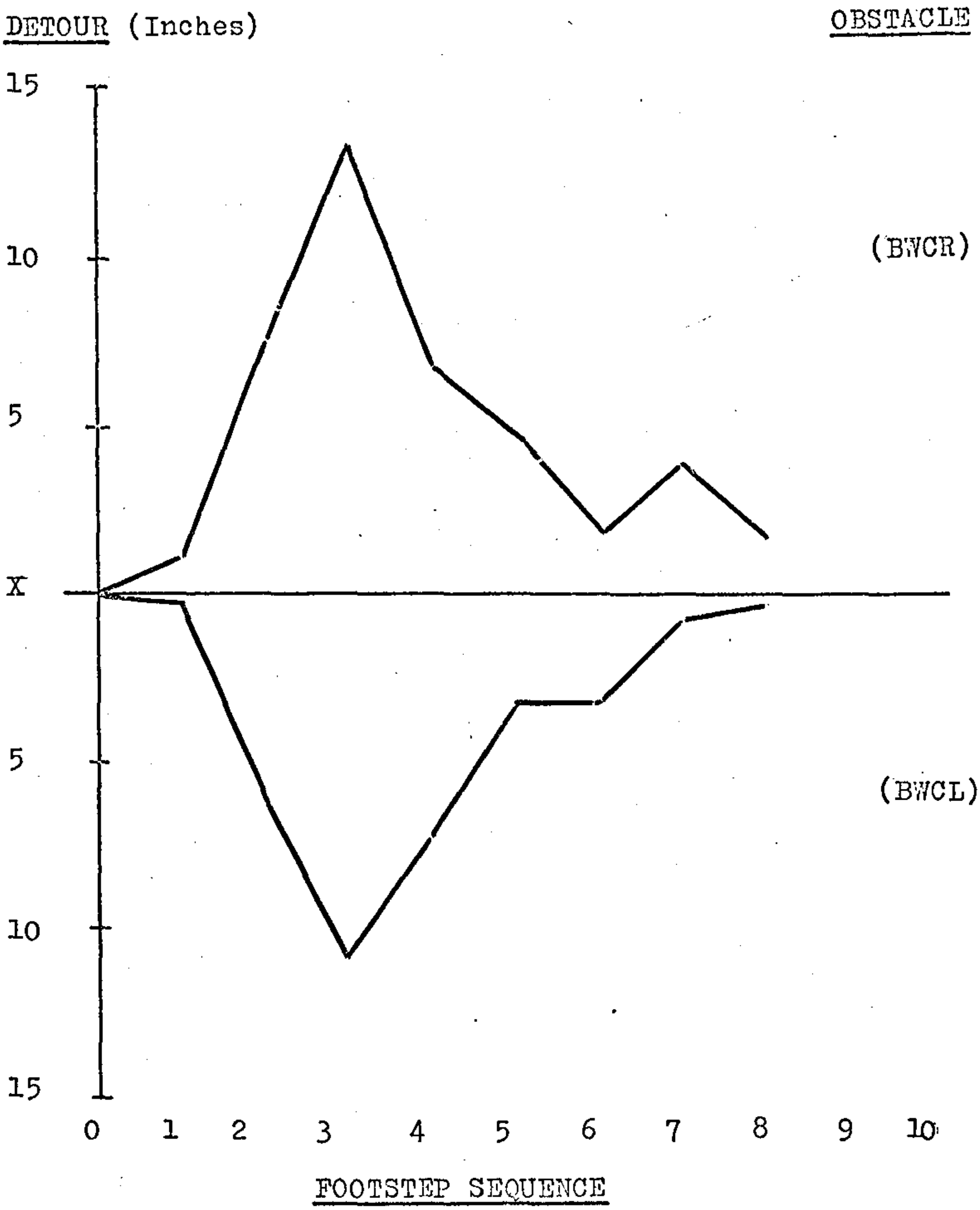


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 84).

FIG.(113) DETOURS IN RESPONSE TO OBSTACLES (TWCR & TWCL). MEAN PERFORMANCE OF ALL MALE Ss.



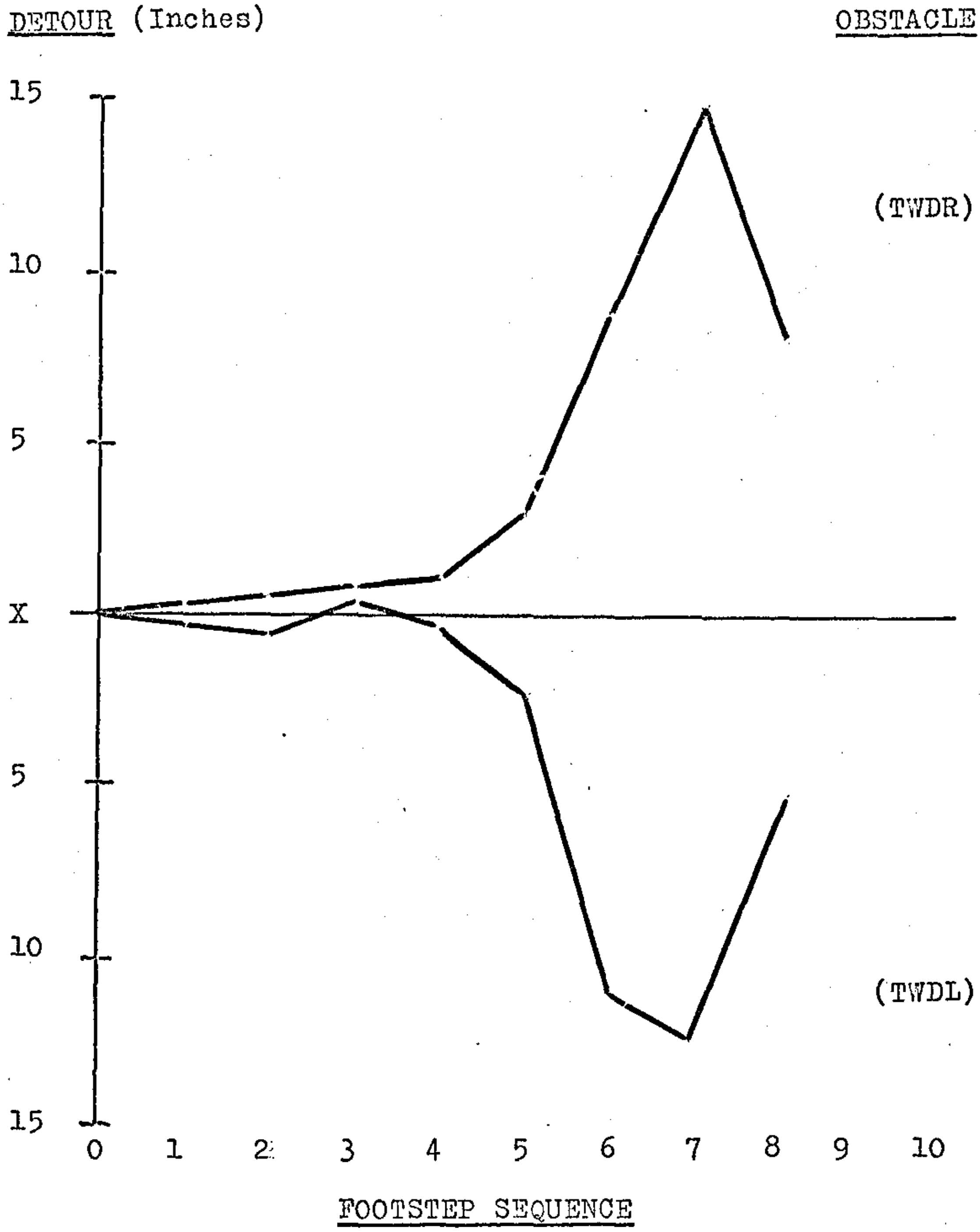
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 84).

FIG.(114) DETOURS IN RESPONSE TO OBSTACLES (BWCR & BWCL). MEAN PERFORMANCE OF ALL MALE Ss.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



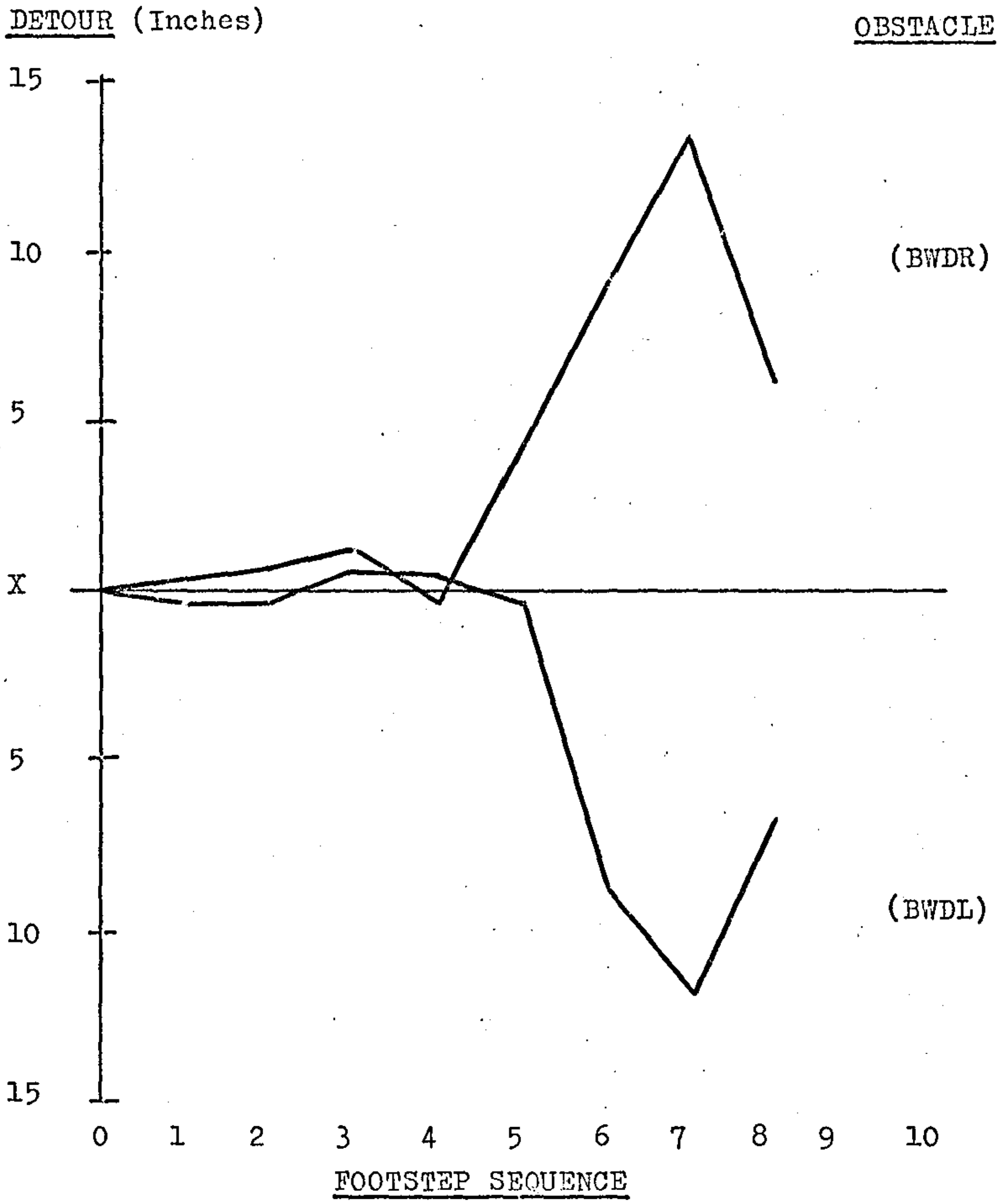
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 84).

FIG.(115) DETOURS IN RESPONSE TO OBSTACLES (TWDR & TWDL). MEAN PERFORMANCE OF ALL MALE Ss.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



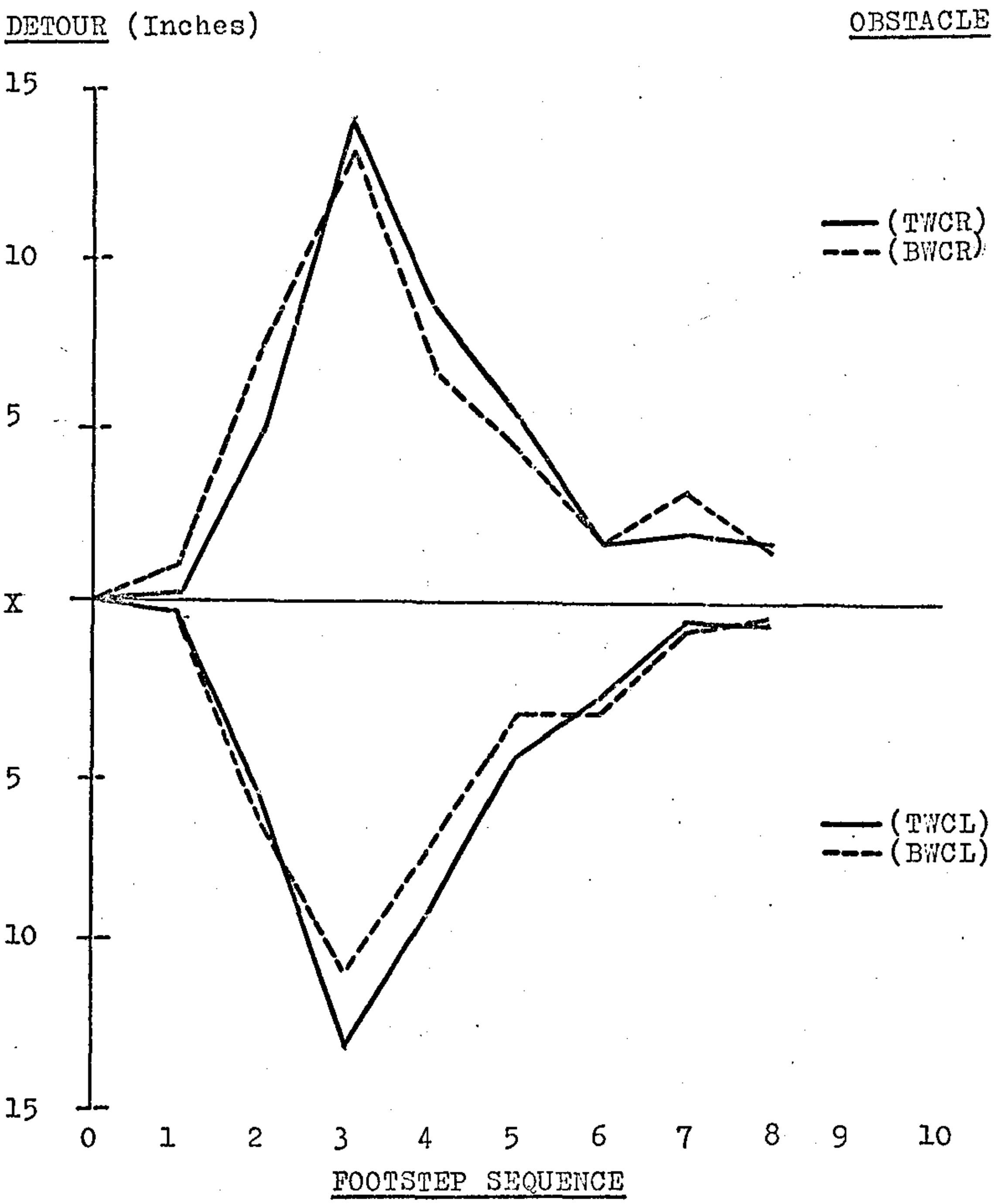
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 84).

FIG.(116) DETOURS IN RESPONSE TO OBSTACLES (BWDR & BWDL). MEAN PERFORMANCE OF ALL MALE Ss.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



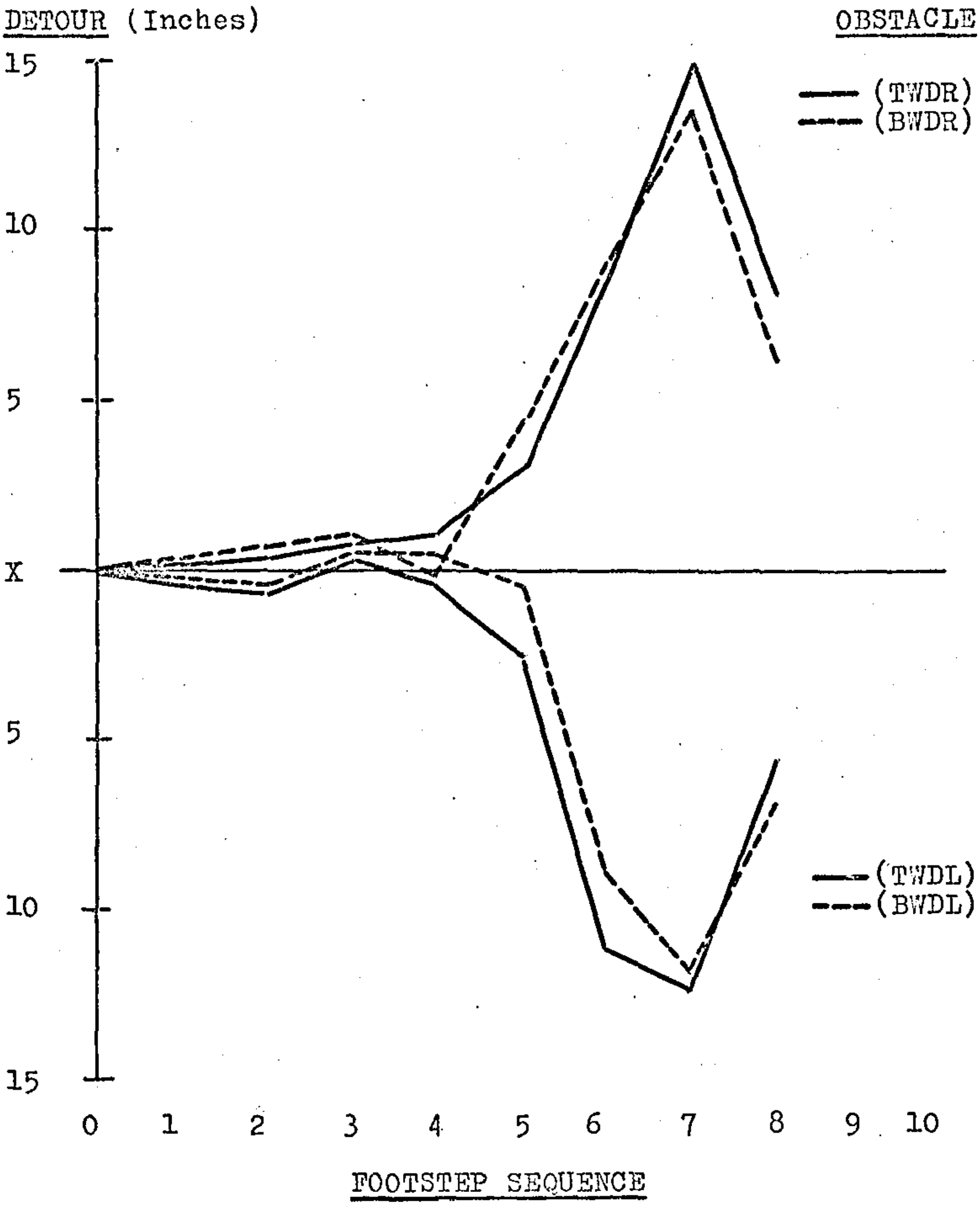
The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 84).

FIG.(117) DETOURS IN RESPONSE TO OBSTACLES (TWCR & TWCL), (BWCR & BWCL). MEAN PERFORMANCE OF ALL MALE Ss.

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES

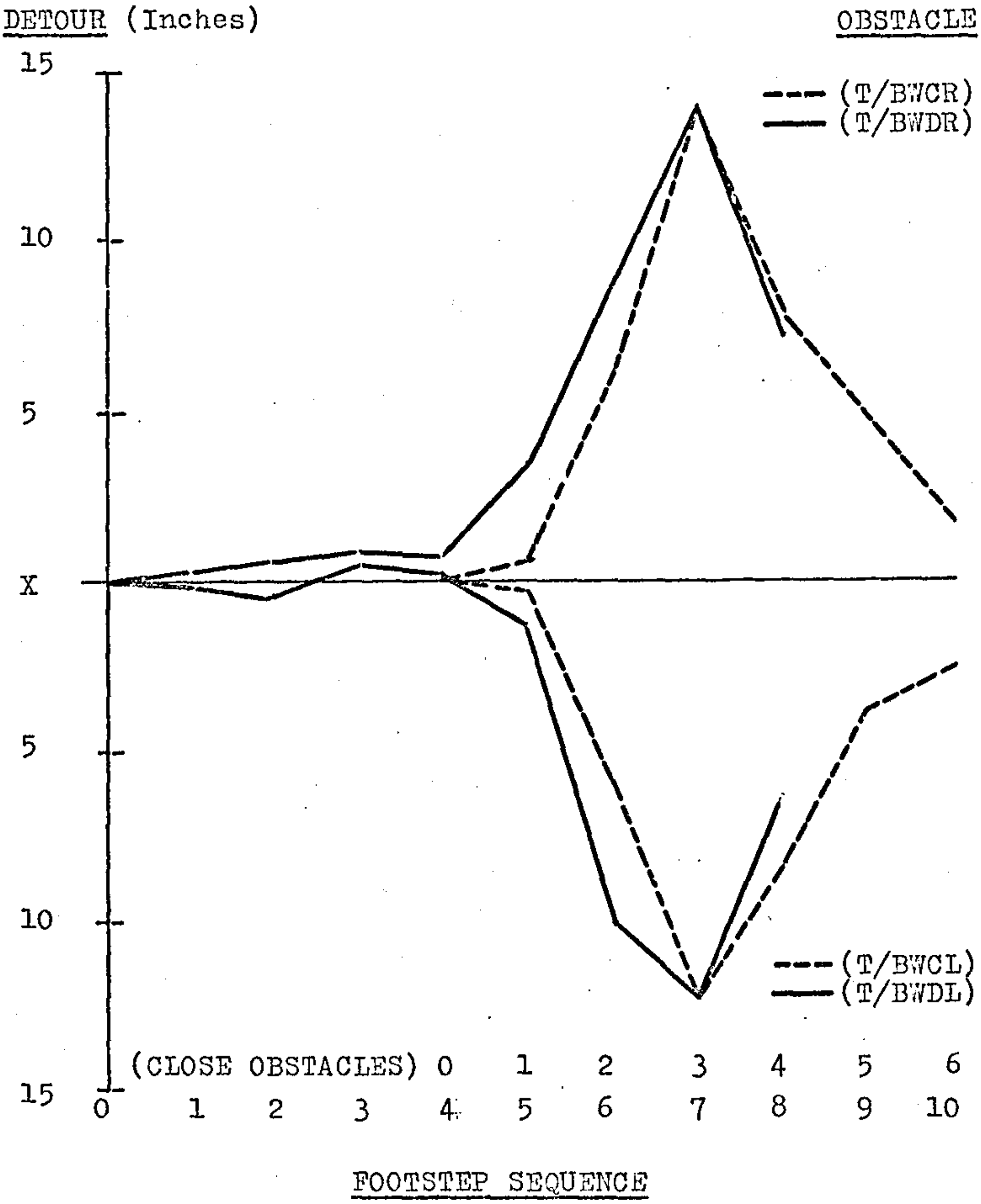


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 84).

FIG.(118) DETOURS IN RESPONSE TO OBSTACLES (TWDR & TWDL), (BWDR & BWDL). MEAN PERFORMANCE OF ALL MALE Ss.

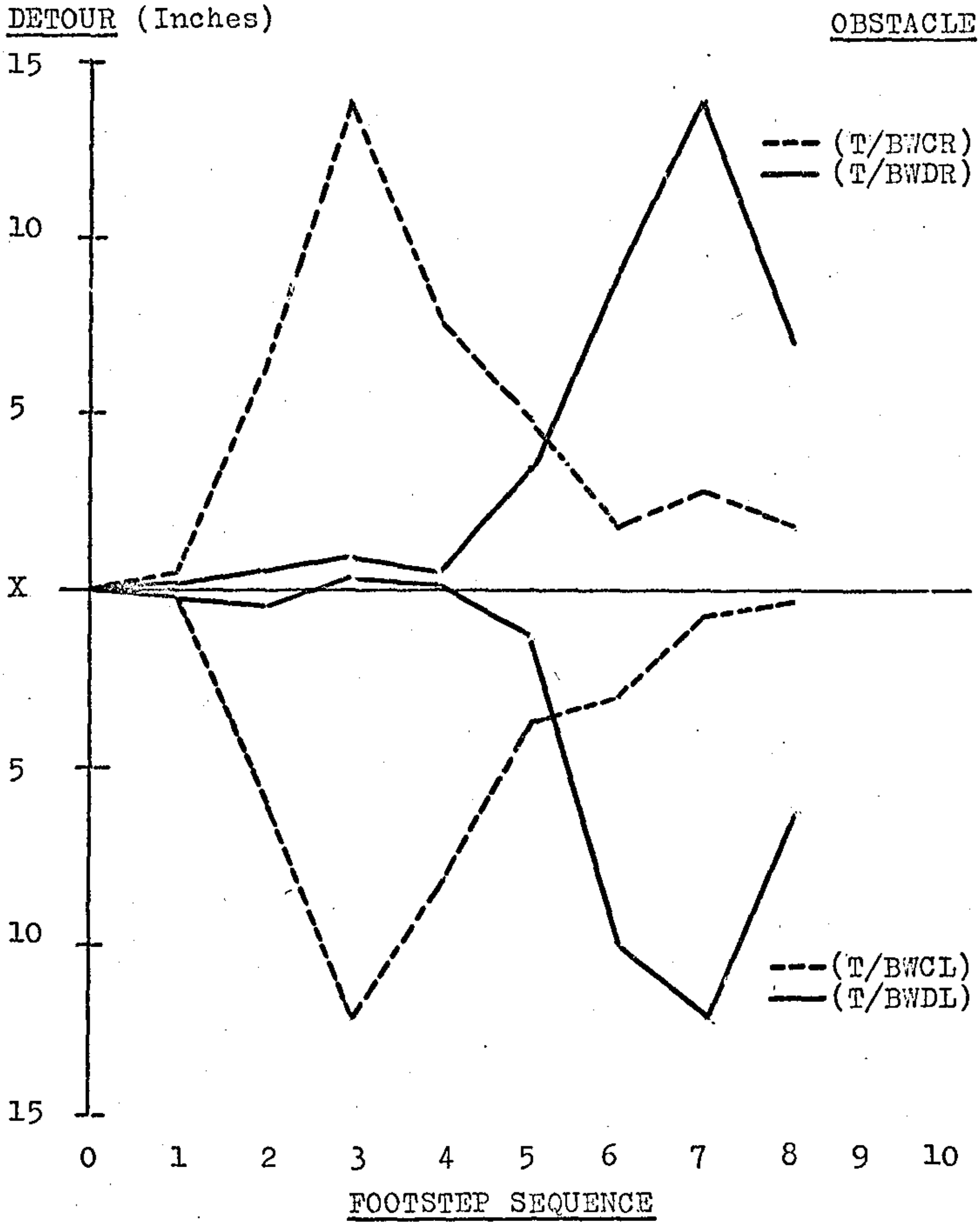


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 76).

FIG.(119) DETOURS IN RESPONSE TO OBSTACLES (T/BWCR &T/BWCL), (T/BWDR &T/BWDL) SUPERIMPOSED. MEAN PERFORMANCE OF ALL MALE Ss.

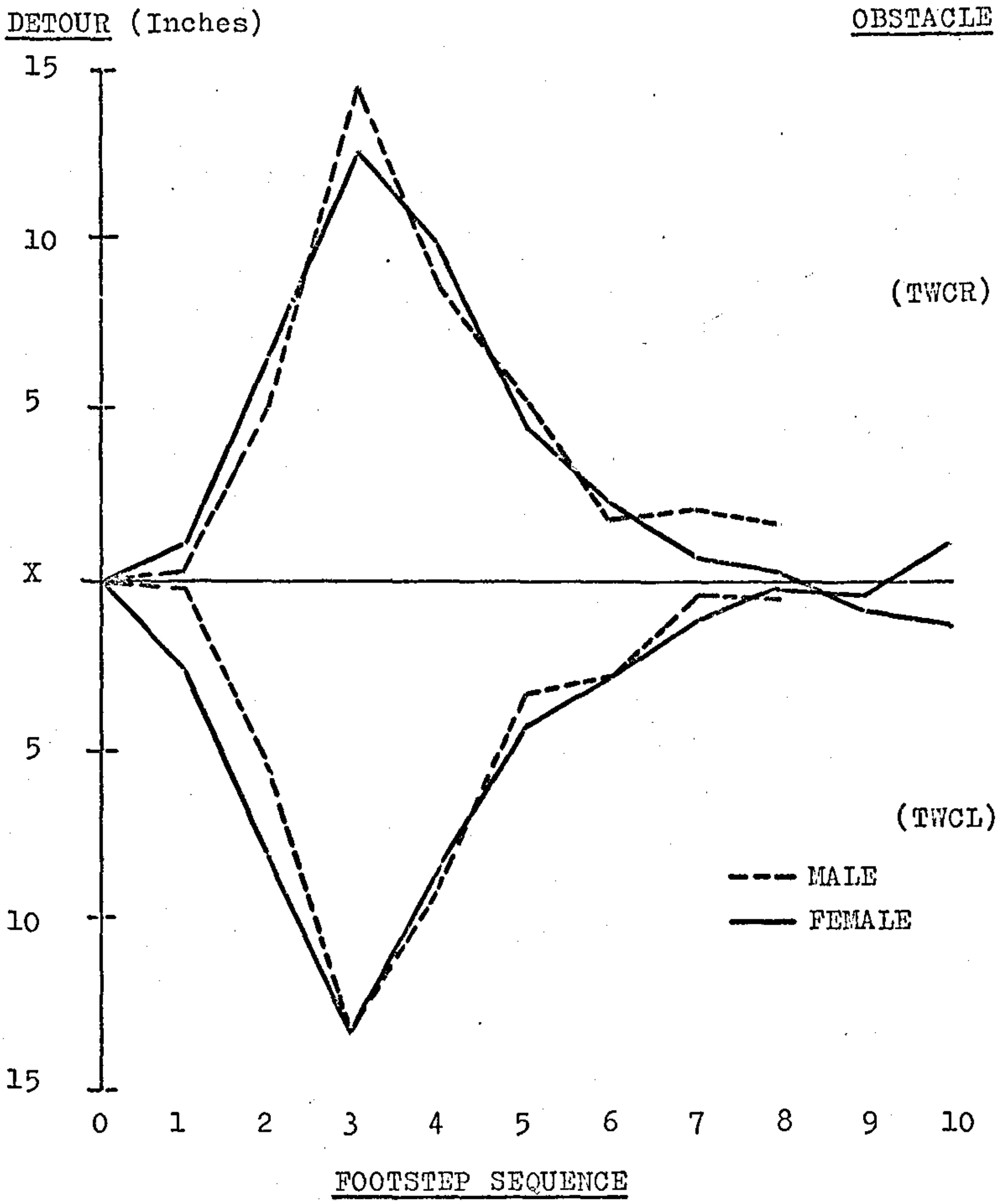


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 76).

FIG.(120) DETOURS IN RESPONSE TO OBSTACLES (T/BWCR & T/BWCL), (T/BWDR & T/BWDL).MEAN PERFORMANCE OF ALL MALE Ss.

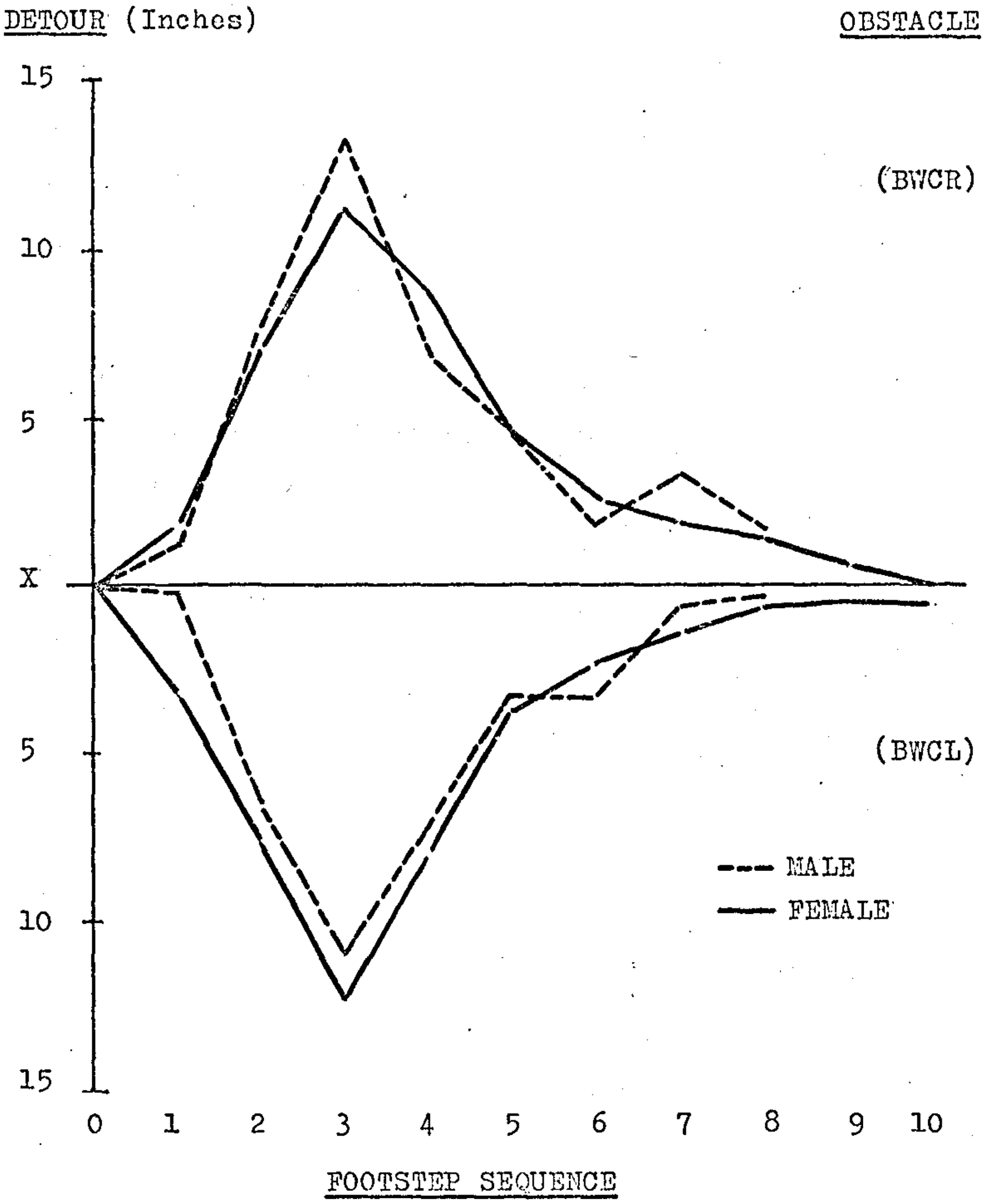


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male and female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 76).

FIG.(121) DETOURS IN RESPONSE TO OBSTACLES (TWCR) & (TWCL).
MEAN PERFORMANCE OF ALL MALE AND FEMALE Ss.

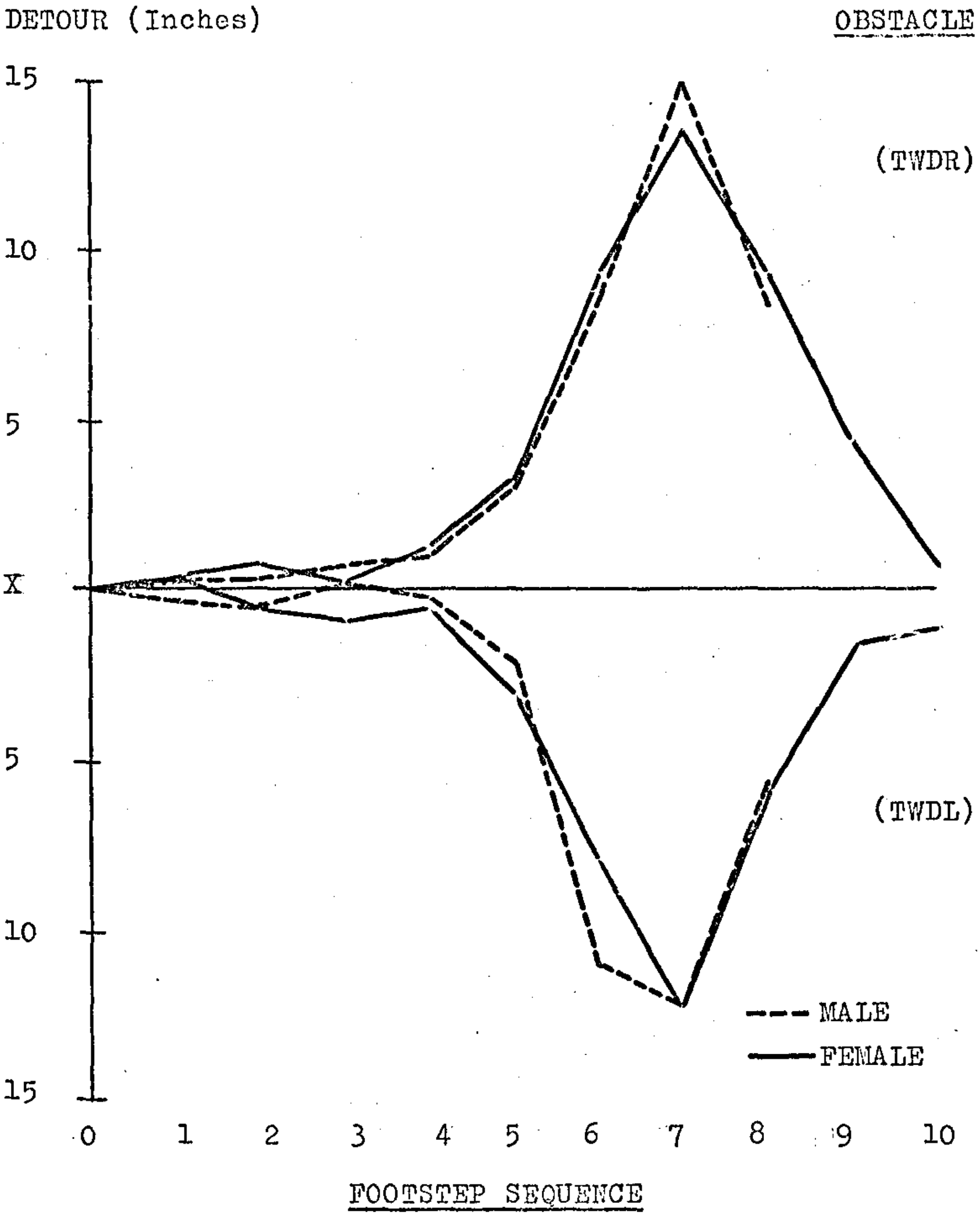


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male and female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distances represented by (X) from the corresponding mean distances recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLE 76).

FIG.(122) DETOURS IN RESPONSE TO OBSTACLES (BWCR) & (BWCL) MEAN PERFORMANCE OF ALL MALE AND FEMALE Ss.

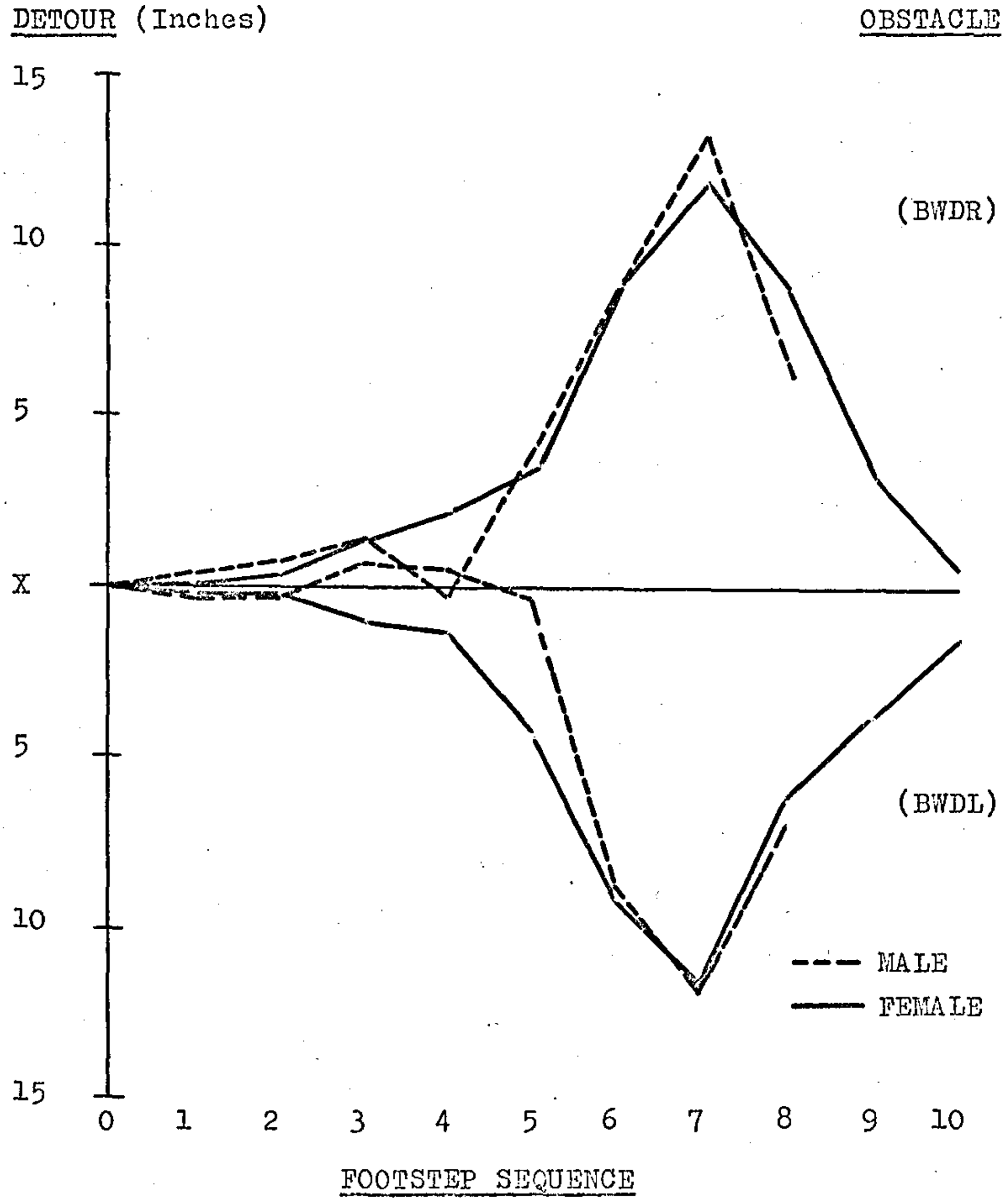


The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male and female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distance represented by (X) from the corresponding mean distance recorded in Trials With Obstacles.

For data of diagram see APPENDIX 2 (TABLES 76).

FIG.(123) DETOURS IN RESPONSE TO OBSTACLES (TWDR) & (TWDL). MEAN PERFORMANCE OF ALL MALE AND FEMALE Ss.



The (X) axis represents the mean distance of each footstep centre-line location from the L.H.Wall for all male and female Ss. during Unobstructed Trials (6-10).

Detour values are obtained by subtracting the mean distance represented by (X) from the corresponding mean distance recorded in Trials With Obstacles.

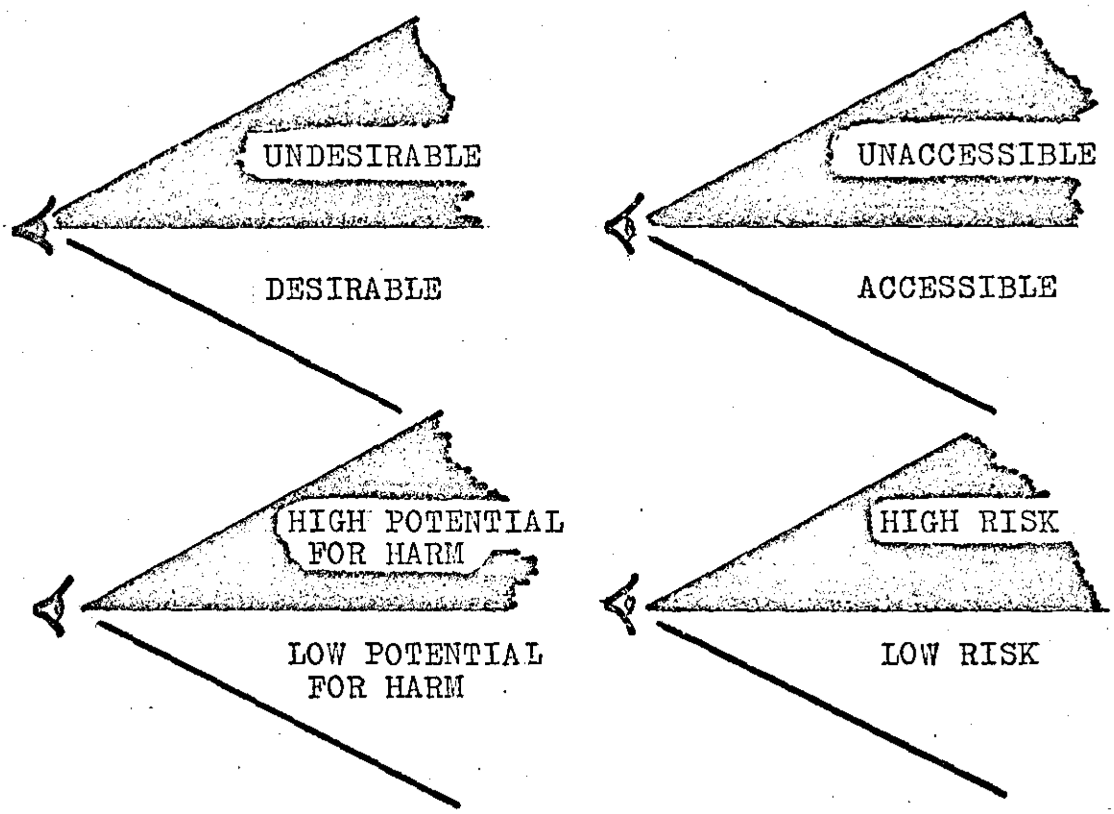
For data of diagram see APPENDIX 2 (TABLE 76).

FIG.(124) DETOURS IN RESPONSE TO OBSTACLES (BWDR) & (BWDL).
MEAN PERFORMANCE OF ALL MALE AND FEMALE Ss.

The gradients of valence.

A final matter for discussion arising from the recorded detours relates to whether they provide any evidence to substantiate the belief that we contour the space surrounding physical objects according to how we evaluate their accessibility, their desirability, and their perceived potential for harm. The named qualities could combine in various ways to shape the topology of such contours, although the intention here is to examine response to perceived potentiality for harm only.

Examples of imaginal gradients:



The RESULTS establish that stride length variations by themselves are an uncertain index to calculations of levels of risk inferred in connection with a S's. progress towards objects of recognised harmful potential. Put another way, they could but need not reveal the measure of increasing risk a person presumably experiences as he draws closer to the possibility of being harmed by not taking care. Thus if the experience of risk in the circumstances of the experiment was supposed as continuous from its onset until successful negotiation of the obstacle, the evidence that two female Ss. made small and discontinuous significant adjustments to their stride length at Step (1) when the WIDE obstacle was at Step (7) is contradictory (F.1:TWDL and F.3: BWDR and BWDL). More positive evidence that Ss. experienced a gradient of risk related to their physical distance from close encounter with an obstacle might be deduced from details of their detour behaviour. This discussion will attempt to substantiate evidence of spatial gradients. Proof may enable acceptance of the likelihood that we navigate our physical routes along valleys in psychological space between the gradients of valence.

Valences were discussed and defined in earlier Sections where it was also mentioned (Sect., 1.1.4 & 1.1.9) how a person engaged in goal-directed, action-orientated behaviour might conceive the prospect of some encounter with mixed emotions. It was explained that his predicament could be expressed diagrammatically in terms of approach and avoidance gradients the properties of which were derived from the attractiveness (unattractiveness) of the goal (place avoided) and his subjective experience of distance from that place. The foregoing is a recapitulation, but it serves also as some reminder to the derivation of the ideas underlying subsequent illustration. A further point relates to the use of the term "gradient". In the work cited immediately above, "gradient" refers to the rate of increase in approach both to things desired or things avoided. It is intended to continue that use.

It was noted earlier in this Section that individual strides taken as part of detour behaviour may be reduced to forward and lateral movement components. These will now be named as the respective approach and avoidance components of detour behaviour. FIGURES (126 - 128) dismantle illustrative detour patterns and reassemble the components in the style of approach and avoidance gradients.

An assumption of the experiment was that Ss. were willing to make detours and to forgo progress by bee-line to the goal. It will be recalled that the Trials with Obstacles were held under experimental rules which effectively prevented that kind of point-to-point movement. ( )

The statement was made (1.1.9) that the actual route followed by a person in goal-directed, action orientated behaviour could be expressed in vector terms as the resultant of the pulling force of the goal event and the deflecting force of objects encountered which possessed negative valence for him. Begin now by considering a typical detour pattern of the kind recorded earlier in response to WIDE obstacles. Such a pattern is simplified below where it is also rotated through 90 degrees in order to obtain the planar correspondence more usually associated with the idea of gradients.

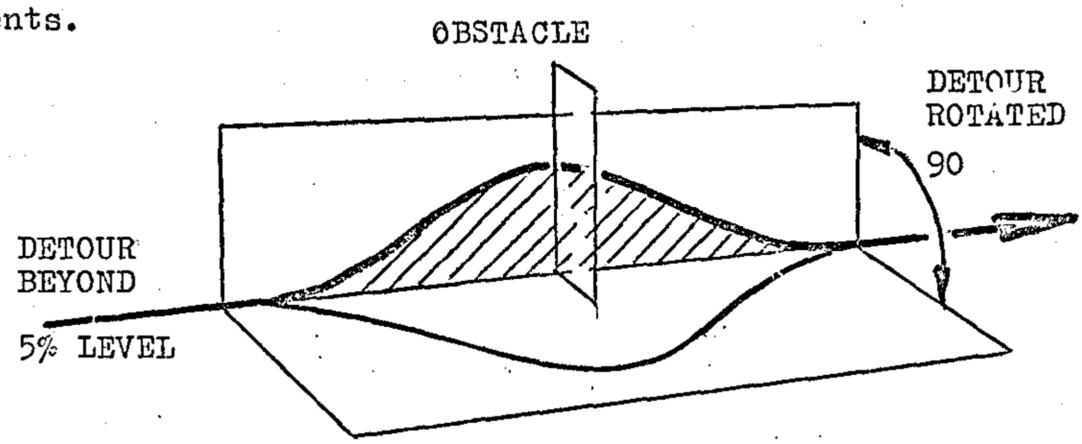


FIGURE (125) below shows how a detour is decomposed into approach and avoidance components. Approach to things avoided becomes visually associated with rising gradients and approach to things desired with falling gradients. It is left to establish the respective rates of increase in the two kinds of approach.

Although both the diagrams mentioned omit detour behaviour which began or terminated within the 95% Confidence Limits for Unobstructed Trials (6-10), for the practical reason of obtaining an adequate number of graphical points to illustrate the gradient of valence it was decided to include footstep data which began <u>or</u> terminated in the manner

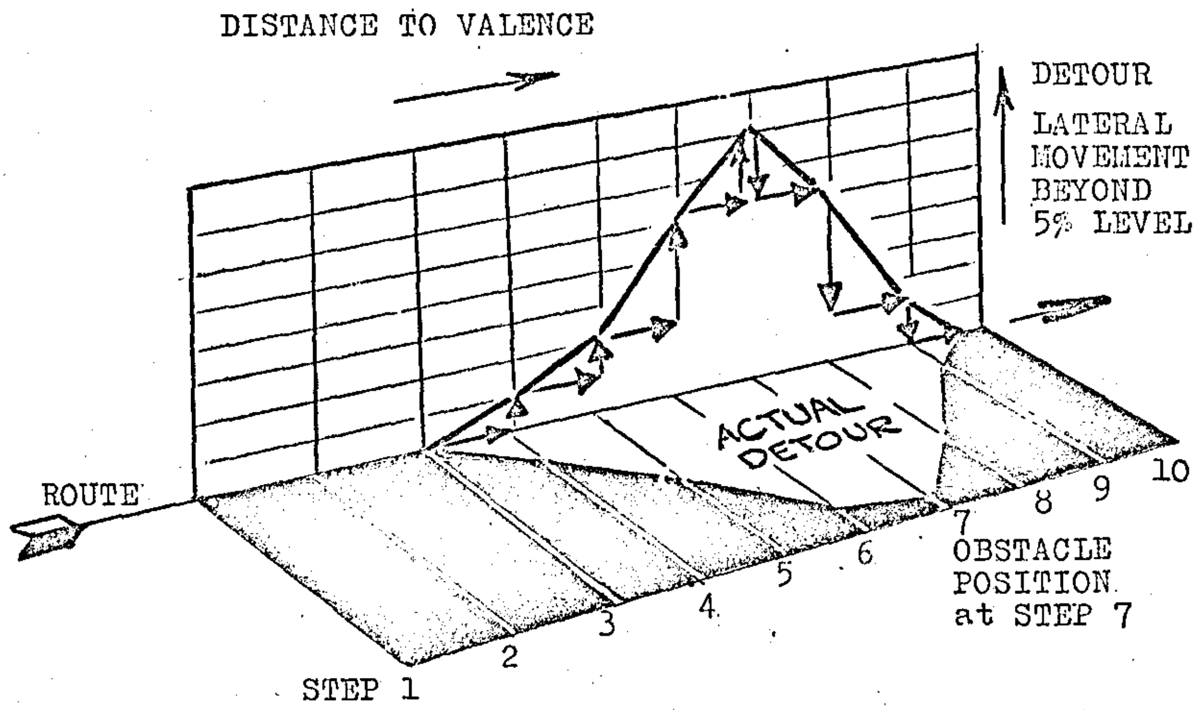
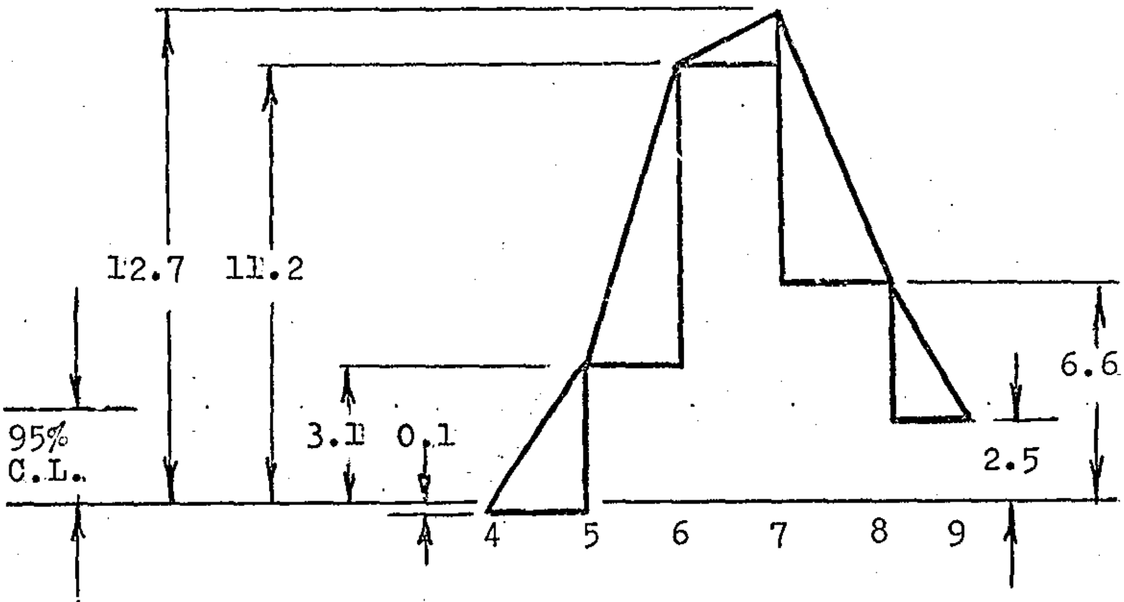


FIG.(125) THE APPROACH AND AVOIDANCE COMPONENTS OF DETOUR MOVEMENTS

described provided that such data was so indicated: a non-significant detour movement is not just an Unobstructed meander. Moreover, since Confidence Limits were applied only to individual performances in the determination of detours, the illustrative analysis of gradients was restricted to those performances.

Gradients were determined by calculating the rate of change in approach with respect to the avoidance components of adjacent footprints. The components of approach were assumed to have unit length.

Now it can be recalled from Sect.(1.1.4) and Sect. (1.1.9) that four principles have been held to apply for most events involving a person in approach and avoidance conflict. Those principles were seen to be upheld to varying extent in the three illustrative examples of detour behaviour (FIGS. 126 - 128) selected for analysis literally at random.



Subject (F.1) Data: APPENDIX (TABLE 77)
Obstacle TWDR Diagram: RESULTS (FIG.77)

	THINGS AVOIDED			THINGS DESIRED	
STEP No.	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9
Approach component	1	1	1	1	1
Avoidance component	3.2	8.0	1.5	6.1	4.1
GRADIENT (dy/dx)	1:3.2	1:8.0	1:1.5	1:6.1	1:4.1
dx/dy (rate of increase in approach)	0.312	0.125	0.666	0.164	0.243

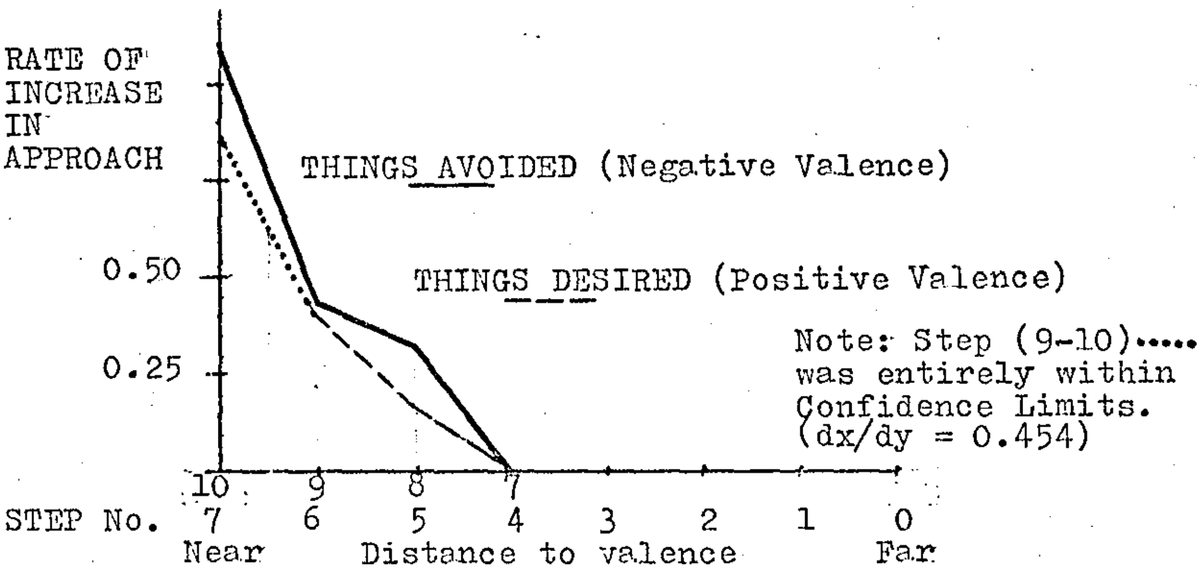
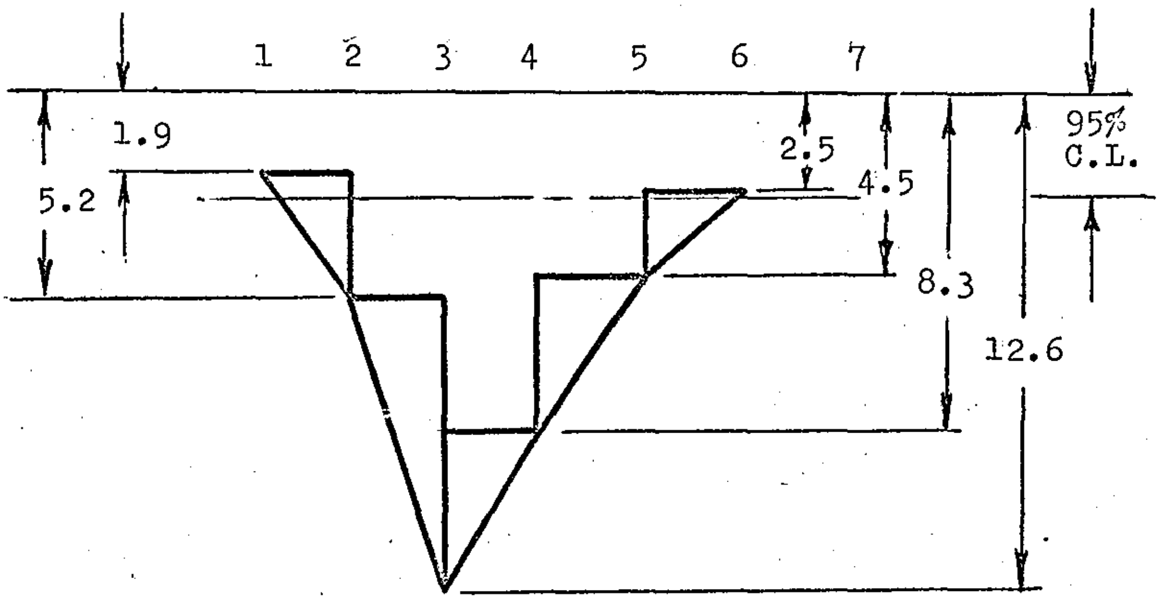


FIG.(126) THE GRADIENTS OF AVOIDANCE DETOUR (TWDR). (F.1)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



Subject (F.3) Data: APPENDIX (TABLE 79)
Obstacle TWCL Diagram: RESULTS (FIG.83)

STEP No.	THINGS AVOIDED 1 - 2	2 - 3	THINGS DESIRED 3 - 4	4 - 5	5 - 6
Approach component	1	1	1	1	1
Avoidance component	3.3	7.4	4.3	3.8	2.0
GRADIENT (dy/dx)	1:3.3	1:7.4	1:4.3	1:3.8	1:2.0
dx/dy (rate of increase in approach)	0.303	0.135	0.232	0.263	0.500

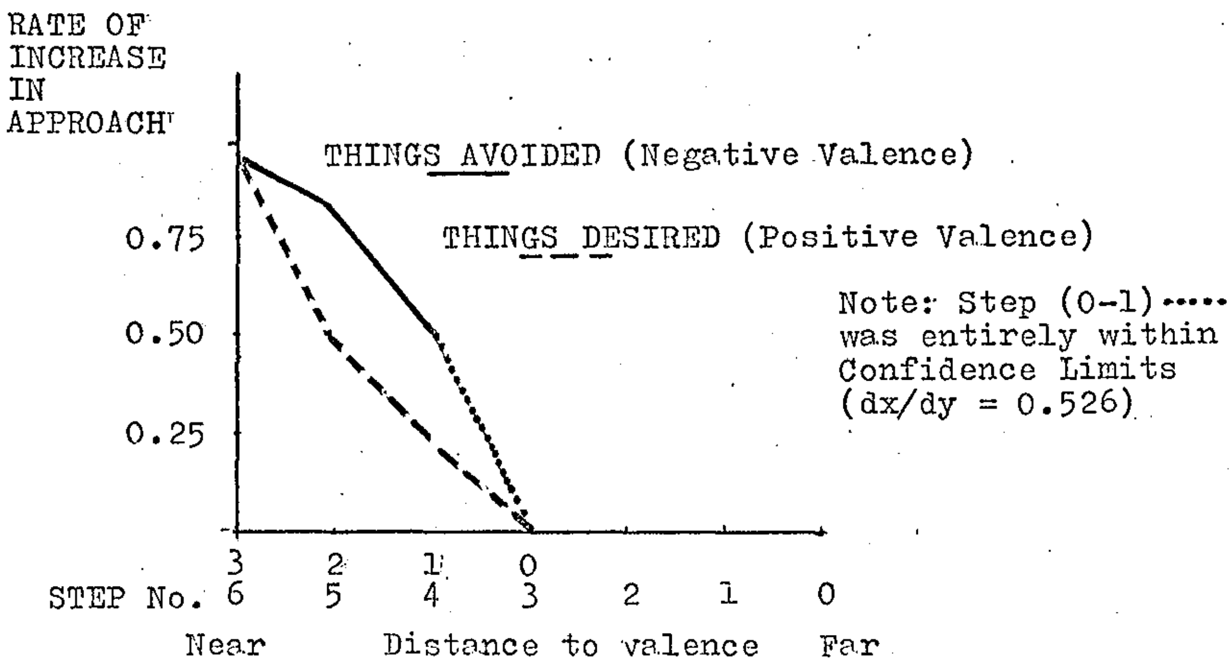
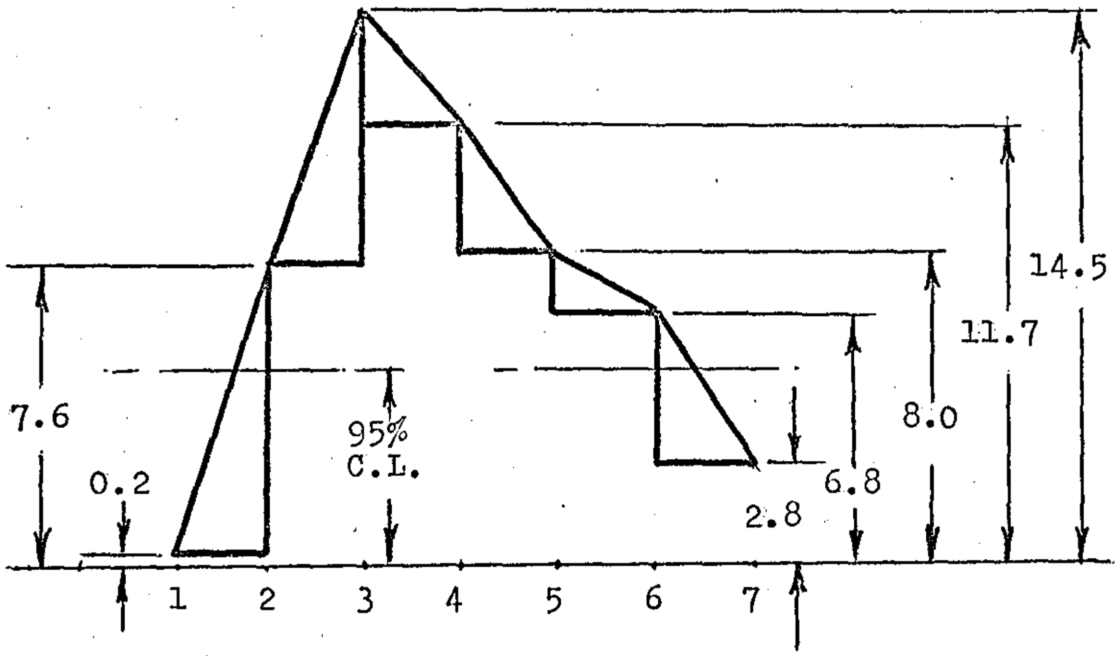


FIG.(127) THE GRADIENTS OF AVOIDANCE DETOUR (TWCL). (F.3)

4.2 (4.2.2) EXPERIMENT (PART 2): TRIALS WITH OBSTACLES



Subject (M.2) Data: APPENDIX (TABLE 81)
Obstacle TWCR Diagram: RESULTS (FIG.91)

STEP No.	THINGS AVOIDED 1-2	2-3	THINGS DESIRED 3-4	4-5	5-6	6-7
Approach component	1	1	1	1	1	1
Avoidance component	7.4	6.5	2.8	3.7	1.2	4.0
GRADIENT (dy/dx)	1:7.4	1:6.5	1:2.8	1:3.7	1:1.2	1:4.0
dx/dy (rate of increase in approach)	0.135	0.153	0.357	0.270	0.833	0.250

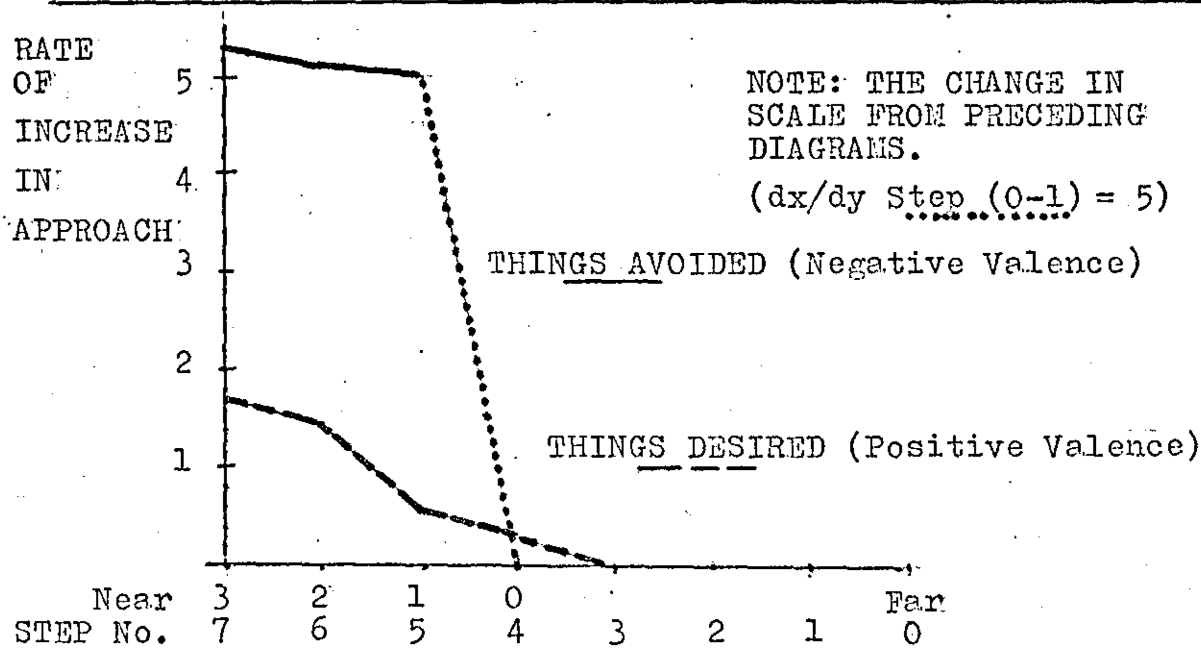


FIG.(128) THE GRADIENTS OF AVOIDANCE DETOUR (TWCR). (M.2)

For example, Principle (1) stated that "the closer the goal the stronger the tendency of the S. to approach"; in the illustrations the "goal" is expressed as "things desired" and equated with the end of the passageway. Movement towards the goal commences at the major point of inflexion of the detour configuration and in each example this point is coincident with the obstacle position. (This is not always the case with detours not analysed). With regard to Principle (1), FIGS.(126 & 127) show a steepening gradient, i.e. a stronger tendency to approach, as the S. made her final step.

Principle (2) stated that "the closer the place avoided the stronger the tendency of the S. to go away from it". In the illustrations, the place avoided is expressed as "things avoided" and equated with the obstacle position. FIGS.(126 & 128) record a steeper gradient in the final step than occurred in the penultimate step.

Principle (3) claimed that "the strength of avoidance increases more rapidly with nearness than does the strength of approach, i.e. the avoidance gradient is steeper than the approach gradient." In all cases, the examples show the avoidance gradient to rise more rapidly.

Principle (4) was that " the strength of the tendency to approach or avoid varies with the strength of the drive motivating them. An increase or decrease in drive can raise or lower the corresponding gradient". FIG.(128) suggests how this might occur by the steepness of the initial rate of avoidance, although, of course, there is no evidence presented as to whether the occurrence was because of an increase in drive.

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CONCLUSION.

Considerations which led to formulation of hypothesis.

This enquiry began by questioning the quality of predictions about human space needs. It held that predictions based on human body sizes took inadequate account of our emotional needs for space; and it suggested that it might be possible to measure the dimensions of emotional space if its boundaries were considered as a device of self-protection. The Safe Distance was proposed as a suitable measure.

In discussion of the Safe Distance attention was drawn to pertinent investigations in related fields.

1). In particular, it was remarked how the Safe Distance was similar to the concept of an animal's Flight Distance which had been found to have remarkable constancy.

2). At the same time, human subjective space needs could also be considered in terms of the space annexed into the body-image. In the latter area, investigations had suggested that the boundaries of the body-image were primarily shaped by ego-involving social contacts rather than by any structuring process occurring from confrontation with non-social events.

3). Discussion then progressed to the conjecture surrounding risk-taking in conditions of subjective uncertainty. Reference was made to the difficulties which had hampered the understanding of the nature of risk-taking, and a recent hypothesis was reported which had framed the view that an individual's maximum risk-taking level is possibly constant in comparable situations although it could be expected to vary from one kind of situation to another.

Arising from the conceptual difficulties alluded to, attention was then turned to the possibility of investigating risk-taking in terms of the theoretical framework of field theory.

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The concept from field theory that objects acquire valence, i.e. power to attract or to repel, which could be differentiated from their subjective worth, i.e. utility, fitted the view that many human actions involving Safe Distance judgements are taken without reference to their utility.

4). Elaboration of the idea of valence then led to discussion of approach and avoidance gradients which connected valence to the factor of subjective uncertainty. Developing from this, the possibility was mooted that we structure space around valent events in terms of stratified contours of negative or positive valence as the case may be, and that such contours necessarily acquire the properties of gradients associated in the instance of feared objects with levels of risk.

The thesis was concerned with human response to inanimate objects having recognised harmful potential, and for that reason the experiment was not framed to investigate the more general human territorial claims which arise during interpersonal confrontation and which involve the spatial concepts of Personal Space and Individual Distance. Nevertheless, should we in fact structure our subjective space in the manner described in our dealings with objects, it would seem likely that the same process would come into operation in our dealings with other people. Should this be so, the Safe Distance could well identify the boundaries of that private "bubble" of space by which we are supposed to surround ourselves from other people.

The physical dimensions of the Safe Distance were given definition. The Safe Distance refers to the outer boundary of the emotionally charged zone we are prompted to maintain between ourselves and what we fear, whereas its inner boundary - the minimum physical space requirement - was termed the Locomotion Envelope. The latter was not determined in the experiment because it was merely a conceptual benchmark which should practical needs require could be ascertained more readily during dynamic activities than the boundaries of the body-image.

The essential issue common to the enumerated items above is the matter of constancy in behaviour. The hypothesis was formed that human avoidance detours around obtrusive objects would assume characteristic patterns related to the characteristics of the obstacle and to the circumstances of its presentation.

Achievements of the experiment.

What evidence was obtained that body bulk is not the prime determinant of human space needs? And to what extent did the experiment confirm the discoveries and propositions advanced in other fields (items 1-4) and below?

Firstly, by the evidence of the detours in response to NARROW obstacles it was seen that the (purportive) caution of female S.(F.3) had more bearing on her avoidance behaviour than could be sensibly accorded to her slim build. More striking is the measure of similarity obtaining between the respective aggregated male and female performances. If body bulk had been the prime determinant of their detour movements, one might have supposed that the different physique of males would have biased their performance more in the direction of their greater stature (average 5.0 in.) and greater stride length (average 3.5 in.).

As regards items (1-4), the constancies of the avoidance detours in response to WIDE obstacles gives weight to the view that Man may possess a self-warning system which parallels the Flight Distance mechanism attested by the behaviour of certain animal and bird species.

The commencement of a detour movement predicated the existence of a Safe Distance judgement. But since it has been advanced in this thesis that the Safe Distance is a protective shield surrounding the body-image, the experiment did not test the matter of whether the body-image boundary is importantly structured by personal confrontation with events not involving other people. Yet the influence of those events upon the structure of the body-image boundary must occur after the Safe Distance has been broached, and perhaps for that reason they acquire enhanced relative importance. Put another way, it is implied that we do not willingly allow such confrontations to occur as might cause serious revision of our body-image boundaries, but should they occur their effect is possibly at least as important as any comparable structuring of the body-image boundary arising from our significant encounters with other people.

Turning to Cohen's (1970) hypothesis that individuals possibly exhibit a constant risk-taking level in comparable situations, it is considered that the data provide proof. At the least, they provide evidence that emotional space needs appear to remain stable in the short-term in closely sequential comparable situations. Of course, implicit in the situation were restrictions upon the nature of the response that Ss. were allowed to make. It is almost certain that had Ss. been allowed either to run or walk down the passageway as the mood took them their Safe Distance judgements would have been correspondingly affected. Comparable situations therefore posit comparable availability of response options.

Situations were described in Sect.(1.1.9) where human avoidance behaviour could be considered as automatic as distinct from behaviour governed by the weighing of pros and cons associated with the resolution of indifference preference maps. It could be maintained that the experiment provided circumstances conducive to an automatic response of avoidance, and that as a result data has been made available which allows the calculation of the effects of subjective uncertainty uninfluenced by considerations of utility. Mathematicians interested in decision theory may welcome such data.

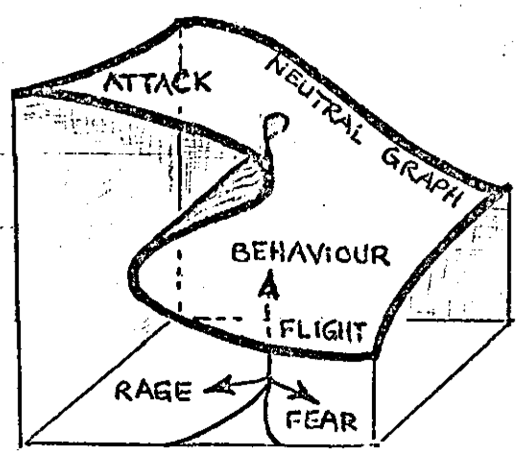
Confirmation that mathematicians are interested in the boundary changes of human behaviour was supplied in

4.3 EXPERIMENT (CONCLUSION)

a public lecture given by Professor E.C.Zeeman of Warwick University in November 1971. Zeeman has developed what he has termed "catastrophe theory" to frame in mathematical description behavioural changes which accompany emotional changes. In an account of his lecture(286) it was stated that:

> Catastrophe theory can be explained by (an example), a dog whose mood is gradually changing from rage to fear or fear to rage.
>
> When you study how this affects the dog's behaviour in either fleeing or attacking you similarly find this remarkable fact - though the changes in the dog's mood have been gradual there is a sudden catastrophic change in his behaviour.
>
> As his rage increases, one second he is still retreating - suddenly he leaps to the attack. Or if he gets afraid during his attack he all at once changes to retreat.
>
> ....every time you have two conflicting factors ....influencing behaviour ....every single graph (of that behaviour pattern) has the same basic shape.

Zeeman's allusion to Flight Distance hardly needs to be emphasised. His other examples were accounts of inter-personal conflicts. For interest, his graph is shown below. Its major characteristic is the fold in the surface.



The particular diagram above relates to the approach and avoidance components of aggression, whereas the experiment was concerned with whether the magnitude of approach and avoidance components could be related to subjective levels of risk, and whether these, in turn, constitute psychological gradients of approach and avoidance. A comprehensive analysis of the detour data was not attempted, but the minute random sample examined in Sect.(4.0) provided strong and favourable indications. The unsampled data would seem likely to yield further affirmation in view of the recorded consistency in S.performance.

The balance of achievement.

The work as a whole is developed in two parts. The first part, Sect.(0.0-3.0), examines the compatibility of various ideas relating to the experience of subjective space, with the purpose of unifying them within some consistent conceptual framework. It presents the view that the dimensions of emotional space are propagated by our wish for self-protection, and that the wish is manifest in the experience of graded values of approachability we assign both to ourselves and what is not-self. The supporting commentary is largely introspective in the derivation of its evidence, and whilst this assisted the clarification of concepts towards the formulation of an hypothesis, had the argument remained inductive its defence would be metaphysical.

For the latter reason, it became necessary to submit the shadowy substance of theory to the crucible of deductive discovery. The hypothesis was promoted that constancy obtaining in human detour behaviour was evidence of a prevailing boundary condition in an individual's experience of subjective space. Tests revealed that Ss. adjusted their detour movements in a way consistent with experience of such a boundary condition, although one can only suppose that the generating circumstance was one of self-protection. Whether Ss. experienced mental gradients of risk in the course of the tests must also remain speculative, despite the demonstrated possibility of its conceptual representation. Proof of constancy relies upon the terms of specified criteria (P.328). Its measure applied to associated male and female performances (FIGS.121-124), belies belief that body size and sexual differences are predominant influences on the scale of adult human space needs.

4.3 EXPERIMENT (CONCLUSION)

The evidence disclosed by the experimental situation has, instead, revealed security patterns of avoidance behaviour common to the sexes and independent of the body size of individuals. This information could advocate a new basis of prediction for human space needs; it directs the future accumulation of data whereby objects of particular location and configuration with respect to the observer, might be associated with expected movement patterns of avoidance.