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DOCTOR OF PHILOSOPHY

Determinants of variability in the behaviour of the severely retarded.

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Award date:
1976

Awarding institution:
University College of North Wales, Bangor

Link to publication

UNIVERSITY OF WALES

DETERMINANTS OF VARIABILITY IN THE BEHAVIOUR OF THE SEVERELY RETARDED

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PHILOSOPHIAE DOCTOR

1976

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ACKNOWLEDGEMENTS

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I would like to thank Dr. P. Harzem my academic supervisor, for his help and advice during the period that this research was conducted. I am also grateful to Dr. G. Joy Pryce, Consultant Psychiatrist, who not only made this work possible with the offer of facilities, but who also showed continual interest and encouragement.

The Wrexham Powys and Mawddach Hospital Management Committee, and later the Clwyd Area Health Authority, provided facilities. In particular Mr. Iorwerth Jenkins, Hospital Secretary, with his energetic enthusiasm and impecable efficiency, ensured that anything and everything that could be provided for the smooth running of the research was promptly made available. Mr. Maldwyn Jones, Sister Mary Lewis, and all the staff at Broughton Hospital were tolerant of disruptions to hospital routine during the experimental phase, and were always ready to help. I would especially like to thank Miss Helen Hughes, who ensured that the experimental room was kept in an immaculate condition every day, and Mrs. Ann Parry who typed this thesis.

My thanks are also extended to Professor T. R. Miles and to Alan Ashton, Albert Brogden, Marian Ellis, Carol Griffith, Ron Jones and Gaerwen Williams of the U.C.N.W. Psychology department for providing technical advice and maintenance. Sheila Kinghorn, Vivian Roberts and Andrew Nowers provided invaluable service as observers in the experiments and Elizabeth Hingley and Katharine Worsley helped with the calculation of data. Mr. W.E. Moore and Mrs.R. Pirani administered the psychological assessments.

I have discussed many of the issues covered in this thesis in many conversations with my colleagues C. Cullen, Graham Davey, John Hattersley, Peter Higson, Ian Lee and Lawrence Tennant, all of whom have given me considerable advice and encouragement. The responsibility for any mistakes or errors is entirely my own.

Finally I would like to thank my wife Susannah, for her patience, tolerance, help and encouragement during the many long hours spent writing this thesis.

The work reported in this thesis was supported by a research grant from the Welsh Regional Hospital Board.

ABSTRACT

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Topographically well-defined classes of behaviour emitted by developmentally retarded subjects were monitored automatically or by an observer. Classes of behaviour included lever-pressing (a descriptive operant) and alternative behaviours (behaviours not specified in a stimulus schedule). Experiments were performed in which various stimuli (e.g. slides, music, sweets, verbal approval, etc) were presented according to various schedules of stimulation. The latter included response-contingent, response- noncontingent and extinction schedules. Several parameters of schedules and stimuli (type of stimulus, duration of stimulus, schedule requirements, etc) were varied systematically and the resulting transition between elements of the behaviour stream were investigated.

In order to facilitate an in-depth analysis, many aspects of the behaviour stream were examined. Several aspects of lever-pressing including response rate, duration of post-stimulus pauses, frequency of pauses in responding, and frequency of responding during stimulus presentations were recorded. In addition the frequency, total duration, bout-length, and temporal loci of alternative behaviours were recorded.

The results revealed functional relationships between the experimental maniuplations and various dimensions of lever-pressing and alternative behaviours. Considerable variability was found between and within subjects, the variability being the result of complex, but lawful, interrelations between elements of the behaviour stream.

The experimental analysis of behaviour has traditionally concentrated on the analysis of relationships between single responses and other discrete events such as reinforcers. The present results add to the growing evidence that it is necessary to analyse behaviour in many dimensions and to consider behavioural phenomena as a continuous stream of interrelated stimulus and behavioural events. In this context the study of alternative behaviours may enhance the analysis of behaviour and provide a basis for the study of the orderly relations involved in the behaviour of retarded persons even when, as is frequently the case, such behaviour may appear haphazard.

CHAPTER 1

THE CURRENT STATE OF BEHAVIOURAL RESEARCH WITH THE RETARDED

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Introduction

In recent years research in the field of developmental retardation (Gardner and Selinger, 1971), as well as in other areas of applied psychology (Kazdin, 1975), has produced a prolific growth rate in the area which has variously been described under the labels of "behaviour modification", "applied behavioural Analysis" and "functional analysis of behaviour". The defining characteristics, practical applications, theoretical basis and rationale of this area of work have been well documented and reviewed at length elsewhere (Woods, 1973; Bijou, 1966; Spradlin and Giradeau, 1966; Kiernan, 1973, 1974).

Skinner, (1938, 1953, 1971, 1974) proposed the basic assumption for a science of behaviour that all behaviour is multiply determined by numerous factors such as the hereditory history of an individual, including his membership in a given species and his personal physical endowment, and the physical environment in which he exists, both past and present. The explicit task of the science of behaviour is to discover all the independent variables of which probability of behaviour is a function. In order to achieve this aim, analysis of the functional relationships between independent variables (hereditary and environmental conditions and events) and the dependent variable (behaviour) is possible without having to incorporate hypothetical intervening variables such as the conceptual nervous system (Hebb, 1949). However, this is not to say that nothing is happening inside the organism or that what is happening is unimportant. It means that in order to be able to describe and explain behaviour it is not necessary to know how the dependent and independent variables are connected, whether the links be real or hypothetical ones.

A functional analysis of retarded behaviour recognises the relevance of heriditary factors and physiological anomalies in determining the behaviour of retardates but conceptualises these as biological setting factors rather than the causes of a retarded behavioural repetoire (Bijou, 1966 ; Girardeau, 1972). Such an approach avoids the futile search for single causes of retarded behaviour and attempts to determine the range of variables related to a retarded behavioural development (Zimmerman, 1965).

This approach to the study of the behaviour of the developmentally retarded generally takes as its point of embarkation the application of the empirically derived laws of learning. It has generally been accepted that there are two "types" of learning; "respondent" or classical conditioning which was first reported by Pavlov (1922) and his associates, and "instrumental learning" or "operant conditioning" which was formulated in the research and writings of Thorndike (1911) and Skinner (1935b, 1938). This dichotomy, based on differences in experimental paradigms and the apparent inability to demonstrate operant conditioning of the various autonomic functions (Skinner, 1938, 1953), is generally acknowledged in commencing a functional analysis of the behaviour of the retarded (Bijou, 1966; Spradlin and Girardeau, 1966). A natural extension of these formulations has been the application of behavioural analysis to modify the behaviour problems and deficiences of the retarded.

Applied behaviour analysis has evolved from basic research concerned mainly with operant conditioning and carried out mainly with animal subjects. More specifically it has centred around analysis of the functional relationships between a discrete operant behaviour (usually a lever-press or key-peck) and events in the environment. Investigations have been concerned with various aspects of the basic three term contingency (Skinner, 1969) which connects antecedent and consequencial events and the operant behaviour selected for direct measurement. Studies of the experimental analysis of behaviour have tended to focus on the patterns of operant responding under schedules of reinforcement.

In its infancy, the experimental analysis of behaviour selected a simple discrete unit of behaviour for its ease of measurement in order to investigate the functional relationships between environmental events and the probability of occurrence of the operant. Skinner (1966a) pointed out that a measure which closely paralleled probability of behaviour was its rate of occurrence * under most of the basic schedules of reinforcement. Rate or frequency of behaviour became the raw data of the experimental analysis of behaviour and it has become almost an axiom for studies of applied behaviour analysis that target behaviours must be defined in such a way that they are capable of producing rate data.

Behaviour modification studies typically employ a single-subject experimental procedure (Sidman, 1960) using a reversal or a multiple-baseline design, (Baer, Wolf and Risley, 1968). A "reinforcer" is generally selected and in the treatment phase of the study the Law of Effect is applied in which the "reinforcer" is made contingent on the occurrence of a target behaviour, following the operant conditioning paradigm. Analysis of changes in rate or frequency of the target behaviour is made under the different experimental phases.

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* This has been qualified by Skinner (1966b) in which he emphasised that a correlation of rate with probability is not always the case:-

> 'Rate of responding is by no means to be equated with probability of responding, as frequency therories of probability and comparable problems in physics have shown' (p.16).

Over the last ten years numerous behaviour modification "techniques" have been developed which cover an ever growing range of behaviours and situations. "Packages" of behaviour change techniques have appeared which provide the "proven" methods for producing desired ends with the behaviour of the retarded. Manuals providing programmes and workshops for teaching the necessary behaviour change skills have proliferated. These "techniques" are generally hailed as having been derived from the facts discovered by "the experimental analysis of behaviour" and there has been a tendency for workers in the field of behaviour modification with the retarded to advocate looking to the experimental analysis of behaviour for further "techniques" to be discovered and used in application (e.g. Cliffe, Gathercole and Epling, 1974).

However, in the euphoria which has accompanied the rapid development of behaviour modification techniques for the retarded, some of the essential ingredients of a science of behaviour seem to have been left behind. A close examination of the outcome of using behaviour modification "techniques" reveals a technology which needs to be re-examined. Furthermore, the assumption that the "facts discovered" by the experimental analysis of behaviour are applicable intoto for use with the retarded needs further examination. At present a number of prominent researchers in the field of the experimental analysis of behaviour are suggesting that revisions are required in the basic frameworks and formulations that have grown out of the early experimental paradigms and need to be replaced by new conceptions of behaviour which would apply new descriptive categories to instances of behaviour (.e.g Schoenfield, 1966; Goldiamond, 1975). An attempt to examine some of these reservations follows in the next three sections and an examination of alternative frameworks will be discussed in the next chapter.

Behaviour Modification Techniques

The analysis of behaviour is a system for describing behaviour and specifying the conditions under which it is acquired, maintained and eliminated. Baer, Wolf and Risley (1968) made the following comments about applied behaviour analysis:-

> 'The differences between applied and basic research are not differences between that which "discovers" and that which merely "applies" what is already known. Both endeavours ask what controls the behaviour under study. Non-applied research is likely to look at any behaviour, and at any variable which may conceivably relate to it. Applied research is constrained to look at variables which can be effective in improving the behaviour under study (Baer et al, 1968, p. 91)'

In their discussion of applied behaviour analysis, Baer et al (1968) point out that the term "technological", when used in this respect, simply means that the techniques making up a particular behavioural application are completely identified and described. However, strict adherence to the criteria which Baer et al (1968) suggest for evaluating applied behavioural studies has not always been met.

There has been a steady increase in the number of behaviour modification "techniques" which are used to "treat" various behavioural problems. Examples of these "techniques" that have been devised for eliminating undesirable behaviour with the retarded include "shock-punishment treatment" (reviewed by Bucher and Lovaas, 1968), "physical restraint by tying the client to a chair" (Lane and Comrath, 1970), "the over-correction principle" (Foxx and Azrin, 1972; Foxx and Azrin, 1973), "autism reversal" (Azrin, Kaplan and Foxx, 1973), "required relaxation" (Webster and Azrin, 1973) and "hand-awareness training" (Azrin and Nunn, 1973). Similarly, techniques to establish desirable behaviours such as "rapid toilet-training methods " (Azrin and Foxx, 1971) and various self-help programmes (Watson, 1969) have appeared which apparently can be applied with minor alterations to produce the desirable change in behaviour with any member of the subject population for which they were devised. However, as Michael and Meyerson (1962) have pointed out:-

> 'A behavioural approach to human control does not consist of a bag of tricks to be applied mechanically for the purpose of coercing unwilling people (Michael and Meyerson, 1962, p 382).

Many "behaviour modifiers" consider their job as that of making technological applications of the findings of basic research. Cliffe et al (1974), for example, consider that "behaviour modifiers" should be 'acquainted with basic research in operant conditioning to be able to work out implications for application (Cliffe et al, 1974, p. 390).' They suggest that the time lag between scientific discovery and technological application should be shortened in order to achieve solutions to some of the behavioural problems which so far have not responded to behaviour modification. As an example of a "principle" looking for application they mention behaviour contrast (Reynolds, 1961 , 1968).*

They speculate that by using this "technique" the frequency of desirable behaviour may actually increase as other behaviour is reduced in frequency under extinction. However, as the above quote from Baer et al (1968) emphasises, this kind of approach is exactly what an applied behavioural analysis should not be doing.

One of the "techniques" of behaviour modification which has had much use in attempting to change behaviour is that of "token economy". The following quote from an account of a leading British token economy project with chronic schizophrenic patients exemplifies how the "techniques" approach has deviated far from the functional analysis of behaviour proposed by Skinner (1938);-

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* Interestingly, recent evidence suggests that behavioural contrast is a species-specific phenomenon in pigeons with key-pecking. Several reports have not found the phenomenon with other species such as rats with lever-pressing (e.g. Boakes, Halliday, and Poli 1973). It seems that the difference could be related to consummatory aspects of key-pecking (Boakes et al, 1973; Staddon and Simmelhag, 1971).

> 'The theory of operant conditioning is that not only does the token motivate the patient to behave in certain ways, but"reinforces" his behaviour. Such reinforced behaviour should eventually become an integral part of the "way he is," continuing even when the token is removed ... Operant conditioning ... is a structured approach with a unified theory behind it, namely that any patient can learn new modes of behaviour if the appropriate reinforcer can be found (Baker, Hall and Hutchinson, 1974, p. 367)'.

Catania (1968, 1969, 1975) has continually made the point that "reinforcement" is not an explanation for behaviour , but is a name for a particular type of behavioural relation.

Homme et al (1968) in examining the phrase "behavioural engineering", have distinguished between the "technology of contingency management" and the "technology of stimulus control". Many of the "behaviour modification techniques" which have been developed for use with the retarded are frequently nothing more than attempts to impose arbitrary contingencies of reinforcement to bring about desirable changes in behaviour. Frequently these contingency management techniques fail to consider the technology of stimulus control. They neglect to investigate the functional relationships between environmental events and the behaviour they wish to change. The "techniques" approach does not ask the question "what controls the behaviour under study?", in order to be able to manipulate the variables which can be effective in improving the behaviour under study, as Baer et al (1968) proposed, it mechanically selects the appropriate method for a particular behavioural problem.

This method of mechanically selecting the appropriate "behavioural technique" to "treat" a particular diagnostic label (e.g. "systematic desensitisation" "flooding" or implosion" for phobics, "aversion therapy" for alcoholics or homosexuals, "relaxation training" or "biofeedback" for neurotics, etc) is typical of studies which claim to use "Behaviour Therapy" (c.f. Marks, Rachman and Gelder, 1965; Eysenck, 1960; Eysenck and Rachman, 1975; Lazarus, 1973).

It appears that many of those who devise behaviour modification "techniques" are under the impression that the findings of basic research in the experimental analysis of behaviour are "the laws of behaviour". This apparent "sound basis" from which "techniques" for application are derived can be seen in statements such as the following:-

> 'The reason for the effectiveness of behaviour modification lies in its derivation from the experimental analysis of behaviour. No other approach in the history of psychology has demonstrated such refined prediction and control over its subject-matter with such scientific rigour, replicability and generality (p. 390)' (Cliffe et al, 1974)

It is true that many studies of the experimental analysis of behaviour have been able to identify and control independant variables producing changes in rate of responding which can be predicted with great precision. It is another thing, however, to say that all analyses of behaviour (including applied ones) must therefore approximate this degree of precision so that:-

> ' ... an effective behavioural technology emerges which is based on a powerful science of behaviour (p.390') (Cliffe et al, 1974).

The next section attempts to examine how misconceptions concerning the findings of the experimental analysis of behaviour (that have encouraged the development of a mechanical application of techniques) have developed.

The Experimental Analysis of Behaviour

"Basic research" in the experimental analysis of behaviour has mainly been carried out in experimental chambers known as "Skinner boxes" with rats, pigeons and monkeys. It has been concerned with examining the functional relationships between discriminative stimuli, rate of responding (lever-pressing or key-pecking) and parameters of reinforcing stimuli such as magnitude or schedule of reinforcement. Before detailed analysis of changes in response rate became possible with the advent of more sophisticated recording equipment, such as computers, patterns of responding were examined on cumulative records (e.g. Skinner, 1938).

Many of the early studies which involved manipulations of reinforcement magnitude generally concluded that once responding stabilises on a particular schedule of reinforcement, particularly one that typically produces high rates of responding, then changes in mangitude of reinforcement does not result in significant change in the pattern of responding (e.g. Ferster and Skinner, 1957). The effect of these findings on the behaviour of experimenters was summarised by Morse (1966) as follows:-

> 'This lack of correlation with rate has led to a neglect of magnitude of reinforcement as a factor in schedule-controlled responding, and has fostered the erroneous tendency to regard reinforcement as a constant effect with magnitudes below some threshold value not being reinforcers, and all magnitudes above that value being equally effective reinforcers.' (Morse, 1966, p. 81).

An example of how this tendency has carried over into the development of applied "techniques" was seen in the quote from Baker et al (1974) in the previous section.

When manipulated, the parameter of reinforcement which produced more noticeable changes in patterns of responding was the schedule. The study of schedules of reinforcement has examined in great detail how different patterns of response rates are produced under different schedules. It became apparent that a great degree of intra-subject, intra-species and inter-species generality existed regarding typical patterns of responding under the same schedule of reinforcement. Fixed-interval schedules typically produced "scallop" patterns on cumulative records, and fixed-ratio schedules produced "break and run" patterns, for example. Similarly, the typical response rate patterns were produced when different reinforcers were used and when different operants were examined. Skinner (1956) showed as an example of significance for comparative phychology and the study of individual differences, three tracings of great similarity from cumulative records of responding under a multiple fixed-interval fixed-ratio schedule. One of the records was produced by a pigeon in an experiment by Ferster and Skinner (1957), one was made by a rat in an experiment by Lorh on anoxia, and the third was made by a monkey in an experiment by Pribram. Skinner (1969) has commented that:-

> 'In the experimental analysis of behaviours many species differences are minimised. Stimuli are chosen to which the species under investigation can respond and which do not elicit or release disrupting responses ... In this way species differences in sensory equipment, in effector systems, in susceptibility to reinforcement, and in possible disruptive repertoires are minimised' (Skinner, 1969, p. 190).

This experimental strategy is designed specifically to eliminate sources of variability between and within species. In discussing the example of inter-species similarities in patterns of behaviour mentioned above, Skinner (1956) made the following observations:-

> 'Of course, these three species have behavioural repertoires which are as different as their anatomies. But once you have allowed for differences in the way in which they make contact with the environment, and the ways in which they act upon the environment, what remains of their behaviour shows astonishingly similar properties ... Difficult problems of idiosyncrasy or individuality will always arise as products of biological and cultural processes, but it is the very business of the experimental analysis of behaviour to devise techniques which reduce their effects except when they are explicitly under investigation' (Skinner, 1956, p. 229).

Despite Skinner's (1956, 1969) emphasis that sources of variability are purposely avoided in studies which have produced the inter-and intra-species similarity in patterns of responding under various schedules of reinforcement, there has been a tendency to search for the general "laws of behaviour" under the assumption that they may be revealed equally well irrespective of which species is examined and by using any combination of discriminative stimulus, response, and reinforcer. This assumption, that the elements of the"three term contingency" are arbitrary and interchangeable, has frequently been made in statements such as the following:-

> 'We arbitrarily choose almost any act from the animals repertoire and reinforce it with food, water, or whatever else the animal will work to obtain ... The same act can be used for any reinforcer ... In effect, in any operant situation, the stimulus, the response, and the reinforcement are completely arbitrary and interchangeable. No one of them bears any biologically built-in fixed connection to the other.' (Teitelbaum, 1966, pp. 566-567).

The notion of reinforcement being an "all-or-none effect" and the assumption of considerable generality of the "laws of Behaviour" have been generally accepted and on the whole experimental results have not contradicted them until very recently. Not surprisingly, these generalaties have been accepted by many "behaviour modifiers" as scientific facts to be applied in a behavioural technology. However, in recent years several areas of research in the experimental analysis of behaviour have produced findings which demand a widening of the field of behavioural analysis (both pure and applied), and suggest a re-assessment of some of the basic assumptions. Some of the results which suggest that these generalisations may be limited in their applicability are reviewed in the next section.

Some Recent Experimental Findings

The classic distinction between operants and respondents, as separate types of conditioning (Skinner 1935b, 1938) has persisted for many years, There has been no universally valid way of identifying operants and respondents other than the operations used to produce them. However, the specifications of relationships between response classes and stimulus classes that are involved can be accounted for in ways that do not require the postulation of two separate kinds of conditioning (e.g. Schoenfeld, 1966; Catania, 1971) and this aspect of the dichotomy will be examined in the next chapter.

The operant-respondent dichotomy was also bolstered by the assumption that the two types of behaviour were correlated with somatic and autonomic effector systems, respectively (Skinner, 1938, 1953). However, much recent work has demonstrated this assumption to be incorrect. Research by N.E. Miller and his associates (e.g. Miller and Carmona, 1967; Miller, 1969; Di Cara, 1970) have demonstrated the use of the operant paradigm to control various autonomic functions such as blood plessure and heart rate. Applications of the operant control of glandular and visceral responses in Man have proliferated in recent years (e.g. Elder and Ruiz, 1973; Shapiro, Tursky and Schwartz, 1970). Similarly there have been demonstrations of respondent control of somatic responses as exemplified in Brown and Jenkins (1968) studies of autoshaping of key-pecking in the pigeon.

With the widening of experimental work in the general field of behaviour analysis several anomalies with respect to the "laws of behaviour" have arisen which when taken together constitute clear evidence that arbitrary combinations of stimulus, response, and reinforcer are not all equivalent. These findings are usually presented under the title of "constraints on learning" and have been reviewed at length by Shettleworth (1972) and Seligman and Hager (1972). One of the earliest examples was provided by Breland and Breland (1961) who described their attempts to train unconventional laboratory animals such as pigs, hens, and racoons. In some cases, as the training proceeded, instead of producing the behaviour that was specified in the "reinforcement contingency", the behaviour of these animals "drifted" towards another behaviour which appeared to be related to the "stimulus situation" or "setting conditions" in which they were placed. Apparently something about the "food-getting" situation was more important than the reinforcement contingency in determining their behaviour. Staddon and Simmelhag (1971) presented a synthesis of examples such as this in which parallels between learning and natural selection were examined. Similarities between processes involved in behavioural change and in the evolution of species have been noted with increasing frequency recently (e.g. Gilbert 1970, 1972; Skinner, 1969, 1974; Staddon and Simmelhag, 1971).

Examples of constraints on learning provided by Shettleworth (1972) cover the relationship between the response and the reinforcer, the relationship between the stimulus and the response, and the specificity of stimulus to reinforcer. Many of these constraining aspects appear to be species-specific and involve various phylogenic and ontogenic determinants of behaviour. Most of the examples which are given as "constraints" on learning are those where strategies to minimise species differences as described in the previous section have not been employed by the experimenter, and hence other factors involved in determining behaviour have been involved.

It appears that whether or not a behaviour is naturally appropriate to a given situation is an important variable which has been to a large extent overlooked or avoided in the past. Riess (1971) for example, demonstrated that efficiency on a free-operant avoidance schedule (Sidman, 1953) is very much a function of the response topography. Rats performed more efficiently when the operant involved running from one compartment to another as opposed to the more usual lever-press. Here, the suggestion is that running is a species-specific reaction which is appropriate to an aversive situation and thus is more easily conditioned than lever-pressing. Similarly, Hemmes (1970) has shown that pigeons' efficiency on differential reinforcement of low rate schedules of pellet reinforcement can be enhanced by changing the required operant from a key-peck to a treddle-press. It seems that key-pecking is greatly affected by a species-specific tendency to peck in a food-getting situation. The pigeons' key-peck has produced several problems in animal laboratories which have not always been documented, such as the type of consequence employed. Training pigeons to key-peck to avoid shock, for example, has proved to be almost impossible (e.g. Azrin, 1959; Hoffman and Fleshler, 1959; Rachlin and Hineline, 1967).

The list of "exceptions to the rule" could be extended to cover intra-species differences, which will be examined with respect to retarded subjects in Chapter 3 . However, these are not examples of constraints in the sense of operant conditioning not working, or where attempts to bring about particular behaviour changes have been unsuccessful. They are instances in which variables other than those explicitly programmed by the experimenter have been simultaneously involved in determining the behaviour of the organism. In this way they have added to our knowledge of factors involved in the prediction of behaviour. The demonstration that there are limits to learning simply reduces the range of operant relations that experimenters may hope to discover empirically; it does not alter the status of those operant relations that have been shown to exist (Catania 1973a, 1973 b), and as Malone (1975) has pointed out:-

> 'Such limits on learning seem reasonable enough and do not constitute sufficient grounds for abandoning what has been a productive approach' (Malone, 1975, p.482).

Schoenfeld, Cole, Long and Mankoff (1973) have made the point that:-

> 'Skinner's demonstrations of behavioural control were all-important in the history of the science because the very possibility of such a science hinged on the success of those demonstrations. Yet the demonstrations did not constitute a behaviour science. They only enabled it. The pragmatic fact that the demonstrations "worked" did not substitute for behaviour science,. they only gave the science a future.' (Schoenfeld, Cole, Long and Mankoff, 1973, p. 154).

The study of the behaviour of the retarded obviously has pragmatic goals which to a large extent should determine the direction that studies with these subjects take (Kiernan, 1973).

However, it is important that the efforts to achieve these goals do not substitute a mechanistic application of "operant techniques" for the explicit task of the analysis of behaviour, - to discover all the independent variables of which behaviour is a function.

CHAPTER 2

SOME RECENT REFORMULATIONS OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOUR

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The Language of the Experimental Analysis of Behaviour

Schoenfeld, Cole, Long and Mankoff (1973) have made the point that;-

> 'A science of behaviour has two primary facets: (a) to divide the behaviour stream into categories for measurement, and (b) to classify the operations which influence those behaviour categories' (Schoenfeld et al, 1973 p. 151).

Historically, however, most introductions to the science of behaviour have commenced with a distinction between two different behaviour processes, operant and respondent conditioning (e.g. Holland and Skinner, 1961). Two type learning therory has customarily taken as its point of departure asserted distinctions between response classes (operant behaviours and respondent behaviours) and between experimental paradigms (operant procedures and respondent procedures). Proposed anatomical distinctions (Skinner, 1938) have not withstood rigorous exmpirical testing (see the previous chapter) but dinstinctions between the two experimental paradigms still persist in the behavioural literature (e.g.Kling, 1971). The operational distinction has remained the fundamental basis for dichotomising between respondent (S-S) and operant (R-S) procedures.

In recent years many prominent workers in the field of the experimental analysis of behaviour have been concerned with reducing the two process therory and have re-examined other aspects of the tradtional operant framework which, they consider, has constrained the development of the science. They have proposed certain reformulations that offer to further our understanding of the science of behaviour. Catania (1971) for example, has dealt with the operational distinction between operant and respondent conditioning by treating them as special cases within a broader context of procedures. He has made the point that it is a classification of behavioural operations rather than a classification of behaviour processes that should be the concern of a science of behaviour that;-

> '... we must reconsider the way in which we speak of behaviour and behavioural relationships. We have inherited a vocabulary that may not correspond in the most effective way to the behavioural events that we observe' (Catania, 1971,p. 217).

In a similar vein, Schoenfeld (1966) offered an approach to reducing the two-process distrinction which;-

> '... would apply new descriptive categories to actual instances of behaviour. The aim would be to show empirically that seeming differences among reflex classes do not survive experimental analysis, that operational differences between the conditioning paradigms may be resolved in terms of common operational elements and parameters and that behavioural measures taken under the two conditioning procedures are indeed similar functions of similar variables. This approach would take its departure from a new breakdown of the behaviour stream, and would undertake among its first tasks the re-statement of the forms of stimulus control over behaviour ' (Schoenfeld, 1966 p. 221).

Both Schoenfeld (1966) and Catania (1971) point out that the experimental analysis of behaviour has tended to neglect the fact that behaviour is a continuous stream and not just a collection of reflexes to be assigned to different temporal relations of reinforcement to response or different conditioning paradigms. They lay the emphasis on behaviour being fundamentally a series of events in time involving stimuli and responses in a continuous stream and propose that the experimental analysis of behaviour should be concerned with the specification of transition among the various events in the stream.

Reflexes and the Nature of the Operant.

Schoenfeld (1966) and Schoenfeld et al (1973) have traced the history and development of the way that behavioural scientists speak about behaviour and behavioural relationships. In particular they note that a single concept, the "reflex", became prominent and provided an analysis of both behaviour and its controlling variables. They maintain that a transfer of Pavlov's conditioning vocabulary to Skinner's operant response class occurred without suitable justification, and argue that the linguistic convention that emerged did so by default. The use of the reflex concept they point out, attributes causality to a hypothetical, deduced connection between behaviour and its related variables;-

> '... the reflex concept has been empirically validated and descriptively refined until at present the "response" has become a credible unit of behaviour, the "stimulus" a tenable unit of influence upon that behaviour, and their interconnection the accepted mediator of that influence' (Schoenfeld et al, 1973, p. 151).

Much of Schoenfeld's recent work (Schoenfeld and Farmer, 1970; Schoenfeld and Cole 1972a; Schoenfeld and Cole, 1972b; Schoenfeld et al 1973) has been concerned with the removal of inferred, hypothetical interconnections between responses and stimuli, which are found in concepts such as "reflex" and "contingency" (discussed in a later section) from the language of the experimental analysis of behaviour.

Skinner (1966) maintains that as the concept of the reflex made no reference to the consequences of a response, he introduced (Skinner, 1937) the term "Operant" to distinguish between reflexes and responses operating directly on the environment. Catania (1973), Schoenfeld (1966), and Staddon (1967) have pointed out that the origin of the concept of the "operant" lies in Skinner's early papers (Skinner, 1931, 1935a, 1935b) in which he called it a type (type I) of conditioned reflex. Staddon (1967) notes;-

> '... examination of the historical antecedants and formal characteristics of the concept of the ... operant indicates that its only essential property is the embodyment of a causal relation between environment and behaviour' (Staddon, 1967)

The view taken by the majority of writers on the subject (c.f. Catania, 1973; Gilbert, 1958; Schick, 1971; Sheldon, 1974; Skinner, 1938;, 1953; Staddon, 1967) is that any segment of behaviour is a member of an operant class if it possesses the property upon which reinforcement is contingent, and if systematic functional relationships between the operant and its environment can be demonstrated. However, Catania (1973) suggests that two distinct uses of the term "operant" can be found in the psychological literature, and these he calls the "descriptive operant", and the "functional operant". The former specifies the precise topography of behaviour which will produce reinforcement. The latter corresponds more with Skinner's original definition and describes the response class for which a functional relationship with the reinforcer is demonstrated. Descriptive operants are specified beforehand and found in the methodological section of experimental reports but, as Staddon (1967) has pointed out, the recognition of a functional operant can only take place after an experiment has been carried out. Hence it is possible that the topographical characteristics of response class defined in the descriptive operant do not define the functional operant (Skinner, 1957).

Where there is a discrepancy between the descriptive and functional operant, then a "false" picture of the behavioural relationships could be obtained. Cullen (1975) for example, reports that a description of the experimenter - imposed contingencies did not adequately describe the functional relationships on a differential reinforcement of low rate schedule with animal subjects. Other studies that have examined dimensions of the response other than rate, such as force of response (c.f. Davies and Burton, 1974; Gollub and Lea, 1964; Haney, 1972, Mintz, 1962; Notterman and Mintz, 1965) and duration of response (Platt, Kuch and Bitgood, 1973) have often found that these (generally un-recorded) aspects of the response are members of a functional operant class.

To Schoenfeld et al's (1973) assertion, quoted at the start of this chapter, that the behaviour stream should be broken down into categories for measurement, could be added that the science of behaviour should be concerned with the search for functional categories into which the behaviour stream can be broken down.

The Functions of Reinforcers

Catania (1968, 1969, 1975) has frequently made the point that "reinforcement" is the name for a particular type of behavioural relation, but historically the term has been applied indiscriminately both to the procedures that generate this relation and to the changes in behaviour that follow from these procedures* . In this

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* Schoenfeld and Cole (1972b, 1975) note that in the current literature, "reinforcement" designates both the stimulus to be delivered and the contingency or dependency of the delivery upon some prior response. Catania (1968) proposed that experimenters should examine the grammar they use with respect to this concept and restrict the usage to the following;-

"reinforcement" is a stimulus operation, a "reinforcer" is a stimulus or a set of stimuli, and that a "reinforcing" effect of such stimuli is <u>response-defined</u>.

respect a descriptive (specification of the operation) and functional definition of a reinforcer, similar to that discussed with respect to the "operant" in the previous section, can be distinguished.

Hendry (1969) distinguishes between two functions of a reinforcer. One function is to maintain the behaviour upon which it is contingent. This is the usual effect implicit in the definition of a reinforcer as a stimulus which increases the future probability of preceding behaviour. The second function of a reinforcer is to control the behaviour which follows it. This controlling effect is not as well understood, although it has been recognised in discussions of the reinforcer as a discriminative stimulus (S^D) (Reid, 1958) and in the distinction made between "temporal" and "situational" control (Staddon, 1972a, 1974). The controlling function of a reinforcer is apparently determined mostly by the temporal characteristics of the schedule (c.f. Staddon, 1972a, 1974) and this will be returned to in a later chapter (chapter 4).

Schoenfeld and Farmer (1970) were concerned with the topography of behaviour during the post-reinforcement pause ($P\ S^R P$) and the control of the reinforcer over this behaviour and suggested that the experimental analysis of behaviour could expand by considering behaviour other than that specified in the reinforcement schedule Schoenfeld et al (1973) noted that;-

> '... a stimulus delivered as S^R might have "no effect on behaviour" if only the preselected R were observed, but might nonetheless have a variety of stong effects upon other parts of the behaviour stream' (Schoenfeld et al, 1973, p. 159).

Reinforcement Contingencies and Stimulus Schedules

The operational distinction between operant conditoning and respondent conditioning included the experimental procedure of making reinforcement "contingent" upon the response class in the former. For example, Hilgard (1964) in distinguishing between operant and respondent procedures stated that in operant conditioning;-

> '... the response that is strengthened is that which produces or leads to the reinforcing stimulus rather than that elicited by the reinforcing stimulus' (Hilgard 1964).

However, this distinguishing feature became questionable following Skinner's (1948) classic demonstration of "superstitious conditioning" which involved temporally regular introjections of a "reinforcing stimulus" into the stream of behaviour. Skinner's(1948) discussion of the outcome included the following comments:-

> 'To say that a reinforcement is contingent upon a response may mean nothing more than that it follows the response. It may follow because of some mechanical connection or because of the mediation of another organism; but conditioning takes place presumably because of the temporal relation only, expressed in terms of the order and proximity of response and reinforcement. Whenever we present a state of affairs which is known to be reinforcing at a given level of deprivation, we must suppose that conditioning takes place even though we have paid no attention to the organism in making the presentation' (Skinner, 1948, p. 168).

However, Schoenfeld et al(1973) had more to say about Skinner's findings:-

> 'Regardless of how the "superstition" demonstration is viewed, it made two things clear: first, that "contingency", conventionally described as "procurement" and "production", could be adequately stated in temporal terms alone, and second

> that operant conditioning was possible without it, that is, without an experimentally specified dependence of the temporal distribution of S^R upon the temporal distribution of R' (Schoenfeld et al, 1973, p. 156).

and further that;-

> 'As "procurement", contingency is certainly dispensible; and contingency per se is equally dispensable, in its raw meaning, that is, when it means no more than the limiting values of temporal parameters, though the same limits may in fact articifially restrict the full range over which the conditional dependency of R and S^R can be quantitatively specified' (Schoenfeld et al, 1973, p. 157).

Schoenfeld (1966) made the point that any stimulus, whether designated as a "reinforcer" or otherwise, when introjected into the behavioural stream is "contingent" upon some responses and antecedent to others, and is also temporally related to all other stimuli, both "reinforcing" and otherwise, in the stream. In an attempt to bridge the apparent discontinuities between contingent and non-contingent schedules and avoid the artificial restriction of response and stimulus relations imposed by reinforcement contingencies and to subsume these procedures together with all other "schedules of reinforcement", Schoenfeld and his co-workers have devised a system of stimulus schedules known as the $t - \tau$ systems (Schoenfeld et al, 1972b). In discussing the advantages of stimulus schedules (such as the $t - \tau$ systems) over traditional reinforcement schedules, Schoenfeld and Cole (1972a) proposed the following;-

> 'if the concent of reinforcement is broadened to include all stimuli, and if "contingency" is dropped from the lexicon of learning therory, then emphasis moves to the temporal relations among the occurrences of R and the intrusions of S^R (the "reinforcements") into the behaviour stream. The viewpoints of the subject and the experimenter will then

> coincide and neither will be more "superstitious" than the other. Reinforcement schecules, and systems like $t - \gamma$ which undertook to order them, become "stimulus schedules", in which a stimulus sheds its inferred "functions" and reverts to what it is, namely, an energy input function describable in terms of its physical and its scheduling parameters alone.' (Schoenfeld and Cole, 1972a, pp 160 - 161).

Such a means of specifying experimental variables encourages the examination of "functional" classes of behaviour, and focuses the experimenter's attention to the analysis of stimulus functions rather than to examining the effects of imposing stimulus operations.

The Behaviour Stream

For many years the experimental analysis of behaviour has examined a single pre-selected response such as a lever-press or key-peck as a kind of representative segment or index of the whole. Schoenfeld and Cole (1972a) have argued that this state of affairs in which all but the selected response is ignored, arose from old ideas that all behaviour was reflex in character (e.g. Skinner, 1931, 1935a) and have expressed dissatisfaction with the "analytical usefulness" of isolating single responses:-

> 'Behaviour theory, to date, has almost exclusively chosen its response as a single punctate event, the "R" and has isolated it from the organism's behaviour stream, the better to measure its rate, amplitude, latency or whatever... Ultimately, the experimental analysis of behaviour will have to be extended to the continuity and complexity of behaviour. An important limitation that comes from isolating R is that it cannot deal with continuity of behaviour, i.e. the fact that behaviour is not made up of "R's" joined together, but is rather a truely intergrated stream out of which "R's" are abstracted' (Schoenfeld and Cole, 1972a, p.161).

Schoenfeld and Farmer (1970) noted that the definition of the response to be reinforced (the R - class) fixed also the definition of the class of responses not to be reinforced which they call the "not - R" ($\not{R}$) class. They referred to $\not{R}$ as the behavioural context of R and reason that because behaviour is an unbroken stream, the outcome of every experiment depends as much upon what responses are not reinforced as upon those that are. By giving $\not{R}$ a temporal specification (t seconds without R) they were able to schedule "reinforcement" of both R and $\not{R}$. This paradigm compliments the $t - \tau$ systems of stimulus scheduling, the use of which they said, partially inspired consideration of $\not{R}$;-

> 'A number of behavioural findings ... secured both in research under the $t - \tau$ systems and outside those systems, urged that some attention be paid to $\not{R}$ as well as R. Among these findings were: the tendency of R rate to rise with continuing exposure to an unchanging reinforcement schedule, (e.g. Sidley and Schoenfeld, 1964; Snapper, Schoenfeld, Ferraro, and Locke, 1966); the resemblence ... of terminal responding under FI to that under FR schedules; the high R rates under fixed-variable - or random-ratio schedules, regardless of ratio size; the general difficulty or recovering earlier how R rates after more recently acquiring high rates; the heavy influence in random interval schedules of the lowest interreinforcement interval ($IS^{R}T$) as a determiner of R rate; and the persistence of short IRT's on DRL schedules. Moreover, ... certain problems respecting the stimulus (discriminative) control of behaviour seemed approachable through $\not{R}$. To bring both R and $\not{R}$ under the experimental attention meant, of course, to return to the behaviour stream from which both classes are abstracted' (Schoenfeld and Farmer, 1970, p. 226)

Perhaps the results of one of the series of experiments reported by Schoenfeld and Farmer (1970) can best exemplify the significance of considering behaviour other than that specified in the reinforcement schedule. $\not{R}$ was temporally defined in terms of segments of the behaviour stream within which no R occurred. It was possible that several occurrences of $\not{R}$ duration thus defined could occur in an interresponse time. When $\not{R}$ was "reinforced" on various schedules it was shown to be a function of the schedule (i.e. a functionally defined operant). In the final experiment in this series $\not{R}$ was "reinforced" as described and R was reinforced on a differential reinforcement of low rate schedule and hence the reinforcment schedule which was in effect they designated as "a modified tandem DRL - DRO". The resulting interresponse time distributions and response rates differed considerably from those on a standard schedule, and they concluded that;-

> 'When an independent variable [a differential reinforcement schedule] can produce seemingly divergent findings, [with respect to the stardard differential reinforcement of low rate literature] ... other factors must be the causes. In the present case, the contribution of $\not{R}$ seems evident; how the behavioural stream is manipulated will help determine what is observed of that segment of the stream that is chosen as the sample R in any experiment'(Schoenfeld and Farmer, 1970, p. 244).

Alternative Sets

An interesting attempt to extent the findings and suggestions of Schoenfeld and Farmer (1970) has recently been presented by Goldiamond (1975). He contrasts two frameworks used for behavioural analysis;-

> '... (1) the present unilinear framework which describes behaviour by the contingencies into which it enters, and (2) a proposed framework of alternative sets, which requires description not only of behaviour and its relation to environmental events, but also of alternative sets of behaviour - environment relations ' (Goldiamond, 1975, p. 50).

In essence, Goldiamond (1975)is attempting to extend the analysis of behaviour to encompass more of the complexity of the behaviour stream. His alternative framework or system involves a well defined target behaviour (TB), a well defined alternative behaviour (AB), and a third class which is defined by exclusion of both TB and AB and is designated as neither behaviour (NB). The NB category could be subdivided into other well defined behaviours, and the classification system could thus be further extended. This is contrasted with the present unilinear framework which has only one well-defined set, the response (R), the alternatives being defined solely by negation or exclusion from that set.

Most laboratory studies which examine the response (TB) and its contemporaneous stimulus assume (implicitly if not explicitly) that any AB is idling (i.e. is not operative). But as Goldiamond (1975) argues, AB is not necessarily idling in every situation and he examined a variety of environmental conditions in which AB is operative. He pointed out that in an alternative-sets formulation in which both TB and AB result in changes in particular environmental events such as reinforcers or punishers, then the TB outcome should not be generally comparable for unilinear and alternative sets;-

> 'To the extent that an effective AB enters into a situation described unilinearly, TB can become unpredictable. The second situation [both TB and AB operative] then becomes a requisite for understanding and application. This point has been made for the laboratory by Schoenfeld and Farmer (1970). For application designed to change behaviour and for understanding (theory) derived from the natural environment, the differences are impressive' (Goldiamond, 1975, p 57).

Indeed some of the examples that Goldiamond (1975) examined are extremely impressive and suggest a re-analysis of many areas in behaviour analysis such as differences in performance outcomes both between and within individuals.

> 'Given identical availability of identical consequences identical occasions, identity in anything else necessary to define environments, and genetically identical organisms with identical responses, different patterns of behaviour will emerge if the precise ways in which the consequences are related to behaviour differ ... Behaviour can increase or decrease for the same schedule, depending on the alternatives (Goldiamond, 1975, p. 84).

An alternative-sets approach further challenges the wisdom of those who would employ differential reinforcement "techniques" without a prior full functional analysis of the total behavioural organisation of a subject.

> 'An applied behaviour analyst who [is] ... under the impression that by substituting differential reinforcement for aversive control, he is tempering the system, is deluding himself. His delusion is supported by a unilinear definition of reinforcement as a positive contingency and the ensuing conceptual neglect of the alternative class which necessarily enters into the definition of reinforcement' (Goldiamond, 1975, pp. 78-79).

The standard laboratory operant conditioning experiment in which variables such as environmental history are controlled, and from which the unilinear system of behaviour analysis has developed, is rarely typical of studies involving human subjects, especially applied studies. The complexity of the behaviour stream is perhaps best approached for analysis, as Schoenfeld and Farmer (1970) have proposed, by considering behaviour other than specified in the reinforcing schedule. In recent years much laboratory work has been aimed at this goal. However, use of unilinear formulations is not confined to behaviour analysis as Goldiamond (1975) has pointed out:-

> '... much of classic psychiatric description is unilinear and the classic operant unilinear system is not alone in this regard. They both may represent a Zeitgeist in which such unilinearity was taken for granted. The Zeitgeist may now be changing - witness the attacks against "mechanistic" approaches' (Goldiamond, 1975, p. 61).

Summary

It appears that the time has come for workers in the experimental analysis of behaviour to examine the verbal behaviour they emit (in particular their concepts) in analysing their data. Indeed, the time has come when they need to re-examine what it is they will use as data. The complexity and variability which has emerged by using the traditional unilinear system of analysis, developed in the animal laboratory, to examine human behaviour cannot simply be explained away with reference to "variables beyond the experimenter's control". Similarly, in situations where differential reinforcement "techniques" have been used with success, the explanation of success in terms of a unilinear system of analysis often leaves much to be desired. Goldiamond (1975) quotes an unfortunate statement by Hilgard and Bower (1966) that;-

> 'The practical use of the [operant] system is based on the conplementary principles of control through presenting and withholding reward. The supplementary principles of stimulus discrimination and response differtiation suffice to insugurate shaping through the method of successive approximations. Beyond that, all that is needed is the experimenter's ingenuity' (Hilgard and Bower, 1966, p. 144).

- and comments that the "experimenter's ingenuity" consists of applying procedures other than those confined by the over-simplified unilinear formulations used.

Schoenfeld's (1966) suggestion to examine more of the behaviour stream that a preselected response has been emphasised in this chapter, as it is felt that the science of behaviour will be able to carry out its analysis more clearly by doing so. Weisburg (1971) has emphasised the importance of measuring dimensions of behaviour other than response rate (discussed in more detail in the next chapter) and pointed out that by concentrating on too few dependant variables, other important relationships may be missed. The selection of a dependant variable is of importance as not all measures of behaviour are useful in identifying functional relationships. Skinner (1938, 1957) has pointed out that in the stream of behaviour, as in the rest of Nature, there are "natural lines of fracture" which we must take into account when looking for the most appropriate dimensions of behaviour to examine.

The limitations of a unilinear system of analysis in which the effects of imposed stimulus functions upon a pre-selected descriptive operant, with a neglect of all the behaviour "surrounding the R" , have been examined in this chapter, as the present study hopes to achieve a better analysis of the behaviour it investigates without such theroretical and empirical constraints. In evaluating the advantages of considering as much as possible of the transition amongst the elements of the behaviour stream, Schoenfeld and Cole (1972a) conclude that;-

'Whatever has been accompished along this line needs now to be applied to broader divisions of behaviour, and to the ever-present problem of behaviour flux or variability. Even if we have not fully succeeded the problems remain empirical and not fanciful, real and not metaphysical' (Schoenfeld and Cole, 1972a, p. 153).

CHAPTER 3

AN OVERVIEW AND CRITIQUE OF LABORATORY AND APPLIED BEHAVIOURAL PROCEDURES WITH THE RETARDED.

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AN OVERVIEW AND CRITIQUE OF LABORATORY AND APPLIED BEHAVIOURAL PROCEDURES WITH THE RETARDED

Introduction

Behavioural investigations with the developmentally retarded can, for purposes of this review, be dichotomised into basic and applied research. The former is usually carried out in an arbitrary experimental laboratory in which every effort is taken to ensure that nothing other than the experimental variables are altered, and the latter in the "natural" environment in which the behaviour under study usually occurs (e.g. mealtime behaviours in the dining room). Both areas of research usually have in common the adoption of an operant conditioning paradigm in which a chosen consequence is made contingent upon a chosen response. Much of the early operant research with sub-groups of human subjects concerned itself with discovering reinforcers and studies involving retarded subjects were no exceptions to this (c.f. Bijou and Sturges, 1959; Spradlin and Girardeau, 1966).

Unlike animal studies, in which a given stimulus under given deprivation conditions would generally be equally effective as a "reinforcer" for any member of the species, such generality has not proved the case with the retarded. This was summarised by Spradlin and Girardeau (1966) as follows;-

> ' (1) What serves as a reinforcer at one time might not be effective at another time and (2) what will serve as a reinforcer for one person might not be effective with a different person ' (Spradlin and Girardeau, 1966, p. 272).

Most animal studies report that the stimuli employed as reinforcing consequences of the behaviour under investigation are durable and can maintain their effectiveness for extremely long periods (e.g. Skinner and Morse, 1958). With the retarded, however, especially the multi-handicapped profoundly retarded, the reinforcing effectiveness of many stimuli, is often a transient, highly idiosyncratic affair (e.g. Meyerson, Kerr and Michael, 1967). Some highly unpredictable results have been reported concerning events that function as reinforcers, involving extensive variability both between and within subjects (e.g. Rice and McDaniel, 1966; Rice, McDaniel, Stallings and Gatz, 1967). At the extreme, Lovaas found that smacking functioned as a positive reinforcer for self-destructive behaviour with a retarded child (Bucher and Lovaas, 1968). However, once reasonably effective reinforcers have been found for use with particular retarded subjects at particular times, research workers have frequently asked one of the two following questions. In basic laboratory studies researchers have asked - "Can the behaviour of retarded subjects be brought under similar stimulus and schedule control as non-human species when under similar experimental conditions", and in applied studies investigators have asked the question, "How can behaviour X be increased in frequency/decreased in frequency/be brought under desired stimulus control". The following review hopes to point out how research conducted within the scope of these questions is restrictive and how the range of empirical questions could be broadened.

Laboratory Studies

The assumption that the "laws of learning" are equally applicable to all species, human and sub-human, was fostered by the similarity of the performances generated under schedules of stimulation in a wide variety of species (see chapter 1). Morse (1966), impressed by the apparent universality of basic schedule performance, stated that;-

> 'Schedules of reinforcement ... are important because they represent the most intensively studied and best understood body of information on the generation and maintenance of operant behaviour ... Radically different patterns of responding and associated general demeanor can be made to appear, change and disappear in the same subject over brief periods of time. Furthermore, any member of most species, will give a similar performance on the same schedules' (Morse, 1966, pp 57 - 59).

A schedule of reinforcement has been defined as "the rule that specifies when an operant response is to be reinforced (Blough and Millward, 1965, p.63)" but as such does not include any a priori groundsfor predicting the patterns of responding which emerge. Nevertheless, "typical" patterns of responding are produced on simple schedules of reinforcement by various animal species. These include the "scallop" patterns (a pause after reinforcement followed by an accelerating response rate) produced early in fixed-interval schedules (Ferster and Skinner, 1957), and the "break-and-run" pattern (a pause after stimilus delivery followed by a run of responding at high constant rate) found on fixed-ratio schedules (Ferster and Skinner, 1957) or later in fixed-interval schedules (Schneider, 1969).

When an organism regularly produces the typical pattern of responding under a particular schedule of stimulation, the behaviour is said to be under "schedule Control" (Morse and Kelleher, 1969). Various arbitrary criteria which specify "schedule control" have been offered such as Gollub's (1964) quarter life index for fixed-interval schedules and a specific interresponse time distribution for differential reinforcement of low rate schedules (e.g. Anger,1956).

A human equivalent of Ferster and Skinner's (1957) "Schedules of Reinforcement" does not exist. However, there exists a number of studies of human behaviour under schedules of stimulation which suggests that the characteristic response patterns produced in other species are not readily produced in man. Research with normal children (e.g. Long, Hammack, May and Campbell, 1958; Long, 1959, 1962), retarded children (e.g. Orlando and Bijou 1960; Bijou and Orlando, 1961) normal adults (e.g. Holland, 1958; Weiner, 1969a, 1970a) retarded adults (Ellis, Barnett and Pryer, 1960) and psychotics (Lindsley, 1956, 1960, 1962) have shown that there can be significant discrepancies between the schedule performance of animal and human populations.

Extensive reviews of retardates' behaviour under schedules of stimulation have been provided by Spradlin and Girardeau (1966), Weisburg (1970), and Woods (1973), and will not be replicated here. In general retardates' performance lacks the consistency of animal performances and includes frequent, unpreditable pauses of varying length. The pauses and general "rough grain" patterns of responding that are often found in the performance of retardates are rarely reported with normal humans. Weiner, (1962, 1963, 1964a, 1964b, 1964c, 1969a, 1969b, 1970a, 1970b) has shown that the schedule performance of normal humans often differs from that of animals, but is usually regular and consistent and does not show the tremendous degree of inter- and intra-subject variability found in the schedule performance of retardates.

Several human studies have shown that other variables can combine with the schedule of stimulation todetermine the subject's performance. These variables included (i) the type of stimulation (Spradlin, Girardeau and Corte, 1965; Stoddard, 1962; Woods and Pryce, 1974,), (ii) the amount of stimulation (Schroeder, 1972), (iii) adding further stimuli, e.g. added clocks (Long et al, 1958), (iv) instructions given (Headrick, 1963; Kaufman, Baron and Kapp, 1966,; Lippman and Meyer, 1967; Baron,Kaufman and

Strauber, 1969; Weiner, 1970b) (v) drugs (Dews and Morse, 1958) (vi) the subject's history of stimulus schedules (Long et al, 1958; Long 1962, 1963; Weiner, 1964b, 1969a, 1969b, 1970a) (vii) "response cost" i.e. making potentially punishing events contingent upon responding (Azrin, 1968; Weiner, 1962, 1963, 1964a, 1964c; Davison and Kirkwood, 1963; Scobie and Kaufman, 1969) (viii) the nature of the required response (Gonzalez and Waller, 1974) (ix) response "effort", e.g. force required to operate the manipulandum (Azrin, 1968, Muller, 1968; Schroeder, 1972) (x) concurrent tasks that the subject may, or must, perform (Laties and Weiss, 1962, 1963; Sanders, 1968; Frazier and Bitetto, 1969; Poppen, 1972; Gonzalez and Waller, 1974) and (xi) manipulating deprivation conditions (Spradlin et al, 1965).

Much laboratory work with human subjects from both normal and abnormal populations has been concerned with how to produce "animal-like " patterns of responding on schedules of stimulation. For example, Stoddard, Sidman and Brady (1960) found that their subjects, who were military personnel, produced "atypical" patterns of responding on fixed-interval schedules, consisting of a pause for almost the full duration of the interval followed by one or two responses to obtain the next token delivery. When a limited-hold specification (Ferster and Skinner, 1957) was added to the schedule contingency, they reported that "the records took on an appearance more like the expected one" (Sidman, 1962, p. 179).

Early studies of retardates under schedules of stimulation concerned themselves with whether it was possible to produce the "expected" patterns of responding to demonstrate effective "schedule control " over their behaviour. Spradlin et al (1965), for example, examined the behaviour of severely and profoundly retarded subjects on fixed-ratio schedules. They found that by appropriate changes of reinforcing stimulus type, or deprivation conditions, they were able to produce close approximations to the "expected" performances with all their subjects. Another example is that of Orlando (1965), who describes how it was possible to "shape the desired terminal behaviour [in sixteen retardates such that they] ... exhibited satisfactory baseline performances on mult VR 25 ext ... [but which] ... required special procedures (p. 135, not his emphases)".

Hence laboratory studies with the retarded have often been concerned with how to achieve greater "behavioural control " or "predictability" over a pre-selected response. Several of the early reports mentioned in qualitative terms how "irregularities" and variability characterised much of the schedule performance of retardates, but then set themselves the task of removing these features by manipulation of factors such as those listed previously (c.f. Spradlin et al, 1965). It seems to have been assumed that more effective behaviour control should be persued in preference to analysis of variability in the belief that most of the variability is the result of the subjects reinforcement history, which is in the large part unknown to the experimenter. To dismiss variability as the result of an uncontrollable past, however, may be as misleading as to attribute it to hypothetical (that is to say unobservable) causes such as "intellectual" factors (Orlando, 1961) or "attentional" factors (Zeaman and House, 1963).

Very few laboratory studies have provided in-depth analyses of the "irregular" schedule performances of retardates. This is quite surprising as it would appear that variability, both within and between subjects, seems to be the rule rather than the exception with retarded subjects. Other "abnormal" human populations have shown similar differences. Lindsley and Skinner, (1954), ran psychotics on variable-interval and fixed-ratio schedules and reported individual differences in overall rate per hour and in the pattern of rate changes within the hour.

One of the "irregularities" of "abnormal" human populations that has received some in-depth analysis is the unpredictable pauses that characterise such performances. Lindsley (1956) with psychotics on variable-interval schedules, and Ellis et al (1960) with retardates on fixed-ratio schedules, recorded the frequency of interresponse times greater than ten seconds. Ellis et al (1960) reported that the frequency of long interresponse times was inversely proportional to the chronological age (C.A.) and mental age (M.A.) of retarded subjects. Similarly, Lindsley (1956) claimed that the frequency and durations of pauses increased with "depth of psychosis".

However, although these two studies showed correlations between the frequency of long interresponse times and other factors they did not uncover any functional relationships between this aspect of performance and any determining variables. Woods and Pryce (1974) reported a study in which the frequency of long interresponse times was a function of the type of consequence employed with a retarded boy. Apart from these studies, however, in-depth analyses of variability in the schedule performance of retardates arenotably lacking in the existing literature.

It would appear that the time has now come when laboratory studies of the behaviour of the retarded must widen their scope by first re-examining the conceptual framework they use in formulating empirical questions. In Chapter 2 of this thesis emphasis was made of the need to examine as much of the "stream of behaviour " as possible and to search for functional relationships between behaviour and environmental stimuli. This contrasts with studies which have merely examined whether the effects of imposing stimulus operations are those that would be "expected" or "predicted". Weisburg (1970) has noted that;-

> 'The early preoccupation with the direct maniuplation of the retardates behaviour, as such, is giving way to an examination of those critical environmental events which will control his behaviour in the long run ... Increasingly, schedules of reinforcement are scrutinised less for their ability to generate a profusion of unique patterns of behaviour in the retardate and are exploited more as necessary accompaniments for the development and assessment of stimulus functions and as control procedures' (Weisburg, 1970, pp 141-142.)

By using traditional "schedules of reinforcement" for the latter purposes suggested by Weisburg (1970) above, it is possible to embark upon in-depth analyses of the stimulus functions of the scheduled events (the"reinforcers") and reveal functional classes of behaviour. Empirical questions could be formulated in terms of a comprehensive breakdown of the "behaviour stream" and should be concerned with the specification of transition among the various events in the stream, as proposed by Schoenfeld (1966). This involves far more than analysis of the rate of pre-selected, descriptive operant. The limitations of such an empirical task were examined in Chapter 2. Weisburg (1970) has further stated that;-

> 'Primary focus on a discrete measure such as the frequency of an event, often ignores or fails to uncover interesting patterns of continuous behaviours and unusual topographies not obtainable from counter readings' (Weisburg, 1970, p. 139).

There are very few studies with the retarded in which a dependant variable other than the rate of responding has served. Morris (1968) examined changes in the force of responding with three retardates. The study concluded that force emission is directly affected by contingency variables (i.e. force of responding was found to be a functional operant) whereas the response rate measure is largely controlled by indirect, extraneous factors (e.g. instructions). However, apart from the few modest attempts at analysis of interresponse time distributions (e.g. Locke and Strayer, 1970), and a study of the spatial location aspects of response topography (Gates and Fixen, 1968) measures other than response rate have not found their way into evaluations of the retardate's behaviour.

Similarly, there is a scarcity of studies in which aspects of the behaviour stream other than the descriptive operant have been examined with the retarded. This work will be reviewed at length in Chapter 5, but it is sufficient here to mention that it is an aspect of the behaviour of the retarded that was dismissed as "other than the required response" in studies which focused on achieving "schedule control".

Chapter 2 of this thesis found that the unilinear system of analysis which focused on rate of response had limitations and suggested how the framework of experimental research could be extended. The variability that characterises laboratory findings with the retarded gives an impression of disorderliness or of being uncontrolable. However, as Sidman (1960a) has pointed out, the disorder is only in our interpretation, not in the behaviour itself. Laboratory studies of the behaviour of retardates can best extend existing knowledge, not by looking for behavioural deficits or by attempting to produce the "expected" performance, but by examining in detail the relations between behaviour and its controlling variables.

Applied Studies

Sidman (1962) has observed that:-

> 'The clinical psychologist is impatient; the press of immediacy impels him to build his clinical house as best he can before an experimental foundation is available'. (Sidman, 1962, p.170).

In chapter 1, it was suggested that a situation has arisen in which the "behaviour modifier" has met the immediate demands of various areas of human behaviour pathology by developing "behaviour modification techniques" based on the unilinear operant conditioning paradigm. It could be said that the impelling nature of problems that confront the applied researcher have encouraged the growth of "techniques" and "packages" of behaviour change in order that as many of the problems can be dealt with as quickly as possible. The shortcomings and inadequacies of a "techniques" approach to applied studies was outlined, and the need for a "full functional analysis" has received cogent advocation (e.g. Kiernan, 1973).

Although the range of subject populations and target behaviours has expanded at the prolific rate in recent years (c.f. The Journal of Applied Behaviour Analysis), most studies still tend to concern themselves with demonstrating the efficacy of reinforcers or the effectiveness of stimulus control. The use of a unilinear system of analysis in which the frequency or rate of target behaviours receive sole consideration has been retained. Only very few studies have directly recorded the occurrence of alternative behaviours (reviewed in chapter 5) and examined the interaction within the total behavioural organisation of subjects.

However, despite inadequate conceptual frameworks and limitations in the way applied empirical questions have been formulated, much consideration has been given to the selection of areas to which applied behaviour analysis should address itself (Kiernan, 1973; Winett and Winkler, 1972). In Chapter 1 it was noted that "Applied research is constrained to look at variables which can be effective in improving the behaviour under study (Baer et al, 1968, p. 91)". However, as Kiernan (1973) points out;-

> '... the approach does not specify what behaviour should be changed and what environment is to be considered as a standard or optimal environment in terms of which behaviour should be modified' (Kiernan, 1973, p. 274)

Winett and Winkler (1972) have suggested that rather than contributing to effective learning, applications of behaviour modification procedures have most often neglected educational performance and have selected the reduction of "disruptive behaviour" as the criterion for education. In challenging the validity of this selection they point out that recent findings indicate that the reduction of disruptive behaviour may not necessarily lead to an increase in academic achievement (c.f. Ferritor, Buckholdt, Hamblin and Smith, 1972).

A recent study by Ayllon, Leyman and Handel (1975) is relevant to this issue and exemplifies how behaviours other than target behaviours can change in frequency even though no contingency management procedures are applied directly to them. The subjects were three "hyperactive" children (a girl aged eight and two boys aged nine and ten). Throughout the study both hyperactive activities (gross motor behaviours, disruptive noise with objects, disturbing others, orientating responses, blurting out and talking) and academic activities (mathematics and reading performance) were recorded in a classroom situation. A time-sample observational method (discussed in Chapter 7) and a multiple-baseline design (Baer et al, 1968) across the two academic subjects was used to assess the effect of token reinforcement for correct academic responses in maths, and subsequently in maths and reading. The results showed that there were considerable improvements in academic performance following the introduction of contingency management procedures. Also, however, there was a concomitant decrease in "hyperactive" behaviour from about eighty percent to about twenty percent for each child.

This finding has relevance for the "curriculum" of behaviour modification projects with the retarded. Much more analysis of the functional inter-relations amongst behaviour classes could make an important contribution to an area which at present has no clear answers to its questions of"What to teach".

Summary and Suggestions

This chapter has emphasied how the vast majority of behavioural studies with the retarded have constrained themselves by adopting a unilinear operant conditioning paradigm. The use of such a restrictive conceptual framework has not only limited the scope and formulation of empirical questioning, but has dictated the way in which such questions are answered. Staddon and Simmelhag (1971) have noted that;-

> 'The theoretical vocabulary of learning is full of terms with an uneasy conceptual status somewhere between explanation, definition and category label. This terminology which is not coherent or internally consistent, makes it difficult to approach particular topics with an open mind. It is too easy to dismiss an experimental result as due to adventitious reinforcement or respondent conditioning without in fact, having any clear understanding of what has been said' (Staddon and Simmelhag, 1971, p. 22)

An alternative framework which emphasises an in-depth analysis of the complexity of behaviour and its transition amongst stimulus elements of the behaviour stream (which was expounded in Chapter 2) offers to extend and enhance the range of behavioural studies with the retarded. In particular it places emphasis on the investigation of behaviour other than a pre-specified, descriptive operant so that the focus of study is aimed at the discovery of functional classes of behaviour. Future behavioural analyses with the retarded could benefit by considering dimensions of behaviour other than response rate and by monitoring as much of the behaviour of the subject as possible.

The next chapter will examine animal studies in which behaviour other than the descriptive operant have been directly recorded and will review the functional relationships that have been revealed. Chapter 5, will extend this literature search to human subjects and will review attempts to extend the range of behaviour analysis to include behaviours other than target behaviours.

CHAPTER 4

ANIMAL STUDIES OF "ALTERNATIVE" BEHAVIOUR

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Terminology

There have been numerous studies reported in the experimental literature in which behaviours other than the descriptive operant specified by the reinforcement contingency have been investigated. Most reports have employed descriptions, which whether intentional or not, infer functional determinants of the "other" behaviour. Some examples of the variety of labels that have been used to describe "other" behaviours included displacement activities (McFarland, 1965), instinctive behaviour (Breland and Breland 1961), respondent behaviour (Shapiro, 1960), interim activities (Staddon and Simmelhag, 1971), schedule induced behaviour (Segal 1972), adjunctive behaviour (Falk, 1971), collateral behaviour (Wilson and Keller, 1953), and mediating behaviour (Laties, Weiss, Clark and Reynolds, 1965).

More recently, however, Smith and Clark (1974, 1975) have suggested the use of the term "intercurrent" behaviour, as a shorthand, to describe behaviour which is not specified by the reinforcement contingency. "Intercurrent" is a description which is neutral with respect to the origin of such behaviour and avoids implying membership of a functional class prior to the commencement of the experiment. However, it has been suggested (Smith and Clark, 1974) that this term be restricted to use for behaviour during interresponse times under temporally spaced schedules of stimulation.

The present study will adopt the terminology proposed by Goldiamond (1975) in his alternative sets framework for behaviour analysis, i.e. in addition to a descriptive operant, the term "alternative behaviour" will be used to describe a well defined class of behaviour. This contrasts with the term "neither behaviour" which is defined by exclusion from the other well defined classes of behaviour. In addition to these, the term "other behaviour" will be used which includes both alternative behaviours and neither behaviour, i.e. other behaviour is defined by exclusion from the descriptive operant. Discussion of previous reports, however, will use the same descriptive term as the author(s) of the particular paper.

Introduction

One of the earliest reports of alternative behaviour was by Wilson and Keller (1953) who observed regular sequences of behaviour terminating in a lever press on differential reinforcement of low rate schedules of stimulation. The earliest interpretation of this occurrence (e.g. Weiss and Laties, 1964) was that the "collateral" chains of behaviour had a mediating role in ensuring that an interresponse time of sufficient duration elapsed in order to allow the next response to be reinforced. It was hypothesised that the "collateral" behaviour was adventitiously reinforced and came to provide time-correlated discriminative stimuli for the reinforced response.

The occurrence of "collateral" behaviour on differential reinforcement of low rate schedules has been reviewed at length by Kramer and Rilling (1970). More recent studies of alternative behaviour on differential reinforcement of low rate schedules (e.g. Smith and Clark, 1974) do not make the assumption that it plays a mediating role nor do they resort to post hoc invocations of adventitious reinforcement to explain its maintenance. Analyses of conditional probabilities of alternative behaviour on differential reinforcement of low rate schedules have shown it to be a simple function of the schedule parameter (Smith and Clark, 1974) and as such provides information that has no place for invoked assumptions.

Shapiro (1960) presented a study in which lever-pressing and salivation were recorded simultaneously with dogs. A two-minute fixed-interval schedule of food presentation for lever-pressing was used and the data indicated that both the rate of salivation and rate of lever-pressing were related to the temporal proximity of stimulation, and that in the period just prior to food delivery the amount of salivation varied directly with the rate of lever-pressing. These results were interpreted as showing that operant and respondent conditioning could occur simultaneously and could be inter-related. However, they also showed that the stimulus used as a "reinforcer" in an operant conditioning paradigm could also be functionally related to behaviour in ways not specified in the reinforcement contingency (whether the behaviour is said to be induced, elicited or whatever).

The study by Breland and Breland (1961) discussed in Chapter 1, also demonstrated how behaviour other than that specified in the reinforcement contingency can develop. This behaviour appeared to be a function of the "stimulus conditions" or "food-getting situation" in which the animals were placed. Several studies have now reported that alternative behaviour can reduce the frequency of stimulus delivery (e.g. Mendelson and Chillary, 1970; Gilbert, 1974a) as did Breland and Breland's (1961) "instinctive drift".

A fortuitious discovery by Falk (1961) led the way to a rapid growth in the number of experimental studies in which intercurrent behaviours were investigated. He trained rats on an ordinary fixed-interval one-minute schedule of pellet delivery using an apparatus which afforded continuously available water from a drinking tube. He observed that his rats drank excessively in these sessions and decided to give this phenomenon further investigation.

The Nature and Determinants of Adjunctive Behaviour

Schedule-induced polydipsia is a phenonomenon which has received extensive coverage in the behavioural literature in recent years (c.f. Falk, 1969; Gilbert and Keehn, 1972). When a food-deprived rat is fed small portions of food at regular intervals with water being freely available at all times, then the rat will consistently follow consumation of the food pellets with an immediate burst of drinking. Although not water deprived, in a three hour session on a variable-interval 1-minute schedule of food presentation for lever-pressing, water intake amounts up to half the body weight of the animal (Falk, 1961). If the same amount of food is delivered all at once and water intake over the following three hours is recorded, then the ratio is 10:1 (Falk 1967).

The polydipsic drinking takes at least a few sessions to develop completely, unlike elicited responses, and this acquisition is not simply due to adaptation to the feeding schedule (Reynierse and Spanier, 1968). Other species besides rats have been reported to show the phenomona including rhesus monkeys (Segal, 1969) chimpanzees (Kelleher, reported in Falk, 1971), and pigeons

(Shenab and Peterson, 1969). Furthermore polydipsia is reported both on fixed- and variable-interval schedules and on response-contingent and response-noncontingent schedules of food-delivery (Falk 1971).

Several variables have been shown to be related to the extent of water ingestion. The amount of water drunk has been found to be a bitonic function of inter-food interval both on contingent and non-contingent schedules (Falk 1966a), and also a direct function of body weight relative to free-feeding weight (Falk, 1969). In a recent study (Allen, Porter and Arazia, 1975) both duration and amount of drinking during the intervals following pellet delivery were shown to increase systematically as per cent of stimulation (on second order schedules) was lowered from one-hundred to ten.

In addition to excessive drinking, several other behaviours have been reported to show excessive aspects on temporally based schedules of stimulation compared with extinction (baseline) conditions. These include tail nibbling (Laties et al, 1965) pecking attacks (Gentry, 1968) biting (Hutchinson, Azrin and Hunt, 1968)preening (Lyon and Turner,1972) air-licking (Mendelson and Chillag, 1970) and pica (Villarreal, 1967). Falk (1966a, 1967, 1971) suggested that:-

> 'When certain schedules induce extra, concurrent phenomena which are strong enough to sustain scheduled behaviour in their own right, that these phenomena be

called adjunctive behaviours' (Falk, 1971, p.578).

and further that;-

> 'Adjunctive behaviour is behaviour maintained at high probability by stimuli whose reinforcing properties in the situation are derived primarily as a function of schedule parameters governing the availability of another class of reinforcers' (Falk, 1971, p. 586).

As adequate reviews of the nature and determinants of adjunctive behaviour already exist (Falk, 1971; Staddon, 1976) they will not be replicated here. The following is a brief summary of the essential characteristics of schedule-induced adjunctive behaviours.:-

(i) Whenever reinforcing stimuli are delivered to a deprived animal in small portions and within a certain range of delivery rates, the animal is likely to engage in excessive behaviour (relative to extinction conditions) that is not obviously related to the reinforcer.

(ii) The type of excessive behaviour that occurs depends on the particular environmental circumstances which exist. For example, rhesus monkeys show a high level of polydipsia when access to water is made available (Schuster and Woods, 1966) and schedule induced pica when shavings are made available (Villerreal, 1967).

(iii) Response contingency is not crucial to the generation of adjunctive behaviours (Falk, 1969; Flory, 1969; Mendelson and Chilag, 1970). The major schedule determinant appears to be that of inter- "reinforcer" interval, independant of whether the "reinforcers" are response-contingent or not.

(iv) Adjunctive behaviour typically occurs in the immediate post-reinforcement period (Falk, 1971). A variety of adjunctive behaviours occurring in various species and on a range of stimulus schedules have been shown to occur predominantly at this temporal point (Azrin, 1966; Falk, 1961; Hutchinson et al, 1968; Gentry, 1968).

The temporal loci of adjunctive behaviours have been invoked in various "explanations" of the phenomenon. Stein (1964) implicated the stimuli associated with food ingestion to be involved in post-prandial drinking, but recent demonstrations that excessive drinking can occur at times other than in the immediate post-stimulus period have rendered such accounts as inadequate. Flory and O'Boyle (1972) and Gilbert (1974 a,b,c) have confirmed that schedule-induced polydipsix by rats is a post-prandial phenomenon only when post-prandial drinking is possible. Falk (1969) has further shown that the polydipsia is not the result of adventitious food reinforcement of water intake, nor is it a mediational function, nor is drinking an unconditional response to eating.

Gilbert (1974a) suggested that the temporal loci of adjunctive behaviour could be related to another factor:-

> 'The frequent occurrence of adjunctive behaviour only at the beginning of the interval may also depend upon local satiation factors that inhibit drinking after a certain amount has been consumed. When water is available throughout the interval, such satiation would effectively limit drinking to the first portion of the interval ' (Gilbert, 1974 a p. 283)

Recent studies using second order schedules of stimulation have further examined the temporal loci of adjunctive behaviour. Rosenblith (1970) reported that two types of drinking developed on a second-order schedule of food presentation.:-

> 'A high-rate drinking occuring after delivery of a pellet and a drinking frequently interrupted for bar pressing after intervals terminated by a light flash and a click alone' (Rosenblith, 1970 p.144)

However, conflicting results concerning the occurrence of adjunctive drinking on second-order schedules have emerged (Falk and Bryant, reported in Falk, 1971; Allen et al, 1975; Porter and Kenshalo, 1974). It appears that post-stimulus drinking on second-order schedules could be a function of the type of brief stimulus used to denote the completion of a component, and the location of the drinking tube (Allen et al, 1975; Wuttke and Innis, 1972).

Research with alternative behaviours has largely been persued along four lines of investigation. These are:- (a) the excessive nature of "adjunctive" behaviour and its implications for extrapolation (b) inductive aspects of "adjunctive" behaviour and parallels with "displacement activities", (c) whether "adjunctive"behaviour can be considered as adaptive or toxic, and (d) the temporal and sequential analysis of alternative behaviour. As the latter aspect is of major relevance to this thesis the next section of this chapter will be devoted to it. The first three lines of investigation are briefly outlined in the remainder of this section.

(a) The excessive nature of "adjunctive behaviour".

Falk (1971) commented that;-

> It is absurd for an animal to drink itself into a dilutional hyponatremia bordering on water intoxication' (Falk, 1971, p. 577)

Emphasis on the excessive aspects of adjunctive behaviour grew out of demonstrations that schedule induced polydipsia was not just post-prandial drinking. Other aspects of the phenomenon showed remarkable differences to findings with "operant" behaviour. For example, polydipsic drinking is difficult to satiate compared to "deprivation-induced" drinking. Furthermore, solutions which will not function as effective reinforcers for operant behaviour can be substituted for water in studies of adjunctive behaviour. Relatively large quantities of highly hypertonic sodium chloride are ingested adjunctively. (Falk, 1964; 1966 b). These findings led investigators such as Gilbert (1974a) to propose that;-

> 'The ability of a reinforcement schedule for one behaviour to induce another behaviour at any time extends the utility of this mechanism as an account of "natural" behaviours that have no apparent cause. Excessive eating and excessive drinking of alchohol solutions are such behaviours' (Gilbert, 1974a, p. 283)

Other "natural" excessive behaviour such as drug-taking and smoking could also be added to his list. As a result of this possibility, the number of studies in which the stimuli made available for the development of adjunctive behaviour have been drugs has increased. Lester (1961) reported on schedule-induced ethanol intoxication and other studies have included investigations of schedule-induced excessive intakes of solutions of barbiturates

(Meisch, 1969; Kodluboy and Thompson 1971) morphine (Thompson Bigelow and Pickens, 1971) and caffeine (Gilbert, 1975).

Gilbert (1974a) proposed the following "explanation" of adjunctive behaviour;-

> 'Spaced feeding of small portions of food within a certain range of mean intervals constitutes a "drive operation" of the kind defined by Catania (1968); i.e. certain stimuli are made more affective as reinforcers' (Gilbert, 1974a, p. 283)

Although still in its infancy, Gilbert (1975) speculates that the study of socially disapproved human excesses such as obesity, alcholism and drug-taking might be extended by adding the model provided by the above "explanation". Previous behavioural analyses of such behaviours have been constrained by the adoption of the unilinear respondent/operant conditioning paradigms (e.g. Stuart & Davis, 1970) outlined in Chapter 2.

(b) Inductive aspects of adjunctive behaviours.

Because of the temporal proximity to "reinforcer" termination, one line of investigation has compared adjunctive behaviour with the concept of "displacement activities" used by ethologists. "Displacement activities" are characterised as being irrelevant, incongruous, or out-of-context and have been defined recently by McFarland (1965) as;-

> 'activities which belong to motivational and functional systems other than that predominantly activated at the time of observation' (McFarland, 1965, p. 293).

Tinbergen (1952) and Tingergen and Van Iersel (1947) have observed that displacement activities occur when 'an external stimulus after having activated a "drive", suddenly stops (Tinbergen, (1952)'. The emphasis is on the dynamic change in the situation. An example of a "displacement activity" given by Tinbergen (1952) is how agressive behaviour in the cormorant changes suddenly to a sexual displacement activity when the opponent flees.

The similarity of adjunctive behaviour to "displacement activities" has been put forward in recent years by those who have been concerned with the provenance of behaviour (Falk, 1971; Staddon and Simmelhag, 1971; Segal, 1972). In particular they have noticed the importance of the stimuli available in the environment . For example, Segal (1972) notes that a male rat subjected to periodic brief shocks will, after receiving a number of spaced shocks, respond to subsequent shocks by promptly mounting and copulating with an available receptive female (Barfield and Sachs, 1968; Cagguila and Eibergen, 1969). If instead of a receptive female, food is made available, periodic shocks will induce an increase in the rate of eating (Ullman, 1951). Similarly, ethological investigations with the Zebra finch have shown that, when threatened, it will feed if food is nearby, sexually mount a female if one is present, or if neither food nor a female is available, will preen or assume a sleeping posture (Morris, 1954; Rowell, 1961).

Research which has addressed itself to this line of study has mainly concerned itself with the "survival value" of adjunctive behaviours and displacement activities and as such is not of immediate relevance to the present study.

(c) Can "adjunctive" behaviour be considered as adjustive or toxic .

This is not a line of investigation, but rather a question of the form of interpretation of adjunctive behaviours. Interpretations of adjunctive behaviour excesses, such as polydipsia, in terms of behavioural toxicity have been placed in the category of explanation known as "normal sources of pathological behaviour (Sidman, 1960b)."

> 'According to this notion, adjunctive behaviour is the manifestation of a maladaptive response to an unfavourable environmental situation similar to the stereotyped responses shown by institutionalised retardates and caged animals' (Falk, 1971, p. 586).

Other interpretations of adjunctive behaviour, such as that outlined in (b) see it as being an "adaptive process" determined by "principles of behavioural variation" (Staddon and Simmelhag 1971). However, all "interpretations" of adjunctive behaviour seem to be based on an evaluation, rather than an analysis of behaviour. Furthermore;-

> 'The question of whether adjunctive behaviour is a toxic manifestation or a creative deviation cannot be answered by a description of the topography of the response ... Ajunctive behaviour may be toxic and intrude upon possible adaptive responses in one environment or have adjustive or creative results in an environment with more prosthetic possibilities '(Falk, 1971 p. 586).

Temporal and Sequential Analyses of Alternative Behaviour.

Most studies of "adjunctive" behaviour have examined one such behaviour at a time and have reported that it nearly always occurs in the immediate post-stimulus period. However, a few exceptions have appeared. Mendelson and Chilag (1970) reported that although schedule-induced air-licking is initiated shortly after pellet delivery, it often continues throughout the entire interval. Knutson (1970) and Lyon and Turner (1972) have noted that with pigeons on larger fixed-ratio values, attacks sometimes interrupt the ratio run. Similarly, Falk (1971) and Segal, Oden and Deadwyler (1965) observed that on fixed-interval or fixed-time schedules of three minutes or more, drinking is sometimes distributed throughout the interval in a series of shorter bursts, rather than the typical sustained burst.

Villareal (reported in Falk, 1971) noted that when both water and shavings are available for rhesus monkeys on fixed-time schedules, some animals engage in drinking preferentially while others time-share between the two activities. Segal (1969) showed that if both water and a running-wheel are made available during a time-based schedule of food delivery, then the rats will run after drinking. Lyon and Turner (1972) examined the occurrence of adjunctive attack and preening on fixed-ratio schedules with pigeons. Although they reported that both behaviours were a function of the ratio size and occurred predominantly in the immediate post-stimulus periods, they do not say whether the two behaviours ever occurred in a single inter-stimulus interval, and if so, in which order they occurred.

In a series of studies with rats and pigeons under various contingent and non-contingent schedules of stimulation, Staddon has recorded a wide range of alternative behaviours for which the opportunities to engage in are simultaneously available (Staddon and Simmelhag, 1971; Staddon, 1972b, 1976; Staddon and Ayres, 1976). This work has made use of automatic recording devices plus actual observations of behaviour. In general, the definitions of behaviours and location of the apparatus have ensured that only one activity is possible at a time. His data is the first to give detailed reports on both sequences and temporal patterns of alternative behaviour.

In studies with pigeons, Simmelhag (1968), Staddon and Simmelhag (1971) and Staddon (1972b) used a standard operant conditioning chamber, and the behaviour of the birds was recorded by an observer, who pushed buttons connected to an event recorder. Buttons were kept continuously depressed to signal the duration of continuous activities, but briefly depressed to signal each occurrence of discrete activities such as pecking. With the exception of an orientation response, "facing the magazine wall", all the activities defined were mutually exclusive. Sixteen alternative behaviours were defined and recorded this way. A variety of time-based schedules of food delivery were used, the main one being fixed-time 12-seconds. All the birds soon developed stereotyped patterns of behaviour under the fixed-time procedure with a characteristic activity occupying each region of the post-food time. Graphs were presented showing the relative frequency with which each behaviour occurred during each second of the post-food time.

Staddon and Simmelhag (1971) proposed that their data revealed two classes of behaviour. One of these was the <u>terminal response</u> which was the last behaviour in the sequence of activities that occurred within each interval, and the other was the <u>interim activities</u>, which were the activities that occurred early in the intervals. They describe the terminal response as a discriminated operant and report that the most common terminal response for all birds was "pecking the magazine wall" in the fixed-time experiments and "pecking the key" in the response-contingent fixed-interval experiments. The interim activities were more variable from bird to bird and included such activities as "turning quarter circles", "wingflapping" and "pacing back and forth along the magazine wall". Similarities were noted between interim activities and adjunctive behaviours, and it was speculated that if appropriate stimuli had been provided, sterotyped adjunctive behaviour would have taken the place of the more variable and relatively undirected interim activities.

Sequential analysis of the behaviour shown in the inter-food interval under the fixed-time schedule was made in such a way that no account was taken of the bout lengths of behaviour. In this way they examined variability of succession only. The analysis revealed (a) that although a given behaviour might fail to occur during a particular interval, it rarely occurred out of sequence

(b) that the variability of sequences was greatest early in the interval, and least at the end, in the period just preceding food delivery, and (c) that each animal showed a relatively small number of different sequences, typically three or four.

Staddon and Ayres (1976) reported data on both sequences and temporal patterns of behaviour with rats. They examined (i) the development and maintenance of alternative behaviours on a fixed-time 30-seconds schedule of food delivery, (ii) changes in the behaviour resulting from the introduction of an extinction condition, and (iii) the effects of removing opportunities to engage in activities. Their apparatus was hexagon shaped and consisted of sectioned-off areas in which different activities were possible, such as feeding, drinking, running in a wheel, observing another rat through a window, and entering a dark tunnel. A total of nine different behaviours were recorded throughout the study with five rats.

At first a variety of activities occurred, but drinking and wheel-running were at relatively low levels. Later on, both drinking in the early and middle parts of the interval and anticipating food (i.e. waiting in the feeder area) towards the end of the interval increased in frequency. After about twenty to thirty days, steady state patterns developed in all animals.

The date was interpreted as showing terminal responses and interim activities, similar to the pigeon studies. All the rats showed gnawing and digging at the feeder as terminal responses which were said to be "food-related" behaviours similar to the pecking reported by Staddon and Simmelhag (1971) with pigeons, and the "inappropriate" but "reinforcer-related" behaviours reported by Breland and Breland (1961).

The modal pattern after eating was, first drinking, followed by running in the wheel in the middle of the interval (sometimes other activities such as being in the tunnel and looking at the other rat occurred at this point), and anticipating the pellet occurred at the end of the interval. However, the overall temporal pattern was associated with different sequential patterns in different individuals. Most rats showed considerable alternation between pairs of activities, e.g. between drinking and being in the tunnel. In general the rats showed more variable sequences than pigeons (Staddon, 1972b) but it was pointed out that there were considerable differences in apparatus and schedule between the two studies.

There was considerable variability from interval to interval for all rats. For example, one rat either ran or drank in a given interval, but rarely both. Nevertheless, the temporal location of running and drinking was such that it produced an overall time graph looking much like the graphs for the other animals. Staddon (1976) maintains that this dismisses any "adventitious chain", explanation of the temporal pattern (c.f. Clark, 1962; Segal, 1965)

Several investigators (e.g. Cane, 1959, 1961; Nelson, 1974; Delius, 1969) have suggested that many behaviour sequences could be Markov chains. The essential feature of a simple Markov chain is that each activity is dependent only on the preceeding one. However, in both the rat and pigeon studies (Staddon, 1972b; Staddon and Ayres, 1976) analysis revealed that behaviour seemed to be more directly related to the time elapsed since the last eating episode than the previous behaviour.

Staddon (Staddon and Ayres, 1976; Staddon, 1976) claims that two main factors seem to determine the temporal distribution of behaviour within the inter-food interval; (a) post-food time, and (b) the "momentum"of ongoing activities. As evidence for assertion (a) he gives the finding of a negative correlation between bout length (i.e. the duration of an episode of a particular behaviour) and starting time of most activities, i.e. the later an activity began the sooner it ended.

By "momentum" Staddon (1976) means that, once begun, a given activity tended to persist for a "preferred" duration. Distributions of activity-bout lengths generally showed a peak, suggesting that the overall temporal pattern may have been partly determined by time since the beginning of a bout. Differences among the temporal distributions of individual rats appeared to be due largely to differences in the second factor.

For one rat in particular the "momentum" of running in the wheel was such that it frequently "over-ran" the delivery of the pellet such that the obtained distribution of inter-eating intervals was closer to a variable- than a fixed-time schedule. For all rats, whenever an activity "ran-through" pellet delivery it was invariably running in the wheel.

Most rats showed some long "momentum effects" (i.e. activities that tended to occur for a particularly long duration) with both wheel-running and drinking. Staddon (1976) reported that in unpublished observations he has noticed that some rats emit extremely long bouts of drinking. Segal (1969b) reported that one rat drank through the entire inter-food interval on a fixed-time schedule and that eventually the drinking pattern took on the appearance of "an operant behaviour" (i.e. a terminal response.

Staddon (1976) reported similar findings with the "wing-flapping" of pigeons. Some birds produced lengthy bouts of this behaviour such that it persisted even when food was made available during a bout. Indeed, pigeons sometimes repeatedly missed food deliveries in this way.

When the fixed-time 30-seconds schedule was changed to extinction (baseline) conditions drinking ceased abruptly and running increased progressively in the first session. After a few sessions in extinction a steady state developed in which a relatively high proportion of time was spent wheel-running. Each animal showed an increase in the mean bout duration of wheel-running compared with the fixed-time 30-seconds sessions, but the mode bout duration did not shift to longer values; rather the distributions took on a more exponential form.

Because of the increase in wheel-running in extinction, Staddon (Staddon and Ayres, 1976; Staddon, 1976) suggested that running is not a schedule-induced interim activity, but an "other" activity which "fits in" at times when the more dominant drinking and food anticipation are weak. In this way he postulates yet another sub-category of alternative behaviours, "other" behaviours* which are behaviours that in baseline (extinction) conditions usually occur with a high frequency. When a fixed-time schedule of stimulation is introduced "other" behaviours may decrease in frequency (as wheel-running does) in marked contrast to the relative increases of terminal responses and interim activities. To support this assertion, Staddon (1976) notes that when Skinner and Morse (1958) made wheel-running the "contingent" response on a fixed-interval schedule of food presentation, they obtained more orderly bouts of running, but the overall frequency was lower.

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*Staddon's (1976) use of the term "other" behaviour differs from that used in the present study. See page

In a final experiment, Staddon and Ayres (1976) showed that elimination of the opportunity to engage in one or more activities resulted in increases in other alternative behaviours but the increases were not in simple proportion to their frequency under baseline conditions.

Summary

Initial attempts by animal experimenters to examine more of the behaviour stream than a pre-selected "operant" have examined a variety of alternative behaviours that are produced under various schedules of stimulation. In particular they have been concerned with the questions of what alternative activities occur, where (in relation to time and stimuli) they occur, and how much they occur. Most studies have selected one such alternative behaviour to examine, but more recently Staddon (1976) has shown that a more extensive analysis is achieved by considering as many alternative behaviours as possible in a situation. This he maintains, is a necessary progression because:-

> 'It is obvious that the function for one activity must depend to some degree on the functions for others that can also occur' (Staddon, 1976).

Several studies (e.g. Falk, 1969; Keehn and Colotla, 1971) have shown suppression of schedule induced drinking by competing behaviour.

As the aim of such investigations is to discover, rather than demonstrate, functional relationships, it is necessary to employ multiple measures —— rates, bout lengths and total time spent —— in an attempt to cover all the possibilities. It is possible that the methodology of ethology can contribute to an experimental analysis of behaviour in this respect (examined in Chapter 5).

The importance of placing emphasis on the discovery of functional relationships was illustrated in recent study of "intercurrent" behaviour by Smith and Clark (1975). They examined the effects of d-amphetamine, chlorpromazine and chlordiazepoxide on the rates of lever-pressing, wheel-turning and licking on differential reinforcement of low rate schedules of food presentation. Drug effects on lever-pressing were found to be systematically related to dose and were consistent for all animals. However, drug effects on the intercurrent behaviours were generally different for each animal. In effect, they had demonstrated that the topographically similar intercurrent behaviours can fall into functionally different classes for different animals. They concluded that:-

> '... the analysis should no longer emphasise a priori conceptual differences between procedurally designated intercurrent and reinforced responses. Rather, the analysis should maintain a descriptive bias and seek to identify those conditions that engender a behaviour' (Smith and Clark, 1975, p. 247)

This quote mirrors the approach to the experimental analysis of behaviour propounded in Chapters 2 and 3 of this thesis, i.e. the previous emphasis on descriptive operant (and alternative) behaviour classes should be replaced with a search for functional operant (and alternative) behaviour classes.

CHAPTER 5

STUDIES OF ALTERNATIVE BEHAVIOURS WITH THE RETARDED

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Alternative Behaviours in Operant Procedures

In this section it is hoped to provide a comprehensive review of laboratory studies using an operant conditioning paradigm with the retarded, in which behaviours other than the descriptive operants have been investigated. A few relevant studies with normal children and psychotic adults as subjects will be included.

Lovaas, Freitag, Gold and Kassorla (1965a) recorded the frequency and duration of self-destructive behaviour with a nine-year old schizophrenic girl. First they recorded for thirty, daily, ten-minute sessions when five-seconds of pleasant talk from an adult, who was sitting opposite her at a table, was made contingent on bar-pressing onacontinuous reinforcement schedule. This was followed by seven sessions of extinction in which the adult totally ignored the subject (by looking down at her lap and not conversing), and then a further four sessions in which the continuous reinforcement contingency was reintroduced. Self-destructive behaviour was recorded simultaneously by an observer and was shown to be higher in frequency in the extinction sessions than in the reinforcement-contingent sessions. Rate of bar-pressing initially increased in the first extinction session but gradually decreased to zero by the final extinction session. When the reinforcement contingency was reintroduced, the previous rate of bar-pressing was recovered.

Lovaas has focused much of his recent work with autistic children on the occurrence of alternative self-stimulatory behaviour on various "learning tasks" following an observation in one of his early studies (Lovaas, Freitag, Kinder, Rubenstein, Schaeffer and Simmons, 1966) in which autistic children could obtain food, or avoid shock, by walking across a room within five-seconds of a signal. He noticed that when a child was halfway across the room, he would often stop and emit self-stimulatory behaviour and in this way would repeatedly miss the opportunity to eat, despite extensive food deprivation, or would receive shock.

Lovaas, Litrownik and Mann (1971) trained three groups of children (mute autistics, autistics with echolalic speech and normals) to approach a dispenser for "candy reinforcement" at the sound of a tone. The dependant variable was the time interval between onset of the tone and reaching the dispenser ("response latency"). They found that amount of self-stimulatory behaviour in this situation varied with the amount of pre-session feeding with candy. They also "obtained some control over the response latencies by experimentally manipulating the amount of self-stimulatory behaviour (p.39)".

In this study, Lovaas intended to demonstrate that autistic children were "less responsive to external stimulation while they were engaged in self-stimulatory behaviour " by including an experiment in which half the stimulus tones were sounded within a bout of self-stimulatory behaviour and the other half sounded when the child was not engaged in this activity. However, with the mute autistic group, this hypothesis was not supported. The results revealed a wide scatter of latencies in the "self-stimulatory initiated" trials, some being extremely short latencies. This led them to conclude that:-

> '... the large amount of variability in response latencies of the mutes during self-stimulation may suggest that we have a poor understanding of self-stimulatory behaviour, that certain of these behaviours are associated with lowered responsivity while others are not. Berkson (1967) has made similar precautions against arbitrary groupings of self-stimulatory behaviour, and suggested different sub-classifications' (Lovaas, Litrownik and Mann, 1971 p. 48).

Another way of stating this conclusion would be that all self-stimulatory behaviours were not in the same functional class for the Mute autistic group. This result further emphasises that arbitrarily defined "descriptive" sub-classes of behaviour are not necessarily equivalent with "functional" sub-classes of behaviour (Skinner, 1938, 1957).

Two of Lovaas' co-workers, Koegel and Covert (1972) reported a study in which they focused on a functional analysis of self-stimulatory behaviour whilst acquisition of a discriminative behaviour was being investigated with autistic children. One of their experiments examined the changes in frequency of self-stimulatory behaviour with a seven-year old autistic child using an ABA experimental design. Ten minute sessions were used throughout the study. The child sat at a consol on which were mounted a response-lever, a stimulus light, and a speaker. In the discrimination-learning sessions (condition B) a discriminative stimulus (S^D) consisting of a bright red light and white noise was present for ten seconds. The absence of these stimuli was designated as S^{Δ} . Lever pressing in S^D resulted in (a) termination of S^D and (b) delivery of one candy. S^{Δ} intervals were between five and fifteen seconds duration (average of ten seconds) but only termination of S^{Δ} was time contingent. Bar presses in S^{Δ} were not reinforced. A "correct trail" was defined as a lever press in S^D and no lever press during the following S^{Δ} interval. In the baseline sessions (condition A) the subject was seated in the experimental room with all equipment present but no training trails were presented.

Self-stimulatory behaviours, (hair twirling, rhythmic finger manipulations, hand or arm flapping, repetitive vocalisations, and gazing at the house-light) were recorded by an observer pressing an event button. A large reduction in the frequency of self-stimulatory behaviour occurred in the first discrimination training session which continued to decrease through the six training sessions. This decrease was accompanied with a concurrent increase in the frequency of "correct trials" which they report, revealed an 'almost perfect inverse relationship between the occurrence of self-stimulation and correct responding (p. 387)'. When baseline sessions were reintroduced the frequency of self-stimulatory behaviour returned to a high level.

Hollis (1968) automatically recorded the rocking movements and ball-pulling of a fifteen year-old severely retarded female (Mental age approximately four years). In daily, fifty-minute sessions two experimental conditions were alternated; (a) candy and Kool-Aid were used alternatively, on a fixed-ratio 100 schedule, as the consequence for ball-pulling and (b) extinction in which there was no consequence for ball-pulling. Under the fixed-ratio condition ball-pulling occured at a high rate and rocking was almost zero. In the extinction condition however, ball-pulling ceased and rocking occurred at a high rate. Administration of chlorpromazine produced no effect on the two behaviours in the fixed-ratio condition, but totally supressed rocking in the extinction periods. In a further study, Hollis (Hollis and St. Omer, 1972) presented similar data with a thirteen year-old severely retarded female (Mental age approximately five years) in which the only difference from the Hollis (1968) study was that a high rate of ball-pulling accompanied rocking in the drug-free extinction condition, and both behaviours were only partially suppressed by administration of chlorpromazine in extinction periods.

Bailey and Meyerson (1970) trained a seven-year old, crib-bound, profoundly retarded boy to press a leather-padded oval lever, attached to his crib, by following each response with vibratory stimulation produced by an industrial vibrator mounted to the springs of the crib. After training, three conditions were varied in ten-minute periods during seven sessions lasting thirty to sixty minutes. The conditions were (a) six-seconds of vibration on a continuous reinforcement schedule contingent upon lever-pressing (b) free continuous vibration for ten-minutes on a non-contingent basis and (c) extinction in which vibration was not available. In addition to lever-pressing, which was recorded automatically, self-injurous behaviour was recorded by an observer using a hand held microswitch. Results showed that rate of lever-pressing was highest in the reponse-contingent periods, and lowest in the non-contingent vibration periods. Frequency of self-injurous behaviour was consistently highest in the extinction periods and lowest in the non-contingent stimulation periods.

Baumeister and Forehand (1971) recorded the stereotyped body-rocking of severely retarded males by visual observation through a one-way screen during forty-minute daily sessions. Five baseline sessions were run from which eight subjects (mean chronological age of twenty-three) were selected on the basis of their high rates of rocking. A response-lever and reinforcement dispenser were then introduced and for the next four sessions a contingent stimulus was delivered on a fixed-ratio 2 schedule for lever pressing. The authors neglected to mention what the stimulus used as a consequence was, but from the description of their apparatus, it could have been tokens, or an edible. In four sessions which followed, fifteen stimuli were delivered on the fixed-ratio 2 schedule, and then an extinction condition was introduced for the rest of the session in which stimuli were no longer available for lever-pressing. Six of the subjects met the "criteria for extinction" set by the experimenters (three responses or less during a four minute interval) in the final four sessions (only these six subjects were reported on for these sessions). All subjects produced body-rocking rates of almost zero in the fixed-ratio sessions, and the six "successful" subjects showed their highest rates of body-rocking in the first four-minute intervals after the extinction criteria had been met.

It is interesting that all studies with retarded subjects which have examined behaviours other than the descriptive operant, have chosen self-stimulatory or self-injurous behaviours to monitor. A finding common to all of them has been that higher rates of the alternative, self-directed behaviours are found in extinction conditions relative to response-contingent stimulus conditions. In this respect it could be speculated that they fall in the same functional class. As yet other types of alternative behaviour have not been reported in studies with retarded subjects.

Bijou (1958) examined the lever-pressing of normal children under fixed-interval schedules of "candy reinforcement" and extinction conditions. Two standard toys were made available for play at any time. He reports that the variety and frequency of alternative behaviours increased in the extinction condition, but provides no details of the occurrence of alternative behaviours whilst the fixed-interval contingency was in effect.

Stoddard (1962) studied the lever-pressing of normal children under differential reinforcement of low rate and then variabile-interval schedules using candy as the response-contingent stimulus. The variable-interval schèdule was devised so that comparable frequencies of stimulus delivery with the differential reinforcement of low rate sessions were produced. He offers as data the "subjective observations" of "collateral" behaviour and the subjects' verbal reports. Admitting the inadequacy of this data, Stoddard reports that when the schedule was changed from differential reinforcement of low rate to variable-interval "most subjects behaved generally as they did during differential reinforcement of low rate (p.94)" However, the frequency of rising from the chair increased in frequency and duration for some children, and there were some who "stopped counting" after a few sessions on the variable-interval schedule.

Etzel and Gewirtz (1967) studied the behaviour of two normal infants using an apparatus in which the subjects sat in a plastic baby seat facing a panel with a rectangular opening, on the other side of which sat an experimenter. The experimenter was able to record the frequency of four behaviours: - cry, fuss, frown and smile. For the six-week old infant the "smile" category also included "eye-contact" with the experimenter. An ABA experimental design was employed incorporating three blocks (Two A's and one B) of three, daily, fifteen-minute sessions. The A condition was extinction and the B condition was presentation of "social reinforcement" contingent upon smiling (i.e. "smiling" was the descriptive operant). "Social reinforcement" consisted of the experimenter's "Good boy" whilst nodding her head up and down twice, followed by a two-second full smile. When the response-contingent stimulation was introduced, the frequency of smiling increased and the frequency of the alternative behaviours decreased to zero. Reintroduction of the extinction condition produced an initial increase, followed by a rapid decrease in the frequency of smiling. Crying remained at a zero rate on the return to baseline, but frowns and fusses increased in frequency.

In a series of studies, Lindsley (1956, 1959, 1960, 1962a, 1963) has examined the behaviour of psychotic patients in an experimental room in which pulling a plunger could result in various stimuli (e.g. food, candy, money, projected slide images, bursts of music) delivered according to various schedules. Lindsley (1959, 1962a , 1963) has reported on the occurrence of alternative behaviours whilst plunger-pulling was being examined. The alternative behaviours he has examined have mainly been "symptomatic" behaviours because these, he reports, are the behaviours that are most frequently produced when plunger-pulling is not occurring. Considerable variability between subjects was found in the nature of these alternative behaviours, and Lindsley (1960) has observed that they are mainly the repetitive behaviours produced by the particular patients on the ward;-

> 'For example, the pacer paced, the hallicinator berated the empty room, the destructive patient tore his clothing, the complusive patient made patterns out of his candies on the floor, the depressed patient just sat, etc (Lindsley Skinner and Solomon, unpublished report).

Lindsley's work in various areas of behavioural research has emphasised the direct and automatic recording of behaviour (Lindsley, 1957, 1962b, 1962c; Lindsley, Hobika and Eston, 1961). It is not surprising, therefore, that his work involving alternative "symptomatic" behaviours has mainly emphasised the direct measurement of such behaviours by automatic devices.

In particular he has reported (Lindsley, 1959, 1962a 1963) on the use of a filtered voice key for recording the frequency of grammatical stresses ("vocal hallucinary responses") and a device consisting of pressure sensitive mats which record a patient's pattern of movement about the room. Unfortunately Lindsley has not reported the occurrence of alternative behaviour in a systematic study comparable with those of Staddon's (Staddon, 1976) for animal subjects. Hence, only portions of this work that are relevant to the present literature search can be extracted from his otherwise detailed reports.

Lindsley did not examine the occurrence of plunger-pulling or alternative behaviours when both are simultaneously in extinction. This shortcoming limits the analysis of relationships between alternative behaviours and schedules of stimulation. However, although both "vocal hallicinatory responses" and pacing are both compatible with plunger-pulling, there is some evidence to suggest that the two alternative behaviours are functionally different. Lindsley (1962a, 1963) reports that only rarely did vocal responses and plunger-pulling occur simultaneously with psychotic patients. The reverse proved to be the case for pacing responses, however, with pacing occuring at its highest frequency at the same moments that the manual responses were occurring at their highest frequencies. Similarly, Lindsley (1960) reported that singing and whistling does not compete with, but rather seems to "pace" along with, the plunger-pulling responses.

In a detailed study of alternative vocal responses, Lindsley (1963) noted that two "hallucinatory patients" showed a gradual increase in the number of vocal responses per hour the more times they were in the experimental rooms.Also in this report, normal subjects were studied under the same "programmed" conditions (money was delivered under variable-interval schedules for plunger pulling), but were administered drugs to induce vocal hallucinatory responses. Unlike the psychotic patients, however, the drug-induced vocal hallucinatory responding in normals did not compete with the schedule specified manual responding. This result indicates that the topographically similar (descriptive) alternative vocal behaviour was in fact functionally different for the two populations.

Another example of the "unusual"functional relationship of a psychotic's vocal hallucinary behaviour with scheduled stimulation was provided by Lindsley (1959). For this patient the "never-reinforced" vocal hallucinary responses occured at a rate of five-hundred grammatical stresses per hour, while he operated the plunger at one hundred pulls per hour on fixed-ratio 20 for candy and cigarette deliveries. Similar rates had been produced for over one-hundred and thirty daily, hour-long sessions. When the contingency was switched from plunger-pulling to the vocal responses, the plunger-pulling decreased from one hundred to ten pulls per hour over one hundred and seventy hours. However, the "reinforced" vocal responses also decreased from five-hundred to ten grammatical stresses per hour. When the contingency was switched back to plunger-pulling, the rate of plunger-pulling increased from ten to fifty pulls per hour, over one hundred and ten hours, and the now "extinguished" vocal symptoms increased from ten to six-hundred grammatical stresses per hour. The grammatical stresses of normal subjects in this situation increased when "positively reinforced" and decreased when the contingency was shifted. This finding again reveals how a "defined" class of behaviour can be "functionally" different in different populations.

Lindsley (1959) did not include a condition with the stimulus contingency not in operation for both plunger-pulling and vocal responses. Had he done so, it would have revealed more about the relationship between the schedule of stimulation and the behavioural outcome. Lindsley's (1959, 1963) account of these "unusual" and "unexpected" results included the following;-

> '... the "negative" effect of positive reinforcement on vocal psychotic symptoms appears to be due to their symptomatic nature. The rate of vocal symptoms was probably increased by induction from the positively reinforced non-symptomatic behaviour and decreased by the distracting effect of the "reinforcing" stimuli' (Lindsley, 1959, p. 269).
>
> 'The results of this experiment suggest that vocal psychotic symptoms are under some form of internal control that resists direct differential reinforcement ... Vocal symptoms appear to have ... independence from their environmental consequences or direct reinforcement' (Lindsley, 1963, p.296).

It would appear that the failure of a unilinear operant conditioning framework to account for his findings has led Lindsley to go "inside the organism" for explanations. The last sentence in the above quote seems most surprising, since Lindsley's results showed that the frequency of the psychotic's vocal stresses were related to the experimental manipulations. That the obtained functional relationship was not the expected one is not the same as the "symptomatic" verbal behaviours having "independence from their environmental consequences".

Kachanoff, Leveille, McLelland and Wagner (1973), in brief communication, reported what they called a demonstration of schedule-induced behaviour in humans. Two female and five male schizophrenics from a token economy ward (chronological ages eighteen to forty-one) took part in thirty-minute sessions in an experimental chamber in which tokens were used as consequences for pulling a cord. A drinking fountain was located in the experimental room, and subjects had free access to drinking at all times. Three behaviours were measured; cord-pulling, drinking (recorded automatically), and "pacing" (recorded by a technician who pressed an event button when he observed the behaviour taking place through a one-way screen). Baseline sessions (extinction) were followed by fixed-interval sessions at different intervals, and finally a series of extinction sessions were reintroduced. The authors claim that all subjects produced "schedule-induced behaviours";-

> 'The schedule induced behaviour appeared to be schedule dependent with frequent verbalisation, jumping, pacing, drinking and self-directed activities, such as grooming occurring during the session' (Kachanoff et al, 1973, p. 397).

Five of the patients were reported to have shown "schedule-induced pacing" (number of paces and time spent pacing were higher in the fixed-interval sessions that in the baseline and extinction sessions) and two of these five were also said to display "schedule induced drinking" (frequency of drinks and amount of water drunk was higher in the fixed-interval sessions that in the baseline and extinction sessions). However, in the extinction sessions, the rates of drinking and pacing were higher than they had been in the baseline sessions, but were slightly lower than in the fixed-interval contingent sessions.

Although not reported by Kachanoff et al (1973), inspection of their cumulative and event records reveals that drinking bouts did not always occur immediately after delivery of a token, and sometimes several bouts of drinking were intersperesed with cord-pulling in a single inter- stimulus interval. Although the findings were not as clear-cut as the "schedule-induced" behaviour reported in animal studies (c.f. Falk, 1971), the experiment did show that the frequency of alternative behaviours can be related to schedule parameters with psychotic subjects.

Apart from a few anecdotal examples (e.g. Woods, 1973; Rheingold, Stanley and Doyle, 1964) very few studies with human subjects have reported on alternative behaviour and there is a dearth of studies which would systematically analyse the functional relationships between alternative behaviours and schedules of stimulation.

The only information on functional classes of alternative behaviour is limited to the self-directed (self-stimulatory and self-injurous) behaviour of retardates and the one study of drinking and pacing with psychotics (Kachanoff et al 1973). However, comparison of these studies reveals that completely different functional classes of alternative behaviours exist and suggests that a great deal more work is required in this area.

Ethological Studies of Stereotyped and Alternative Behaviours

As the majority of alternative behaviours that have been reported in laboratory studies with the retarded have been stereotyped self-directed behaviours, it is perhaps worth looking at what else is known about the occurrence of this very board class of behaviours. A considerable amount of research on the stereoptyped behaviours of retardates has been carried out using ethological methods of observation and analysis.

Schwartz (1974) and Shettleworth (1974) have pointed out that both ethology and the experimental analysis of behaviour are concerned with the determinants of behaviour, but some fundamental differences is orientation, underlying epistemology and methodology exist between them. Ethology views its subject matter as primarily the result of native endowment (Lorenz, 1965) and emphasises the species - specific character of behaviour. Essentially, ethology is a study of the structure of behaviour (Eibl-Eibesfeldt, 1970; Tinbergen, 1951) aimed at understanding the ways in which behaviours are ordered and the nature of the "internal structures" that allow such order to be expressed.

Ethologists criticise radical behaviourists for (a) their "overemphasis" on the role of experience in determining behaviour,(b) the trans-species generalisations which they say are made by behaviourists,and (c) their "over emphasis" of the functional analysis of behaviour without apparent regard for the nature of the "interval structures".

Skinner (1969) has pointed out that ethologists often resort to hypothetical causes "within the organism" to answer their core question; why does the animal behave as it does?. He has also pointed out (Skinner, 1969) that the ethological account of the structure of behaviour is one that centres on interrelations among topographically identified units which may or may not correspond with functional classes of behaviour.

However, since the experimental analysis of behaviour and ethology both include well developed bodies of theory and data about behaviour, it has been suggested that both might be encompassed within one general framework (e.g. Staddon and Simmelhag, 1971; Shettleworth, 1974; Schwartz, 1974). With the increasing number of reports in which a unilinear operant conditioning analysis has proved to be of limitation, discussed under the rubric of "constraints on learning" (e.g. Shettleworth, 1972; see chapter 1), several advocations of a move in this direction have appeared, For example Schwartz (1974) proposed that;-

> 'These observations suggest a significant contribution by species-specific behavioural characteristics to the phenomena obtained within the context of the experimental analysis and help bridge the methodological gap by providing a substantial data base for the interconnection of ethological principles with the principles developed from the experimental analysis' (Schwartz 1974, p.183)

Research in ethology centres around the systematic observation of "naturally" occurring phenomena. Bijou (1970) and Weisburg (1971) have proposed that the study of "naturally" occurring phenomena with normal and retarded children can be carried out using the methodology of ethology, but emphasise the need for a functional analysis.

> 'There may be times ... when one does not wish to state formal rules a priori and look at the resulting behavioural development and stabilisation. Instead, one may wish to "write" the schedule as it naturally evolves from the unique interactions which take place between responses and reinforcer in a specified environment' (Weisburg, 1971, p.134)

Lovaas (1967) has defined the ritualistic stereotyped behaviours of retarded children as "self-stimulatory behaviours" because they do not produce any obvious social consequences for the child. A description of self-stimulatory behaviour was provided by Lovaas, Litronwnik and Mann (1971) as follows:-

> 'Usually such behaviour is stereotyped and repetitive and appears to have no observable effects upon the child's social environment instead providing the child with sensory inputs from the movements of his own body. Sometimes these behaviours are rather gross as when the child rocks his body, either in a sitting or standing position, jumps up and down on both feet, paces the room, or flaps his arms.

> Sometimes the behaviour is more subtle, such as when the child "regards" his cupped hand, moves his eyes by rolling or crossing them, stares out of the corners of the eyes, presses his finger into the same spot on the body, walks in a peculiar gait, either on toes or with a "rolling gait" on the soles of his feet. Sometimes it involves the interaction of two or more body parts, as when the child flips his hands rhythmically with fingers extended in front of his eyes. It may involve the use of objects which the child often will spin, such as coins, or ash trays, at which point they will be drawn to a flickering visual input, approaching it to within a couple of inches maintaining a rigid and glazed facial appearance, flapping arms vividly at the wrists, perhaps also jumping up and down. Seemingly they will generate similar stimulation by running back and forth in front of a picket fence or twirling a string by their fingers in front of their eyes. Sometimes the behaviour seems primarily supported by tactual input, as in rocking, picking at their body, or mouthing. Sometimes the behaviour has primarily support, as in children who smell objects handed to them At other times there seems to be a preponderance of visual feedback involved, as in spinning, gazing or rolling of the eyes. At other times, auditory feedback seems predominant as when the child emits the same pattern of three tones, repeatedly for hours and days at time'. (Lovaas, Litrownik and Mann 1971 p. 40)

Berkson and co-workers carried out a series of ethological studies of "stereotyped movements" of retardates. "These behaviours include unusual postures of the limbs and repetitive movements such as rocking and head banging" (Berkson and Davenport, 1962). Observers recorded behaviour over lengthy periods using a time-sampling method (discussed in chapter 7) with a forty-eight item checklist. Most of this work examined frequencies of behaviour in relation to different settings (e.g. playroom, dormitory, etc) and different times of day, but did not include sequential analyses of behaviours. Group data were provided in all their reports and hence their statements were about statistical rather than functional analyses of behaviour (Sidman, 1960a). The findings of these studies can be summarised as follows;-

1. 'Stereotyped behaviours were related significantly to self-manipulation, I.Q.,age,and length of institutionalisation' (Berkson and Davenport, 1962 p. 852).

2. When novel objects (ball, rubber, doll, etc) were presented to retardates, 'Subjects who engaged in more stereotyped behaviour manipulated objects less than did Ss who stereotyped less frequently. The frequency of stereotyping was lower when Ss manipulated objects than when they did not' (Davenport and Berkson,1963,p.881).

3. A similarity to findings with isolation-reared chimpanzees (Berkson, Mason and Saxon, 1963) was that ' ... in a familiar, spacious situation where there are opportunities to perform manipulations of the environment and locomotion, the stereotyped behaviours in both groups retardates and chimpanzees decrease while in novel, restricted situations they increase' (Berkson and Mason, 1963, p. 412) *

4. Berkson and Mason (1964) commented on the wide individual variation in behaviour between the profoundly retarded (although they presented group data), and spoke of the "reciprocity" between stereotpyed behaviours and behaviours which involved physical contact with stimuli in their environment. A similar "inverse relationship" between these two "behaviour classes" was reported by Guess and Rutherford (1967).

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* Surprisingly, Berkson and Mason (1963) concluded that "The findings are consistent with the view that these subjects are relatively unaffected by environmental events " (p.412).

5. Five sub-groups of retardates were observed continuously for two days on their Ward, and the findings were as follows:- 'In no group were interactions with the physical or social environment prominent. A profoundly defective blind group and one which did mostly complex movements of the hands spent most of their time doing stereotyped movements. This was less true of a group which did mainly body rocking as a stereotyped act. A profoundly defective group which did no stereotyped movements was similar in behaviour to a severely retarded group, but did not communicate as much. Patients who did stereotyped motor acts also tended to be stereotyped with respect to the variety of places in which they were found and the number of objects they manipulated' (Berkson 1964).

Kaufman and Levitt (1965) studied three stereotyped behaviours ("body rocking", "head-rolling", and "waving hand before the eye") in eighty-three institutionalised retardates. Time-sampling records were taken throughout the day over a two week period and the group results indicated statistically significant variations in the rates of body rocking and head rolling as a function of the time of day.The highest rates of these behaviours occurred prior to meals and "break" periods (when organised activities were at a minimum), and the lowest rates followed meals and "break" periods. However, measures of "waving hand before the eye" varied little throughout the day, but occurred more frequently in younger than older subjects. A similar result reported by Klaber and Butterfield (1968) showed that amount of stereotyped rocking correlated with the ward routine.

Davis, Sprague and Werry (1969) recorded the frequency of "head rolling" in retardates by attaching a small transmitter to a light hockey helmet to detect head movements. They commented on how some of the subjects would not exhibit long-standing stereotypes of various types with the helmet on, or while being observed. They also studied the effects of different drugs on different stereotyped behaviours and found that in some subjects;-

> 'Not only was there great variation between Ss in terms of changes in frequency of behaviours but there were also intraindividual differences depending on the nature of the behaviour under consideration' (Davis, Sprague and Werry, 1969, p. 725)

The results of the Kaufman and Levitt (1966) and Davis et al (1969) studies clearly indicate that the descriptive class of "stereotyped behaviours" contains several different functional classes of behaviour, and is thus limited as a unit of behaviour for a functional analysis.

An attempt to refine the ethological method of recording children's behaviour was provided by Hutt, Hutt and Ounsted (1963). They devised a technique for studying "exploratory behaviour" (e.g. Berlyne, 1960) in a "free field" situation (described in chapter 7.). The "free field" consisted of a waiting room which contained only a washbasin, radiators, a light switch and a junction box. A one-way mirror was located on one of the walls through which "objective observations"(e.g. turning on tap, jumping, etc) were made. One of the dimensions of behaviour they reported was the duration of activities (bout lengths). The "attention span" of the activity was defined as the mean duration of bout length.

In a pilot study they compared the behaviour of four brain-damaged children with that of four "behaviour disordered" children under similar conditions in the "free field". They compared four sessions of fifteen to twenty minutes duration, in which different stimuli were present in the room. These were (a) empty, (b) coloured bricks,(c) coloured bricks and a female experimenter sitting passively, and (d) coloured bricks and a female experimenter who tried to get the children to play with the brikcs. Individual data were provided which indicated that (i) the "attention spans" of brain damaged children were generally shorter than those of the "behaviour disordered" children, and (ii) the brain-damaged group was characterised by comparative invariability with changes of environment unlike the "behaviour disordered" children, whose behaviour varied with the changes.

Using the same "free field" and the same four experimental conditions, Hutt and Hutt (1965) studies six autistic children "who shoed marked and frèquent stereotypes" (i.e. repetition in an invariant pattern of certain movements). The stereotyped patterns of behaviour varied from child to child but in each case there was a preferred or characteristic pattern. Four categories of behaviour were studied; (a) stereotypes,(b) body-manipulation (e.g. nose-picking),(c) brick-manipulation,and (d) fixture manipulation (light switches, taps etc). They found that;-

> '... the general stereotyped movements increased with increasing complexity of the environment. The presence of the active adult, however, appeared to have some inhibitory effect on these movements' (Hutt and Hutt, 1965, p. 2)

Hollis (1965a, 1965b) examined the behaviour of retarded children in a "free field" test situation when different social and non-social stimuli were introduced. His dependant variable was the frequency of occurrence (i.e. number of fifteen-seconds time-sample periods in which at least one bout occurred) of various behaviours. Statistical analysis of group data showed significantly that when "other-directed responses " (grasping, physical contact, etc) had a high frequency, the "self-directed responses" (clasping, stereotyped movements, etc) occurred at a low frequency (i.e. they were negatively correlated). The results were said to show that specific forms of physical and social stimuli have "definite and differential effects" on the behaviour of profoundly retarded children.

Lovaas, Freitag,Gold and Kassorla (1965b) described an apparatus and a procedure which they developed to facilitate recordings in child observation studies (described in chapter 7). They described a pilot study, using this apparatus, which was concerned with temporal and sequential inter-relationships amohg behaviours. Two behaviours (repetitious verbal behaviour and self-stimulation) were studied when an experimenter "strengthened" the repetitious verbal behaviour. Unfortunately, they did not describe the subject, nor did they specify how the repetitious verbal behaviour was "strengthened". However, they reported that when the repetitious verbal behaviour was "strengthened", there was a concurrent increase in the frequency of the self-stimulatory behaviour. The temporal relationship between these behaviours was determined by calculating the time interval at which the non-verbal response occurred in relationship to the onset of the verbal response. This revealed that there was an increase in self-stimulatory behaviour accompanying (within two seconds of) the repetitive verbal response).

Speculations concerning the determinants of stereotyped self-stimulatory behaviour have abounded and have tended to stress hypothetical organismic variables. Kaufman and Levitt (1965) suggested that this behaviour is an expression of tension, discomfort, on unsatisfied needs. Others maintain that it is frustration induced (Lourie, 1949; Mulhern and Baumeister, 1969) and increases substantially when a goal-directed behaviour is blocked such as when the opportunity to consume an edible is denied (Forehand, 1970; Forehand and Baumeister, 1970). Berkson, Mason and Saxon (1963) proposed that novel situations produced a high level of stereotyped behaviours by inducing a high level of excitation or arousal.

The science of behaviour, however, is concerned with the functional relationships between independent and dependent variables. Postulation of hypothetical intervening variables, such as conceptual physiological processes, places the subject matter outside the domain of a physical science by making quantitative specification in physical terms impossible (Skinner, 1966b). Thus the above speculations have no place in a functional analysis of stereotyped self-stimulatory behaviour.

Knowledge about self-stimulatory behaviour can be expanded by investigations aimed at discovering the real hereditory and environmental variables of which it is a function. In particular studies are required which will examine how self-stimulatory behaviour is inter-related with other behaviours in the behaviour stream. That is, ethological studies of self-stimulatory behaviour need to be concerned with the organisation of all behaviours in the behaviour stream and need to determine how the behaviour is functionally related to all elements in the behaviour stream.

Most ethological studies of retardates' behaviour have limited their dependent variables to "frequency of occurrence". A few studies (e.g. Hutt and Hutt, 1965; Lovaas et al, 1965b) have added bout lengths and sequences of behaviour to this list. The development and refinement of temporal and sequencial analyses of behaviour could enhance the research methodology of ethological studies of behaviour with the retarded.

Reports of Alternative Behaviours in Applied Studies

Chapters 1 and 3 outclined how "behaviour modification" developed as a unilinear system using an "operant conditioning" paradigm for the purpose of producing desirable changes in behaviour. The limitations of this framework have been pointed out from a variety of viewpoints, one of which is that of an "ecological" perspective;-

> 'Applied behaviour modification is an astonishgly simple and successful technology of behaviour change. However, its precision and objectivity depend, in the large part, upon its application to single dimensions of behaviour, one at a time.The question of larger and unintended effects within interpersonal and environmental contexts and over long periods of time beg for evaluation and research, because lessons learned in other areas suggest that we should always be sensitive to "other" effects of single-dimensional intrusions' (Willems, 1974 p. 155).

Very few applied behavioural studies with the developmentally retarded have reported behaviours other than the target behaviours. Occasionally incompatible behaviours have been measured in studies which have reduced the frequency of undesirable behaviours by making positive reinforcement "contingent"upon acceptable incompatible behaviours (e.g. Husted, Hall and Agin, 1971) or where punishment of undesirable behaviours have resulted in increases in desirable behaviours (.e.gRisley, 1968). Apart from these only anecdotal reports of concomitant changes in alternative behaviours have appeared concerning the developmentally retarded. However, in recent years, a number of studies with other groups of children have monitored behaviours other than the target behaviours.

Following anecdotal observations in early studies (Johnson Kelly, Harris and Wolf, 1966; Harris, Johnston, Kelly and Wolf, 1964), Buell, Stoddard, Harris and Baer, (1968) recorded several behaviours in a study with a three year old pre-school girl with deficits in both motor and social repertoires. Social consequences (praise etc) by teachers was made contingent upon use of outdoor play equipment. Use of a reversal design (Baer et al, 1968) demonstrated that increases in the frequency of the target behaviour resulted from the contingency management procedures. However, of the alternative behaviours that were monitored, four increased in frequency (touching other children, verbalisation to other children, co-operative play, and using children's names), three remained unaltered (touching teacher, verbalisations to teacher and parallel play) and one behaviour decreased in frequency (baby behaviour).

Wahler, Sperling, Teeter, Thomas and Luper (1970) discovered that contingency management procedures which improved non-verbal "problem" behaviours with two boys referred for stuttered speech, also resulted in improved speaking. Experimental test probes showed that the shifts in stuttering were dependent on changes in the non-verbal behaviours, but that there were no systematic changes in measured environmental stimuli for the stuttering. Similarly, Nordquist (1971) showed that contingency management procedures which reduced the frequency of "oppositional" behaviours with a five-year old boy resulted in a concomitant decrease in the frequency of nocturnal enuresis.

Sajway, Twardosz and Burk (1972) found that ignoring, by a teacher succeeded in reducing the frequency of a pre-school boy's "nagging" behaviour and also led to systematic changes in alternative behaviours by the child in the same setting and also in another setting (at home). Some of the "side effects" were desirable (increasing speech initiated to children and co-operative play) some were undesirable (decreasing task-appropriate behaviour, increasing disruptive behaviour) and some were neutral (use of girls' toys). Arguing against a unilinear operant conditioning paradigm interpretation of these findings, Wahler (1972) raised the possibility of indirect stimulus control i.e. that one set of behaviours can be maintained or affected by stimuli that are made contingent upon another (descriptive) behaviour. He uses the term <u>response class</u> to denote naturally occuring convarying, functional units of behaviour and argues;-

> 'Not only are developmental and maintenance features of the response class unknown, but predictions about which behaviours will become so organised are equally vague. When a clinical investigator restricts his operations to one child behaviour, he has no way of knowing what other behaviours emitted by the child will be affected by that operation. Unless his baseline observations encompass multiple behaviours including a correlational analyses of these observations, the complete outcome of his intervention procedures cannot be predicted in most cases ... Simply stated, these guidelines first require the investigator to monitor more than a single troublesome behaviour presented by the child. However, rules concerning what other behaviours to record are necessarily vague at this point'. (Wahler, 1972, unpublished).

Willems (1974) has classified some of the kinds of effects on alternative behaviours that are possible;-

> '(a) desirable, neutral, or undesirable behaviours may be affected; (b) the behaviours may increase or decrease; (c) the target subjects, other persons, or both may be affected; (d) effects may occur in the setting where the manipulation occurred, other settings, or both; and (e) effects may occur immediately, somewhat later, or much later (Willems 1974, p. 162)

Wahler (1975) used a coded observation system to study nineteen behaviours in two settings (home and school) with two predelinquant boys over a period of three years. After a two-month baseline, behaviour categories were intercorrelated, demonstrating that each child showed a group of behaviours that covaried predictably. Each child showed particular clusters of convarying behaviours which were stable over time (three years). In both cases, a child's behaviour cluster in one environment was different from his behaviour cluster in the second environment. Contingency management procedures were applied to each child's "problem" behaviour in one setting and reversed according to an A B A B experimental design. Results showed that the baseline group of convarying behaviours continued to covary over the three experimental phases. Although no behaviour covariations extended across either child's home and school settings, contingency management procedures produced across-setting effects.

The study also included within-session analyses of behaviour clusters. An attempt was made to assess temporal relationships between the behaviours in each cluster and social stimuli in the environment. To conduct the analyses, three sets of conditional probabilities were computed for each behaviour category in each cluster. These computations involved examining stimulus occurrence probabilities in the same observation interval (time - sampling with ten-seconds observation intervals and five seconds record intervals alternating) as that containing a relevant behaviour in the observation interval before the behaviour, and in the interval after the behaviour. However, within-session analyses of the behaviour clusters yielded little information.

This was the first study to attempt such a breadth of correlational and experimental analyses of within and across-setting events. Wahler (1975) points out that the within-sessions search for environmental determinants was restricted to a small number of stimulus categories, and only very brief temporal spacings between these events and relevant behaviour categories were examined. Hence, the negative findings should not deter further in-depth within-sessions analyses. It is likely that the development of temporal and sequencial analyses of behaviour clusters could broaden the scope of applied behaviour analysis to include more of the complexity of the behaviour stream.

CHAPTER 6

INTRODUCTION TO THE EXPERIMENTS: AIMS

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Most aspects of the developmentally retarded (aetiology, prognosis, etc) are typified by extensive variability both between and within subjects (e.g. Tredgold and Soddy, 1963; Clarke and Clarke, 1973). The behaviour of the developmentally retarded has been described as "characterised" by its variability (Spradlin and Girardeau, 1966). This has been shown to be particularly so when the behaviour of the retarded is examined under various schedules of stimulation (e.g. Spradlin et al, 1965; Woods, 1973). The study of retardates behaviour under standardised schedules of stimulation provides a basis for systematically examining factors of which behavioural variability could be a function.

Previous descriptions of performance variability under schedules of stimulation have mainly been in terms of rates and general patterns of one "operant" behaviour upon which a "reinforcer" has been made contingent. However, the specification of behavioural variability with the retarded has been criticised for failing to cover a wide range of relevant independent variables (Gardner, 1969).

The present study intends to investigate aspects of the transition amongst elements of the behaviour stream, under schedules of stimulation, with the developmentally retarded. Not only does the study intend to extend the dimensions of "operant" behaviour (terminal responses) it examines, but also it intends to look at other components of the behaviour stream. The emphasis of the study will be upon discovering functional relationships between elements of the behaviour stream.

Staddon (1976) has suggested that alternative behaviour can roughly be divided into three arbitrary categories (a) locomotor activities (b) undirected movements of parts of the body, and (c) activities directed to objects in the external environment. Within their limitations, the experiments reported in this thesis hope to cover all these sub-categories of topographically defined behaviour. However, the aim of the experiments was to be able to specify functional classes of behaviour and to do this it was necessary to record various aspects of behaviour topography simultaneously.

> 'Of all the attributes of behaviour serviceable for the assessment of operant performance, frequency measures, either in the form of total number of responses or the ubiquitous conversion to rate of responding have and continue

> to receive the greatest attention ... After a decade of research it is time to take stock of response rate, to consider whether it has lived up to its earlier claims, and whenever relevant, to suggest newer and different methods of behavioural evaluation'. (Weisburg, 1971 p. 135).

However, this is not to question the empirical usefulness of rate of responding, but to ask what gives the best estimate of probability of behaviour.

Studies with animal species which have attempted in-depth investigations of various behaviours under schedules of stimulation have included temporal&sequential analyses (e.g. Staddon, 1976). In the experiments which follow, temporal analyses of alternative behaviours were employed. The range of experiments was determined by, among other factors, the following consideration;-

> 'There is much need for a "natural history" of [alternative] behaviours. More purely descriptive work needs to be done to map out the sequences of behaviour that occur with a variety of comginations of species, schedule [parameters] , reinforcer [parameters] and supporting environment ... Only one interim activity, schedule-induced drinking, has been studied in anything like the necessary depth' (Staddon, 1976).

The study is primarily a descriptive one but hopes to contribute to knowledge in this area by concerning itself with a functional analysis of alternative behaviour. Various parameters of stimulus schedules will be altered systematically, and the functional relationships with both leve-pressing (the "operant) and alternative behaviours will be examined.

CHAPTER 7

INTRODUCTION TO THE EXPERIMENTS: METHOD

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Introduction

The experiments reported in this thesis were carried out at Broughton Hospital, Clwyd, North Wales. At the time of the experiments, it was known as a "Subnormality Hospital" and catered for thirty-five resident patients. Of these, several were profoundly retarded, cot-bound children who, because of extensive physical handicap, could not be included in the experiments. Apart from these, most patients served as subjects. However, due to various factors, such as transfer to other institutions, long illnesses, refusals, and spontaneous extinction (see appendix 1) not every subject completed an experiment.

Subjects

Prior to any experimentation, all subjects were given numbers to identify them in experimental reports. The same numerical system has been used in this and other reports (Woods, 1973; Woods and Pryce, 1974). Subjects included in this thesis are described in Table 1.

In table 1, under the heading of "Intellectual" Assessment the following abbreviations are used:-

G: Griffiths Mental Development Scales
R: Reynell Developmental Language Scales
M-P: Merill-Palmer Scale of Mental Tests
S-B: Stanford-Binet Intelligence Scale.
P: Peabody Picture Vocabulary Test

All assessments were carried out at the commencement of the study by two clinical psychologists. Chronological ages refer to the start of experimentation. Medication was unaltered throughout the study for all subjects. The information for the "Aetiology Diagnosis, and Brief Clinical Description" is taken from the medical records.

TABLE 1

Subject	Sex	Age (CA)	Fairview Self-help Behavioural Age	"Intellectual" Assessment	Medication	Aetiology, Diagnosis and Brief Clinical Description
1	M	12.4 years	1.5 years	M-P: M.A. 1.10 yrs.	Nil	1. Down's Symdrome 2. Congenital heart condition.
3	F	18.1 years	2.8 years	R: Comprehension 2.10 years Expression 3.0 years M-P M.A.3.10 years P: 2.1 years	Phenobarbitone 60 mg BD Epanutin 100 mg BD Serenace 1.5 mg nocte	1. Epileptic 2. Meningitis with consequent brain damage at 2 years 3. "Behaviour disorder"
5	M	10.10 years	1.5 years	R: Comprehension 1.6 years Expression 1 year M-P: M.A.2.7 years	Valium 4 mg TDS Welldorm 10020ml SOS	1. Ataxia and congenital nystagmus, Aetiology unknown 2."Emotional problems"
10	M	20.4 years	1.6 years	R. Comprehension 6.0 years Expression 1.9 years	Phenobarbitone 30 mg TDS	1. Epileptic 2. Spastic quadriplegia

TABLE 1 (continued)

Subject	Sex	Age (CA)	Fairview Self-help Behavioural Age	"Intellectual" Assessment	Medication	Aetiology, Diagnosis and Brief Clinical Description
11	M	20.2 years	1.9 years	R. Comprehension 3.5 years Expression 5.5 years	Phenobarbitone 30 mg TDS Welldorm 10-20 ml PRN	1. Epileptic 2. Cerebral Palsy
12	F	20.6 years	1.6 years	R: Comprehension 2.0 years Expression 1.11 years M-P: MA. 2.10 years S-B: M.A.2.4 years	Artane 2mg BD Sodium Amytal 400 mg nocte Wellcorm 20 ml nocte SOS Surmontil 100 mg 8.15 p.m. Largactil 75 mg TDS Duphaston 1 tab daily 20 days p.m.	1. Autistic features 2. Marked change in behaviour following death of father at age 3.

TABLE 1 (continued)

Subject	Sex	Age (CA)	Fairview Self-help Behavioural Age	"Intellectual" Assessment	Medication	Aetiology, Diagnosis and Brief Clinical Description.
13	F	26.0 years	2.2 years	G: 1.6 years	Phenobarbitone 30 mg BD Epanutin 50 mg BD Sparine 50.100 mg SOS Neulactil 20 mg TDS Welldorm 20 ml SOS	1. Epilepsy 2. Brain damaged - forceps delivery
16	F	33.4 years	1.8 years	M-P: 2.6 years	Librium 20 mg TDS Welldorm 10 ml PRN Thyroid 30 mg BD Sodium Amytal 400 mg nocte	1. Autistic features 2. Hypo-thyroid 2. Retarded development exacubated after father's death in 1952.

TABLE 1 (continued)

Subject	Sex	Age (CA)	Fairview Self-help Behavioural Age	"Intellectual" Assessment	Medication	Aetiology, Diagnosis and Brief Clinical Description
17	F	25.9 years	1.0 years	G: 10 months (excluding locomotive scale)	Welldorm 2 tabs nocte Phenobarbitone 60 mg TDS Epanutin 100 mg BD	1. Tubercular meningitis at 16 months 2. Strabismus with moderate degree of ptosis and nystagmus
19	M	16.9 years	4 months	Untestable	Phenobarbitone 60 mg BD Zarontin 250 mg in 5 ml BD Mysoline 5 ml BD Epanutin 10 ml BD Ospolot 200 mg BD Wellcorm 20 ml FRN	1. Epileptic 2. Right hemiplegia of upper limbs 3. Contractures in both knees.

TABLE 1 (continued)

Subject	Sex	Age (CA)	Fairview Self-help Behavioural Age	"Intellectual" Assessment	Medication	Aetiology, Diagnosis and Brief Clinical Description.
20	F	22.0 years	4.7 years	M-P: 412 years	Thyroid tabs 30 mg BD Welldorm 10-20 ml SOS	1. Downs Syndrome 2. Slight hypothyroidism
21	F	22.5 years	1.11 years	No suitable tests at Hospital	Phenobarbitone 60 mg TDS Welldorm 20 ml PRN Largactil 50 mg TDS	1. Congenital cataracts 2. One month premature
22	F	25.2years	1.10 years	R: Comprehension 4.0 years Expression 1.7 years	Sparine 50-100 mg TDS Valium 5 mg TDS Neulactic 5 mg TDS Artone 5 mg BD Sytron 10 ml TDS Stromba 5 mg BD	1. Daughter of first cousins 2. Cerebral Palsy

TABLE 1 (continued)

Subject	Sex	Age (CA)	Fairview Self-help Behavioural Age	"Intellectual" Assessment	Medication	Aetiology, Diagnosis and Brief Clinical Description
23	F	27.6 years	1.11 years	M-P: 2.1 years	Phenobarbitone 60 mg BD Sparine 50-100 mg SOS Artane 2 mg BD Serenace 1-5 mg TDS Welldorm 10-20 ml PRN	1. Daughter of first cousins 2. Cerebral diplegia with measles 3. Strabismus
24	F	16.10 years	2.0 years	R: Comprehension 4.0 years Expression: 4.6 years M-P: 2.9 years	Phenobarbitone 30 mg TDS Welldorm 10-20 ml PRN	1. Epileptic 2. Spastic diplegia
25	F	11.1 years	9 months	Untestable	Trinuride ½ tab TDS Valium 5 mg TDS	1. Epileptic

TABLE 1 (continued)

Subject	Sex	Age (CA)	Fairview Self-help Behavioural Age	"Intellectual" Assessment	Medication	Aetiology, Diagnosis and Brief Clinical Descriptio
26	F	14.7 years	3 months	Untestable	Maxolan 5 ml TDS	1. Epileptic 2. Spastic quadriplegic 3. Marked equine varus in both feet and contractures in both knees. 4. Caesarian section 5. Severe brain damage with hypotonia

Apparatus

Experiments were carried out in a room partitioned to make two separate sections ——— the experimental room and the observation/recording room. Figure 1 shows a plan of the location of equipment in these rooms.

The experimental room was 218 cm x 235 cm x 292 cm high and contained a subject seat and a console. Housed inside the console was a Kodak Carousel projector. 35 mm slides could be back-projected onto a 25.4 cm x 17.7 cm perspex screen which was mounted on the front of the console. Also mounted on the console were four neon lights, a circular response panel (7.1 cm diameter) and a bowl (16.2 cm diameter).

A speaker was mounted on the wall above the console and was connected to both a tape-recorder and a microphone via an amplifier, which were situated in the observation room. A one-way screen enabled observation into the experimental chamber from the observation/recording room.

The experimenter sat at a narrow table in front of the one-way screen. On the table were the microphone, a panel of four event-buttons, and a hand-counter. All programming and recording was carried out with the use of solid-state equipment which was located in the observation room. Data were recorded by use of counters, a cumulative recorder, and a Rusrak event recorder.

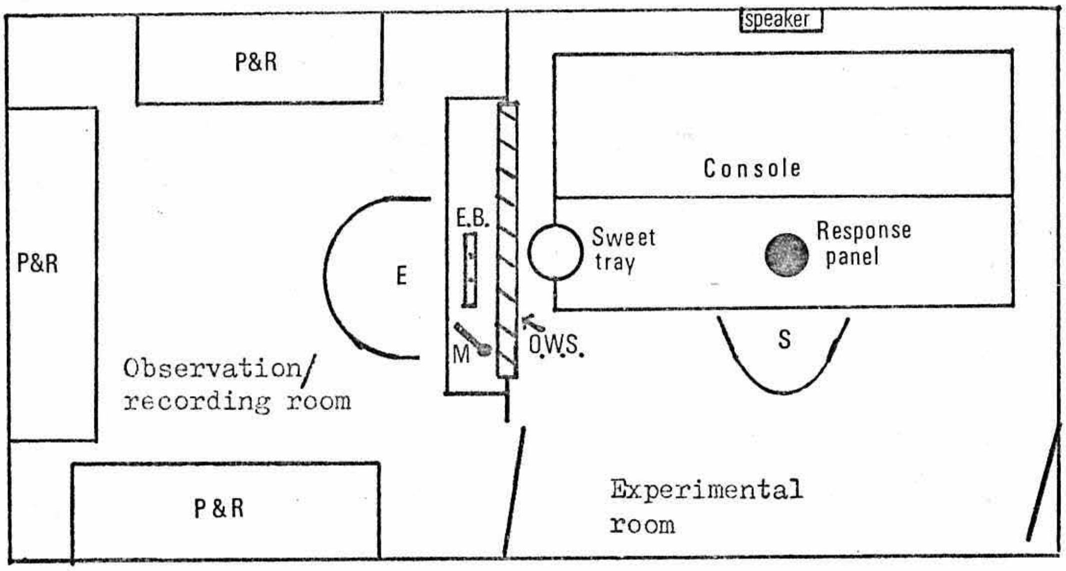

Figure 1 Plan of Observation/recording room and experimental room.

Key to symbols;

E: Experimenter's seat

S: Subject's seat

E.B: Event buttons

P&R: Programming and recording equipment

M: Microphone

O.W.S. One way screen.

Walt Disney coloured cartoon slides were used as stimuli* in some experiments. All slide exposures were of five-seconds duration and a total of eighty-one different slides were placed in the slide rack so that each slide presentation was different. Five different sets of eighty-one slides were used and these were changed daily in a regular sequence.

In some experiments, five-second segments of pop-music were played through the speaker. Each segment was different during any one session but the same tape was used for each session. It was possible to illuminate a red neon light on the console if this was required as a stimulus. The other three neon lights were never illuminated.

The door between the experimental chamber and the observation room was kept closed for all experiments except when sweets were used as contingent stimuli. When this was the case, a 60 cm piece of plastic piping was secured in place and led from a gap in the door to the bowl. The experimenter would release a "smartie".

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* As the purpose of this study is to examine the functional relationships between schedules of stimulation and different behaviours, a stimulus which is delivered will not be referred to as a "reinforcer" as this implies, prior to empirical verification, that the stimulus is a member of the functional class. However, in order to keep within the standard abbreviation system, the symbol S^R will be used to denote the stimulus which is specified in the schedule. Similarly, PS^RP will denote post-stimulus pause.

at his end of the pipe and it would quickly roll into the bowl. The angle of the pipe was about forty-five degrees to the horizontal. A neon-light mounted in front of the experimenter was used to signal when he should release each sweet.

A different response manipulandum was used for Subject 26. This consisted of a 30 cm square panel secured to a Morse key, and covered with hesian, which was mounted on a table at about 66 cm from the ground. A force of 1·25N was required to operate both manipulanda (except when this was varied in chapter 14). The manipulanda had connecting terminals at their resting position and at the point where they were fully depressed. A spring returned the manipulanda to the resting position when they were released. The terminals were connected to a bistable which enabled the automatic specification of a response. For a lever-press to count as a response it was necessary to press the lever from the resting position to the "fully depressed" position, thus switching over the bistable. The lever then had to return to the resting position, to switch the bistable back, before another response could be counted.

The recording equipment was able to count the following occurrences directly; the number of responses, number of stimuli delivered, number of over-runs of responding, number of responses emitted during stimulus presentations, number of response runs through consecutive stimulus deliveries without a pause, number

number of pauses of ten-seconds duration or more, and number of pauses of thirty-seconds duration or more. These will be explained in the section on dependant variables.

General Procedure

Because of inter-subject differences in the types of stimuli which will function as "reinforcers" for lever-pressing with retardates (Spradlin and Girardeau, 1966), different stimuli were used with different subjects. For some subjects slides alone were used, and for others slides and pop-music were presented simultaneously. Other stimuli which were used included sweets, eye-contacts (described in chapter 9), and neck-tickling (described in chapter 15). Slides and pop-music were always presented in five-second bursts. The type and duration of stimuli used will be described in each experiment.

Sessions were of fifteen minutes duration (except chapter 16) unless terminated by the subject leaving the room. Subjects were free to leave whenever they wished. Each subject's sessions were at the same time of day, and inter-session intervals were between one and three days. The subjects were brought to and from the experiments by the experimenter. No instructions were given.

In all experiments the "operant" behaviour which was specified in response-contingent schedules was a lever-press. The schedules of stimulation that were used included the following;-

(i) Fixed Ratio —Every n'th response produced a contingent stimulus

(ii) Fixed Interval - The fixed-interval was programmed "by the clock" (Ferster and Skinner, 1957) which meant that every n-seconds the opportunity for a stimulus delivery occurred, contingent upon a response. Only the first response in the n seconds produced a stimulus

(iii) Fixed Time - A stimulus was delivered every n-seconds on a non-contingent basis.

(iv) Differential Reinforcement of Low Rate - A stimulus was delivered contingent upon a single response providing a minimum period of n-seconds had elapsed since the previous response.

Subjects 1,3,5,10 and 11 had taken part in previous studies (Woods, 1973; Woods and Pryce, 1974) and so did not require any response training. The other subjects were given about three or four training sessions prior to the commencement of experiments. In a training session, slides and music (eye-contacts for Subject 26) were made contingent upon successive approximations to lever-pressing until the response was acquired. They were then gradually taken up to fixed-ratio 10 and then switched to a fixed-interval 10-seconds schedule.

In addition to counter readings, cumulative and event records of all responses and stimulus deliveries were taken in every session. After the experiments had terminated, the experimenter extracted information about inter-response times, post-stimulus pauses (PS^R P's) and split-runs from the cumulative records. To do this a grid of plastic, calibrated in two-second intervals, was used. The grid was placed on the cumulative records and the intervals between responses read off.

During initial session "alternative" behaviours were selected for monitoring in the experiments. There were vast differences between subject in the alternative behaviours that were produced and so different alternative behaviours were examined for each subject. No set criteria were used for selection, merely that the subject emitted the behaviour. Each alternative behaviour is given the abbreviation AB with a suffix. The recording and analysis of alternative behaviours is reported in Chapter 8.

TABLE 2 Alternative Behaviours

Subject	Alternative Behaviour
1	AB_1 "Mouth over lights". The subject would place his mouth over one of the neon lights on the console. This was compatible with lever-pressing.
	AB_2 "Waving finger in front of face". The subject would wave an index finger in front of his face repetitively. This was a behaviour which he regularly emits in his daily life and has been described as "self-stimulatory". This was compatible with lever pressing but was with AB_1
3	AB_3"Vocalising" This included bizarre verbalisations and laughter. This was compatible with lever pressing
	AB_4 "Stiffening". This consisted of the girl turning her head back and to the right and holding her body from the trunk upwards in a rigid position. This was a behaviour which she regularly emits in her daily life and has been described as "posturing". It was compatiable with lever pressing and AB_3
5	AB_3 "Vocalising" This was compatible with lever pressing
	AB_5 "Aeroplane movements". This consisted of the boy waving his hand in the air. He always used the same

TABLE 2 (continued)

Subject	Alternative Behaviour
5 (cont.)	hand (left) as he did for lever pressing hence the two were incompatible. It was compatible with AB_3
10	AB_3 "Vocalising". This was compatible with other behaviour recorded
	AB_6 "Touching lights" This consisted of the boy touching one of the neon lights with his hand. As he used the left hand for touching the lights and for lever-pressing, the two were incompatible
	AB_7 "Tapping near screen". This consisted of the boy tapping repetitively on the console near the screen. Again he used his left hand for this behaviour and hence it was incompatible with lever-pressing and AB_6
11	AB_8 "Rocking". This consisted of the boy rocking his body from the waist upwards back and forth repetitively.. It was a behaviour that occurs regularly in his daily life and was compatible with lever-pressing and AB_3
	AB_3 "Vocalising". This was compatible with lever-

TABLE 2 (continued)

Subject	Alternative Behaviour
11 (cont.)	pressing. It was compatible with AB_9 except when the sweet was being placed in the mouth.
	AB_9 "Eating sweets". This commenced when his hand entered the sweet bowl and terminated when a sweet was placed in his mouth. As the left hand was used both for lever-pressing and for taking sweets, the two were incompatible.
12	AB_6 "Touching lights" This consisted of her touching the neon lights. It was incompatible with lever-pressing AB_{10} and AB_{11}.
	AB_{10} "Face in hands". This consisted of the girl placing her face in her two cupped hands. It was a behaviour that occurs regularly in her daily life and was incompatible with lever-pressing.
	AB_{11} "Rubbing hands". This consisted of the girl rubbing her hands together at the left of her head. It was a behaviour which was said to immediately precede her attacking other patients when it occurred on the Ward. It was incompatible with lever-pressing and AB_{10}

TABLE 2 (continued)

Subject	Alternative Behaviour
17	AB_3 "Vocalising". This was compatible with lever-pressing.
	AB_6 "Touching lights". This consisted of her touching the neon lights. It was compatible with lever pressing and AB_3
19	AB_8 "Rocking". This entailed him rocking his body from the waist upwards back and forth. It was a behaviour that occurred with high regularity in his daily life and was compatible with lever-pressing
20	AB_3 "Vocalising". This was compatible with lever-pressing
	AB_{12} "Fiddling with bag, clothes or hearing-aid". This consisted of the girl manipulating any of these items which she regularly brought to the sessions with her. It was incompatible with lever-pressing but compatible with AB_3
21	AB_3 "Vocalising". This was compatible with lever-pressing.
24	AB_6 "Touching lights". This consisted of her

TABLE 2 (continued)

Subject	Alternative Behaviour
24 (cont.)	touching the neon lights. Again she used her right hand to emit this behaviour and hence it was incompatible with lever-pressing and AB_{13}.
	AB_{13} "Hand on lap". This consisted of her right hand making contact with her lap. Because she also used her right hand for lever-pressing, the two were incompatible.
25	AB_3 "Vocalising". This was compatible with lever-pressing.
26	AB_3 "Vocalising". This was compatible with lever-pressing. It consisted mainly of screams which she regularly produces in her daily life.
	AB_{14} "Turning head". This consisted of her turning her head away from the experimenter through an angle of at least ninety degrees (explained in more detail in chapter 9) It was compatible with lever-pressing and AB_3

Dependent Variables

The equipment was able to record directly the occurrence of responses, stimuli-delivered, and various aspects of the pattern of responding. Counter readings together with information extracted from the cumulative records were used to calculate the dependant variables related to lver-pressing that were examined. The dependant variables were as follows;-

(i) Response rate.

This was calculated by dividing the number of lever-press responses by the duration of the session and expressing in responses per minute. It was thus a measure of the overall rate of responding.

(ii) Over-runs of responding.

An over-run of responding was defined as the occurrence of four or more responses within two-seconds following the commencement of a stimulus delivery

(iii) Responses in stimulus presentation.

This was the total number of responses in a session which were emitted during the period that a stimulus was being presented.

(iv) Runs through consecutive stimulus deliveries without a pause.

This was the total number of times in a session that a run of responding had continued from the commencement of one stimulus delivery to the commencement of the next without an interresponse time of two-seconds or more.

(v) Split-runs.

Split runs were defined as the occurrence of at least one interresponse time of two-seconds or more, apart from post-stimulus pauses (PS^{R} P'S) between consecutive stimulus deliveries. They were calculated by inspection of cumulative records using the procedure described previously.

(vi) Percentage of stimuli delivered.

This dependant variable was examined in fixed-interval schedules only. As the fixed-intervals were programmed "by the clock" there was a maximum number of stimulus deliveries possible. For example, in a fifteen-minute session on fixed-interval ten-seconds the maximum number of stimulus presentations possible is ninety. The percentage of stimuli delivered in fixed interval sessions was calculated by using the following formula:

$$\frac{\text{Number of stimuli actually delivered}}{\text{Maximum number of stimuli possible}} \text{ X } 100$$

(vii) Number of stimuli delivered.

This was used in chapter 16 in order to compare performance between fixed-interval and differential reinforcement of low rate schedules.

(viii) Post stimulus pauses.

A post-stimulus pause (PS^{R} P) was defined as the interval between the commencement of stimulus presentation and the next response. They were measured from the cumulative records in two second intervals. For example, a post stimulus pause of 5.6 seconds would fall into the four-to-six-second category. If an over-run of responding had occurred, then the post stimulus pause was calculated from the last response in the over-run.

(ix) Interresponse times

Interresponse times (the interval between successive responses) were examined in chapter 16. Four dependant variables relating to interresponse times were calculated one of which was the post stimulus pauses. The other three were;-

(a) Interresponse time distributions.

The interesponse times were presented in histogram form to examine their distributions and determine the model interresponse time category.

(b) Conditional probabilities.

"Conditional probability" is equivalent to the function termed interresponse times per opportunity by Anger (1956). It is calculated by the formula

$$Cj = Nj \Big/ \sum_{i=j}^{R} Ni$$

where Cj is the conditional probability of a response in Time category J, and Nj is the number of entries in time category J; R is the total number of categories. However, when the total number of entires in the denominator was less than 20, the conditional probability was not computed in order to avoid unreliable estimates (Weiss, 1970). The conditional probabilities were presented in histogram form to examine their distributions

(c) Dwell times.

Dwell time (Shimp, 1967; Weiss, 1970) designates the proportion of a session occupied by the variour interresponse times. It is a weighted interresponse time distribution calculated by multiplying the number of entries in a category by the midpoint of the category in seconds. For example, nine entries in the four-to-six-second category would give a dwell time of firty-five seconds. Dwell times were presented in histogram form.

(x) Inter-stimulus patterns of responding.

These were examined in chapter 12 and were calculated from inspection of the cumulative records. The following mutually exclusive categories of inter-stimulus response patterns were used in this analysis;-

A) $S^R \longrightarrow PS^R P \longrightarrow R(n=1) \longrightarrow S^R$

Stimulus presentation is followed by a post-stimulus pause and then a single response produces the next stimulus

B) $S^R \longrightarrow PS^R P \longrightarrow R(n>1) \longrightarrow S^R$

Stimulus presentation is followed by a post-stimulus pause and then a run of more than one response is followed by the next stimulus.

C) $S^R \longrightarrow PS^R P \longrightarrow R(n \geq 1) \longrightarrow I\ R\ T > 2 \text{ secs} \longrightarrow R(n \geq 1) \longrightarrow S^R$

Stimulus presentation is folowed by a post-stimulus pause and then a single response or run of responses is followed by a pause of greater than two seconds, which is followed by a single response or run of responses which results in the next stimulus. This is basically as split-run with a single split.

D) $S^R \longrightarrow PS^R\ P \longrightarrow \left[R\ (n \geqslant 1) \quad \text{IRT} \quad 2 \text{ secs} \right] \xrightarrow{i > 1} S^R$

This is similar to C except that it is a split-run with multiple pauses in responding.

E) $S^R \longrightarrow R\ (\geqslant 4) \longrightarrow \left[\text{IRT} > 2 \text{ secs} \quad R\ (n \geqslant 1) \right] \xrightarrow{i \geqslant 1} S^R$

This is basically an over-run of responding which is not included in D.

F) $S^R \longrightarrow R\ (n > 1 : \text{all I R T's} < 2 \text{ secs}) \longrightarrow S^R$

This is a response run through two consecutive stimulus deliveries without a pause in responding of two seconds or more.

CHAPTER 8

THE RECORDING AND ANALYSIS OF ALTERNATIVE BEHAVIOURS

CHAPTER 8

THE RECORDING AND ANALYSIS OF ALTERNATIVE BEHAVIOURS

A Review of Methods of recording

The systematic collection of objective records of behaviour is an integral part of behaviour analysis. In animal studies, direct measurements of activities such as drinking, attacks and wheel-running have been developed. Several studies with human subjects have employed automatic recording devices to measure behaviours directly. Davies et al (1969) for example, used a Telemetric Motion Transducer to detect head movement in two planes (frontal and lateral) with retardates. A small transmitter attached to a light hockey helmet was placed on the subject's head for this purpose. Lindsley (1960, 1963) has developed devices to record vocal responses and movements directly.

Unfortunately, however, mechanised recording devices that are adequate to monitor human behaviours such as complex social behaviours have not been developed. For this reason, investigators have formulated operational definitions of the specific behaviours under investigation, and have trained observers to observe and record behaviour. Several different methods of taking "direct" records of behaviour via an observer have been developed.

In formulating operational definitions of behaviour, several factors must be considered. As Staddon (1976) has pointed out, there is the problem of defining a "bout" of a given activity;-

> "When the activity is highly periodic, and tends to occur in runs (licking is an example) there is little difficulty ... However, if not ... an element of arbitrariness enters into any attempt to segment the behaviour". (Staddon, 1976, in press)

Definitions of behaviour should be as unambiguous as possible and, as Hutt et al (1963) have urged, they should try to;-

> "... avoid two of the pitfalls which may trap workers in this field, namely the use of inferential observations (usually of the child's motivations) and the use of arbitrary categories into which all the observations are forced". (Hutt, Hutt, and Ounsted, 1963, p. 233).

Many observational studies of retardates' behaviour (reviewed in Chapter 5) have failed to heed this warning, an example of which is the following;-

> "... self-generated movement has been classified as such when it has been judged by observers to be undirected and failing to fall into any known response behaviour to the situation around. Stereotyped movements fall into this category" (Campbell, 1968, p 188).

Pencil and paper records using behaviour checklists have frequently been used in both single-subject and group observational studies. In group studies (e.g. (Klaber and Butterfield, 1968) observers count the number of subjects engaging in a particular behaviour (e.g. rocking) at regular intervals (e.g. every ten minutes) by systematically scanning the room. This figure would be divided by the total number of subjects present in the room to give the dependant variable.

Baumeister and Forehand (1971) reported a study in which observers, looking through a one-way mirror, counted the number of body-rocks (a movement back and forth counted as one body-rock) that occurred during a session. Many single-subject studies, however, have employed a time-sampling method of recording. In time-sampling, regular periods of observing and recording by the observer are alternated. In a recording period, the observer ticks off those behaviours on his check list which he has observed occuring at least once in the immediately preceding observation periods in which a behaviour has occurred. Because behaviours could occur in the "record" periods and be missed, time-sampling is only an approximate record of behaviour.

In a recent evaluation of time-sample measures, Powell, Martindale and Kulp (1975) compared continuous and time-sample measures of the "in-seat" behaviour of a secretary. Measurement error (i.e. the extent to which the sample measures deviated from the continuous measure) was a function of the frequency of the sample measurements and the criterion used to score an example of behaviour. They concluded that (a) the error in interval time sampling will be a function of the mean time per response (i.e. the average bout length), and (b) this error will not be consistent across experimental conditions.

Some observational studies have used dictated records of behaviour (c.f. Wright, 1960). Hutt et al (1963) observed children in a "free field" through a one-way mirror and gave a descriptive commentary on a two-channel tape recorder. The use of a two-channel tape recorder enabled examination of inter-observer agreement. They reported no disagreements about changes of position, "fair agreement" on timing of activities, and "closer agreement" on the content of one-second intervals. However, this is an extremely laborious and time consuming method of analysis and reliability calculation. In discussing the disadvantages of written or dictated accounts of childrens behaviour, Lovaas et al (1965b) note that;-

> "These disadvantages centre on the concentration of attention that the observer must give to the mechanics of recording rather than to the child, on the difficulty in measuring duration of a particular behaviour, and especially on the assessment of covarying relationships between behaviours of the child, or aspects of the child's behaviours and the contexts in which they occur" (Lovaas, Freitag, Gold, and Kassorla, 1965b, p 108).

In an attempt to overcome some of these disadvantages, Lovaas et al (1965b) developed an apparatus and a procedure to facilitate recordings in observation studies. This involved the use of a panel of twelve event buttons connected to an event recorder. Observations, using this apparatus, were made through a one-way mirror. Various behaviours were defined and each behaviour corresponded with a designated button on the panel and, consequently, with a specified pen on the recorder.

The appropriate button was depressed at the time that the behaviour occurred and was held down until the behaviour terminated. In this way the apparatus kept a running account of both frequency and duration of each behaviour. Temporal relationships between behaviours and bout lengths of behaviours were calculated from the event recordings. This was carried out by using a grid of clear plastic, calibrated to correspond with the variour time intervals, which was placed over the records to read off the intervals required.

In another study using this apparatus, Lovaas, Freitag, Gold and Kassorla (1965a) examined the total number of bouts (responses) in a session. For this purpose an arbitrary definition was employed, to destinguish between separate bouts. If more than two seconds separated two responses (on the event recording) these were recorded as separate bouts. However, if less than two seconds intervened between two button-depressions on the event recording these were counted as being in the same bout of the behaviour.

Recordings of animal behaviour have also been made vīa push buttons operated by an observer(e.g.Staddon and Simmelhag, 1971) and Tobach, Sehneirla, and Aronson (1962) further developed their appartus to enable quantification concurrent with recordings, thus reducing the time involved in manually scoring event records. In the Staddon and Simmelhag (1971) study, response categories were arrived at on the basis of initial observation during habituation sessions and were altered as necessary to accommodate new behaviours.

Methods of Recording and Analysis of Alternative Behaviours Used in the Present Study

In the present study, whenever the experimenter observed a subject emitting one of the operationally defined alternative behaviours, he depressed an appropriate event button and kept it depressed for the duration of the behaviour, releasing it only when a bout terminated. A four-channel Rusrak event recorder was used, and two of the channels were used to record lever-press responses and stimulus deliveries so that temporal and sequential relationships with alternative behaviours could be examined. However, this meant that only two alternative behaviours could be examined simultaneously using this apparatus.

Only one or two alternative behaviours were recorded in most experiments (see Chapter 7). For two subjects, however, third alternative behaviour was investigated. These were AB_7 ("Tapping near screen") with Subject 10, and AB_6 ("Touching lights") with Subject 12. Whenever a bout of these alternative behaviours occurred, the experimenter made a single press on a hand-counter that was held in a holder on the table in front of him. In this way only the total number of bouts of the third alternative behaviour was possible.

Apart from the two "third" alternative behaviours, several dimensions of alternative behaviour were recorded using the automatic recording equipment. The total duration of each alternative behaviour was recorded in each session. In all experimental conditions except extinction, the number of inter-stimulus intervals (IS^RI's) in which at least one bout of the alternative behaviour occurred was recorded. By dividing this figure by the total number of stimuli delivered, the frequency of occurrence of the alternative behaviour in inter-stimulus intervals was calculated and expressed as a percentage.

Two arbitrary dimensions of alternative behaviour, relating to the time since the previous stimulus delivery, were examined. This was an attempt to investigate the temporal loci of alternative behaviours. Inter-stimulus intervals were divided arbitrarily into two periods. Type X periods were designated as the ten seconds immediately following the commencement of a stimulus delivery. Type Y periods were designated as the remainder of inter-stimulus intervals. These two periods are represented schematically in figure 2. Although all type X periods were equal in duration, type Y periods varied with the IS^RI's.

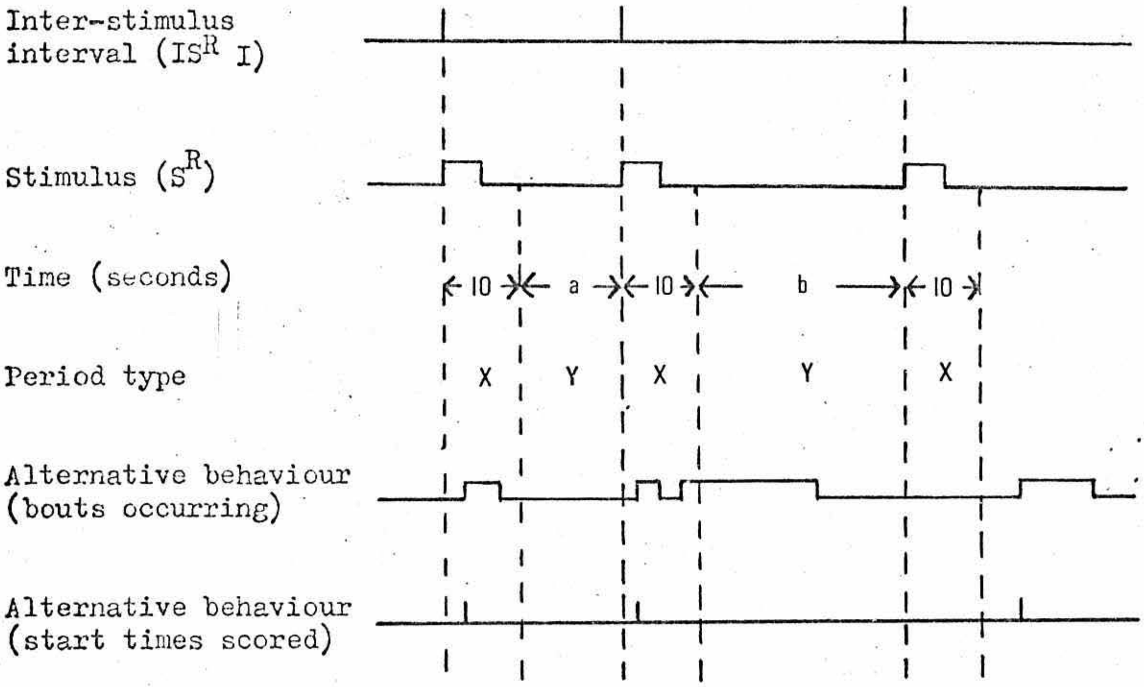


Figure 2 Schematic representation of type X and type Y periods.

Type X periods were always ten-seconds in duration, but the duration of type Y periods varied with inter-stimilus intervals. Start times were scored when a bout of alternative behaviour commenced in a type X or a type Y period. A single "start time" was scored if more than one bout of the alternative behaviour commenced in a single type X or type Y period.

The total durations of each alternative behaviour in type X and type Y periods were recorded separately in each session. Also the number of type X periods and type Y periods in which at least one bout of the alternative behaviour occurred were recorded separately in each session. By dividing these figures by the total number of stimuli delivered, the frequency of "bouts occurring" of the alternative behaviour in the type X and type Y periods (respectively) were calculated, and expressed as a percentage.

It was possible for a single bout of an alternative behaviour to extend across a type X to a type Y period, or across a type Y to a type X period. This would be the case if an alternative behaviour had what Staddon (1976) refers to as long "momentum". Another temporal dimension of alternative behaviour that was examined was the "start time" of bouts. To do this a clear plastic grid, calibrated in five-second intervals, was made, similar to that used by Lovaas et al (1965 b) described in the previous section.

Using the plastic grid, each event record was scrutinised and a tally made of the number of type X periods and the number of type Y periods, in which at least one bout of an alternative behaviour started. In the schematic diagram in figure 2, it can be seen that although some type X and type Y periods have "bouts occurring", they may not have any "start times". By dividing the number of "start times" by the total number of stimuli delivered, the frequency of "start times" of the alternative behaviour in the type X and type Y periods (respectively) were calculated, and expressed as a percentage.

Another dimension of alternative behaviour that was examined was the frequency distribution of "bout lengths" in sessions. Again this was achieved by scrutinising the event records with the plastic grid. The same definition to distinguish between separate bouts as used by Lovaas et al (1965 a) was employed, ie. if less than two seconds separated two event-button depressions these were counted as being in the same bout. Frequencies of "bout lengths" were recorded in five-second categories.

An additional dimension of AB_9 ("eating sweets") with Subject 11 was examined in Chapter 10. This was the total number of sweets consumed in a session. In Chapter 9, the duration of alternative behaviours in successive three-minute intervals through the sessions were examined (also reported for Subject 26 in chapter 14). However, due to technical failure this dependent variable was not recorded in the other experiments.

A Review of Inter-Observer Reliability

Rosenthal and Lawson (1964) reported a longitudinal study of the investigatory practices of experimenters and concluded that even in basic research with laboratory rats, the identification of the experimenter with a particular theory or point of view, which he always has to some extent, will cause him to record the data in a manner that reflects something other than the behaviour itself. Changes in data produced by the observers rather than by the independent variables have been referred to as "observer bias" (Gelfand and Hartmann, 1975; Johnson and Bolstad, 1973; Romanczyk, Kent, Diament and O'Leary, 1973; Rosenthal and Rownow, 1969; Weick, 1968).

One of the most frequently reported observer effects has been the "reactive effect" on the subject being observed. An example of this was reported in Chapter 5, where Davis et al (1969) found that some of their retarded subjects would not exhibit long-standing stereotyped behaviours while being observed. Other examples of subjects' reactivity to the presence of observers can be found in the literature (e.g. Johnson and Bolstad, 1973; Wiggins, 1973). For this reason several investigators have made use of one-way screens and mechanical recording devices for obtaining observational data (e.g. Bernal, Gibson, William, and Pesses, 1971; Nordquist, 1971). However, a recent study (Johnson and Bolstad, 1975) which compared the behaviour of family members at home with a tape-recorder found that there were no differences with an observer present or absent. This aspect of observational research clearly needs further investigation.

Azrin, Holz, Ulrick and Goldiamond (1961) replicated an investigation by Verplanck (1955) which had purported to show that the opinions expressed by a speaker could be increased ("reinforced") or decreased ("extinguished") by a listener who agreed or disagreed with the speaker or remained silent. In the replication, undergraduate students consitently "found" that agreement increased opinions and extinction decreased opinions, and that these results were reported to please the instructor. Advanced psychologists (with (i) a Ph.D or M.A., (ii) skill in shaping animal behaviour, (iii) a healthy respect for negative results, and (iv) practice in defining opinions) who were not in a student-teacher relation did not obtain these results. Students who were given the expectation that agreement with opinions would result in a decrease, rather than an increase of opinions, reported a decrease. They concluded that the results of studies such as this may be more a reflection of the experimenter's expectations and therories than of the subject's behaviour and that;-

> "These results demonstrate the importance of objective recording and programming and interobserver reliability as prerequisites for credibility of a study even when the usual criteria have been satisfied of statistical significance, practical importance, and theoretical coherence" (Azrin, Holz, Ulrich and Goldiamond, 1973, p 186).

However despite this warning in 1961, Peterson and Hartmann (1975) have noted a lack of concern for factors related to reliability of observational data in the applied behaviour analysis literature.

In most observational studies, pairs of observers will occasionally compute a reliability coefficient to determine their level of agreement with each other. Reliability in time-sampling studies is usually determined by dividing total number of times observers made the same checks by the total number of checks made by one or both of them (i.e. total number of intervals in session minus number of intervals when both agreed that behaviour had not occurred). This is usually expressed as a percentage. Romanczyk et al (1973) have made the following comments with regard to inter-observer reliability coefficients;-

> 'The level of reliability obtained may vary greatly depending upon the type of behaviour observed, and the method of reliability calculation ... Demonstration of high reliability is critical for clear interpretation of experimental data. To the degree that different observers record different behaviours, it is uncertain what behaviour is "actually" being emitted by an experimental subject. Depending upon the specific experimental design employed, low reliability of behavioural recordings may result in behavioural measures that include a high proportion of error, and, therefore, are insensitive to the effects of an experimental manipulation. More seriously, behavioural recordings of low reliability may result in data that are confounded with and biased by the idiosyncratic observational criteria employed by each observer' (Romanczyk, Kent, Diament, and O'Leary, 1973, pp 175 - 176).

A high reliability coefficient is usually assumed to reflect the general adequacy of the observational process at times when reliability is not being measured. However, Reid (1970) reported that observers obtaining median reliabilities of seventy-five percent when they were aware that reliability was being assessed, dropped to a median relability of fifty-one percent when they were told that reliability would not be assessed. Other studies have also reported on the "reactivity" of observers to a second observer's presence (e.g. O'Leary and Kent, 1973).

Romanczyk et al (1973) trained five observers to take time-sampling records (twenty-seconds observe, ten-seconds record) of nine categories of behaviour ising a coding system with school children. All observations were made from a room adjoining the classroom which was equipped with a one-way screen and an audio-amplification system. Reliability of observational data from the five student observers was measured simultaneously by two assessors who had had two years experience with this task, under two experimental conditions; - overt and covert assessment. During overt assessment, observers were told that reliability would be measured by one of the two assessors thus permitting computation of reliability with an identified and an unidentified assessor. During covert assessment, observers were not informed of the reliability measured. Throughout the study, each of the assessors employed a unique interpretation of the standard observational code.

They found that reliability coefficient varied between eighty to ninety percent when observers knew that reliability was being assessed and between twenty and seventy-five percent when they were not informed of a reliability check. Further, the frequency of behaviour recorded was twenty-five percent lower when observers were not instructed that reliability was being assessed. In the overt assessment condition, reliability of observers with the identified assessor was consistently higher than reliability of observers with the identified assessor. In the covert assessment condition, reliability with the two assessors was substantially lower than during overt assessment, and the observers consistently recorded lower frequencies of behaviour codes than the two assessors.

O'Leary and Kent (1973) presented data showing that when observers were separated and restricted to computation of reliability, they soon began to "drift" in their application of a behaviour code. This effect may not be detected by the ordinary reliability methods, particularly when the same gradual changes occur with both observers —— sometimes called consensual observer drift (Johnson and Bolstad, 1973).

Gelfant, Hartmann, Lamb, Smith, Mahan, and Paul (1974) and Patterson and Harris (1968) have devised a method for detecting observer drift which involves taping sessions at the beginning, midpoint and end of a study, and getting a third observer to rate the three. If the latter tapes are rated higher or lower by the two regular observers in comparison with the rating made by the third observer, then this would suggest that a drift of criteria has occurred.

Lovaas et al (1965 b) tackled the problem of inter-observer differences by developing an additional piece of apparatus for training observers and for ensuring optimal inter-observer reliability of recording. This consisted of a panel of lights whose ends were plugged into separate event-button panels. It was programmed such that if two observers, recording on their respective panels, were in disagreement, a light on the panel was illuminated signalling the particular button on which they were disparate. The immediate feedback ensured that the discrepancy between observers could be quickly identified. In the results section of the paper, only activities that could be easily agreed upon by any two observers composed the variables.

A similar apparatus was used by Lovaas et al (1971). Details of this study were given in Chapter 5. The experiments included comparisons of trials in which the subject was or was not engaged in self-stimulatory behaviour when a stimulus (a tone) signalled the start of a trial. For this purpose, two observers independently decided whether or not the self- stimulatory behaviour was occurring. They independently depressed a button to initiate a trial, but the tone would not sound until both buttons were depressed simultaneously. In this way the two observers were always in agreement regarding whether or not the trial was initiated during a bout of self-stimulatory behaviour. They report that the observers rarely disagreed on on-self-stimulatory trials but their agreement on self-stimulatory trials was low, falling often to fifty per cent in some sessions.

In a recent introductory text to behaviour analysis, Gelfond and Hartmann (1975) have given the following warning;-

> 'Failure to check the reliability of your data may result in data of questionable accuracy, which consequently would be meaningless' (Gelfant and Hartmann, 1975, p 202)

Despite this, many otherwise excellent observational studies of alternative behaviours have failed to demonstrate high inter-observer reliability. For example, Staddon and Simmelhag (1971) employed the same observer throughout and no inter-observer reliability checks are reported.

Inter-Observer Reliablity Checks in the Present Study

The experimenter (P.A.W) recorded alternative behaviours throughout the study. However, for each alternative behaviour examined in every subject, five inter-observer reliability checks were made at intervals scattered across experiments. Three observers were used for the reliability checks and all three made at lease one check for each subject and each alternative behaviour.

When the checks were being made, the observer sat behind the experimenter in the observation/recording room and viewed the subject through the one way screen. The observer was equipped with a stopwatch and a hand counter and was required to monitor the occurrence of one of the alternative behaviours. Whenever the specific alternative behaviour commenced, the observer would start the stop-watch and stop it at the termination of a bout. Also, at every stimulus delivery, the observer would make one press on the hand-counter if at least one bout of the alternative behaviour had occurred in the previous inter-stimulus interval.

The observer and the experimenter could not see each other's hands on their manipulanda, and, because counters and clocks were making noises continually, they were unable to determine whether the other person was recording. In this way, inter-observer reliability checks could be made for total durations of alternative behaviours and frequencies of occurrence of alternative behaviours within inter-stimulus intervals.

An interesting finding was that if there was a discrepancy between the two figures, the experimenter always recorded the highest durations and frequencies. To calculate inter-observer reliability coefficients, the observer's frequency (or duration) was divided by the experimenter's frequency (or duration) and expressed as a percentage.

For AB_7 with Subject 10 and AB_6 with Subject 12, both the experimenter and the observer counted the total number of bouts in a session. Complete agreement was obtained in both cases. The raw data from which inter-observer reliability coefficients were calculated are given in appendix 2, and the results are summarised in table 3.

Although these findings suggest that there was a high degree of inter-observer reliability in all the alternative behaviour categories examined, the limitations of the method of calculation must be recognised. Firstly, although the total durations recorded were similar, it is not to say that the experimenter and observer recorded them at the same time. Secondly, there is no check on the durations and frequencies of alternative behaviours in type X and type Y periods. Unfortunately, the limited recording facilities did not permit more accurate methods of assessing inter-observer reliability.

Despite these shortcomings, however, no mean realiability figure fell below eighty percent, and most were over ninety percent. From this it can be assumed that a reasonable degree of accuracy in recording was acheived by the experimenter and thus the data can be said to be representative of the actual dependent variables examined.

TABLE 3 Inter-Observer Reliability Coefficients

Subject	Alternative Behaviour	Mean of five inter-observer reliability checks with the range in parenthesis	
		Total durations	Frequency of occurrence in inter-stimulus intervals
1	AB_1	90.6% (86.2-100.0%)	98.9% (94.4-100.0%)
	AB_2	92.6% (87.5-98.0%)	100.0%
3	AB_3	92.8% (91.0-94.8%)	100.0%
	AB_4	90.2% (84.8-95.8%)	100.0%
5	AB_3	93.2% (85.6-97.5%)	96.3% (85.1-100.0%)
	AB_5	96.8% (89.4-100.0%)	100.0%
10	AB_3	98.5% (92.9-100.0%)	100.0%
	AB_6	93.5% (80.0-100.0%)	100.0%
11	AB_3	87.2% (75.9-97.6%)	98.3% (95.7-100.0%)
	AB_8	92.5% (85.3-99.0%)	100.0%
	AB_9	94.4% (85.7-100.0%)	100.0%
12	AB_{10}	90.8% (83.3-97.5%)	99.4% (97.2-100.0%)
	AB_{11}	99.1% (95.8-100.0%)	100.0%
17	AB_3	98.2% (91.2-100.0%)	100.0%
	AB_6	93.0% (82.0-100.0%)	100.0%
20	AB_3	93.1% (88.6-96.9%)	99.4% (96.9-100.0%)
	AB_{12}	94.2% (84.5-100.0%)	100.0%
24	AB_6	89.3% (75.0-100.0%)	100.0%
	AB_{13}	92.5% (84.1-95.8%)	98.9% (96.8-100.0%)
25	AB_3	95.1% (90.9-98.4%)	100.0%
26	AB_3	92.7% (85.3-97.6%)	97.9% (92.7-100.0%)
	AB_{14}	81.1% (60.7-96.4%)	92.2% (83.3-100.0%)

CHAPTER 9

COMPARISONS OF CONTINGENT STIMULATION, NON-CONTINGENT STIMULATION AND NO STIMULATION

CHAPTER 9

COMPARISONS OF CONTINGENT STIMULATION, NON-CONTINGENT STIMULATION AND NO STIMULATION

Introduction

Hermstein (1966) reported an experiment with pigeons in which fixed-interval 11-seconds, fixed-time 11-seconds, and extinction conditions were examined systematically. He reported that when the non-contingent food schedule was introduced, although the rate of key-pecking declined, it remained at a substantial level. This contrasted with the extinction sessions in which the rate of key-pecking eventually ceased altogether. Rescorla and Skucy (1969) used similar operations with rats as subjects and reported that although fixed-time produced a much more gradual decrease in responding, there were small differences in the final asymptotic levels of responding between fixed-time and extinction conditions. Similarly, Boakes (1973), with pigeons, found that response rates decrease more slowly following introduction of fixed-time food delivery than following the omission of food delivery both in single and multiple schedules.

Other studies have reported that the fixed-time schedule generates response patterns consisting of an initial pause followed by positively accelerated responding (Appel and Hiss, 1962; Lattal, 1972; Zeiler, 1968), although responses occur less frequently in fixed-time than fixed-interval schedules. Alleman and Zeiler (1974) showed that when pigeons were first exposed to a differential reinforcement of low rate schedule for key pecking and then food was presented on a response-independent fixed-time basis, responses still occurred at a steady rate in both conditions. Once the birds had been exposed to a fixed-ratio schedule, however, response rate under fixed-time schedules was positively accelerated. They concluded that the effects of fixed-time schedules on patterning depended upon experimental history.

Staddon and Ayres (1976) reported that when a non-contingent stimulus schedule was changed to extinction, some behaviours increased in frequency and others decreased in frequency. The alternative behaviours which decreased in frequency were described as interim activities or adjunctive behaviours, but the alternative behaviours which increased in frequency were described ad "preferred" activities. Staddon (1976) has suggested that:-

> 'It would also be useful to find a preferred, but non-schedule-induced activity, analogous to running in rats, that could be used in similar fashion to tease out the interactions among induced activities in pigeons. It is not yet clear what such an activity would be' (Staddon, 1976).

The review of the literature suggested that self-stimulatory and stereotyped behaviours increase in extinction sessions with retardates. This experiment was carried out in order to examine functional relationships between various alternative behaviours and three experimental conditions; contingent-stimulation, non-contingent stimulation and no stimulation.

Subjects

Subjects 1 and 26. This experiment immediately followed the one reported in Chapter 14 for Subject 26.

Apparatus and Procedure

The standard procedure was carried out with Subject 1 and slide exposures of five-seconds duration were used as stimuli. With Subject 26, the second manipulandum described in Chapter 7 was used, and the experimenter held a panel with two event buttons for recording alternative behaviours. Three seconds of "eye-contact" were used as the stimulus event with Subject 26.

AB_{14} ("turning head") was defined as the subject turning her head through an angle of at least ninety degress from the experimenter. As the experimenter only looked at the subject when he was provide eye-contact, a mirror was mounted on the wall above

Subject 26, through which the experimenter could see the back of her head. Whenever the subject's nose appeared in the mirror, the experimenter recorded it as AB_{14}. The subject never looked directly at the mirror, because her physical handicap prevented her from turning in a full one hundred and eighty degrees.

For each subject the schedules of stimulation used were fixed-interval 20-seconds, fixed-time 20-seconds, and extinction. The sequence of experimental conditions and number of sessions in each condition are indicated in figures 3 and 4.

Results

When inter-observer reliability was checked, the observer did not have the same view of Subject 26 from the observation/recording room. For this reason, the observers had to use different criteria for AB_{14}. Whenever an observer could no longer see Subject 26's nose (because she had turned her head) he would record it as an occurrence of AB_{14}. The fact that different criteria were used for AB_{14} by the experimenter and the observers probably contributed to the relatively low inter-observer reliability coefficient for durations (mean of eighty-one percent).

Neither subject obtained every possible stimulus delivery in the fixed-interval sessions. Figures 3 and 4 show the mean overall response rates in each schedule condition and the obtained frequency of stimulation in the fixed-interval conditions relative to the fixed-time and extinction conditions.

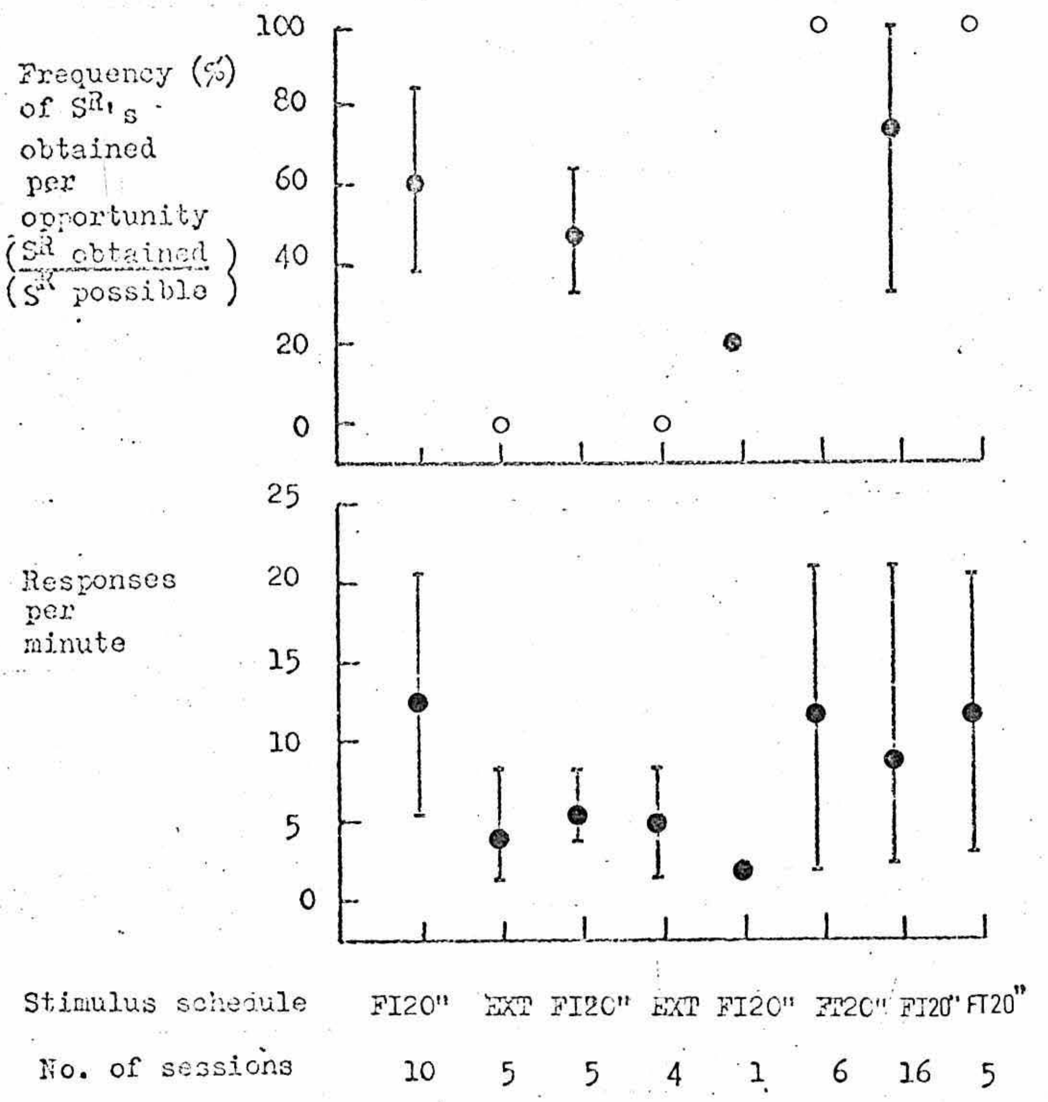


Figure 3 Frequency of stimuli obtained per opportunity and responses per minute for Subject 1, Means and ranges.

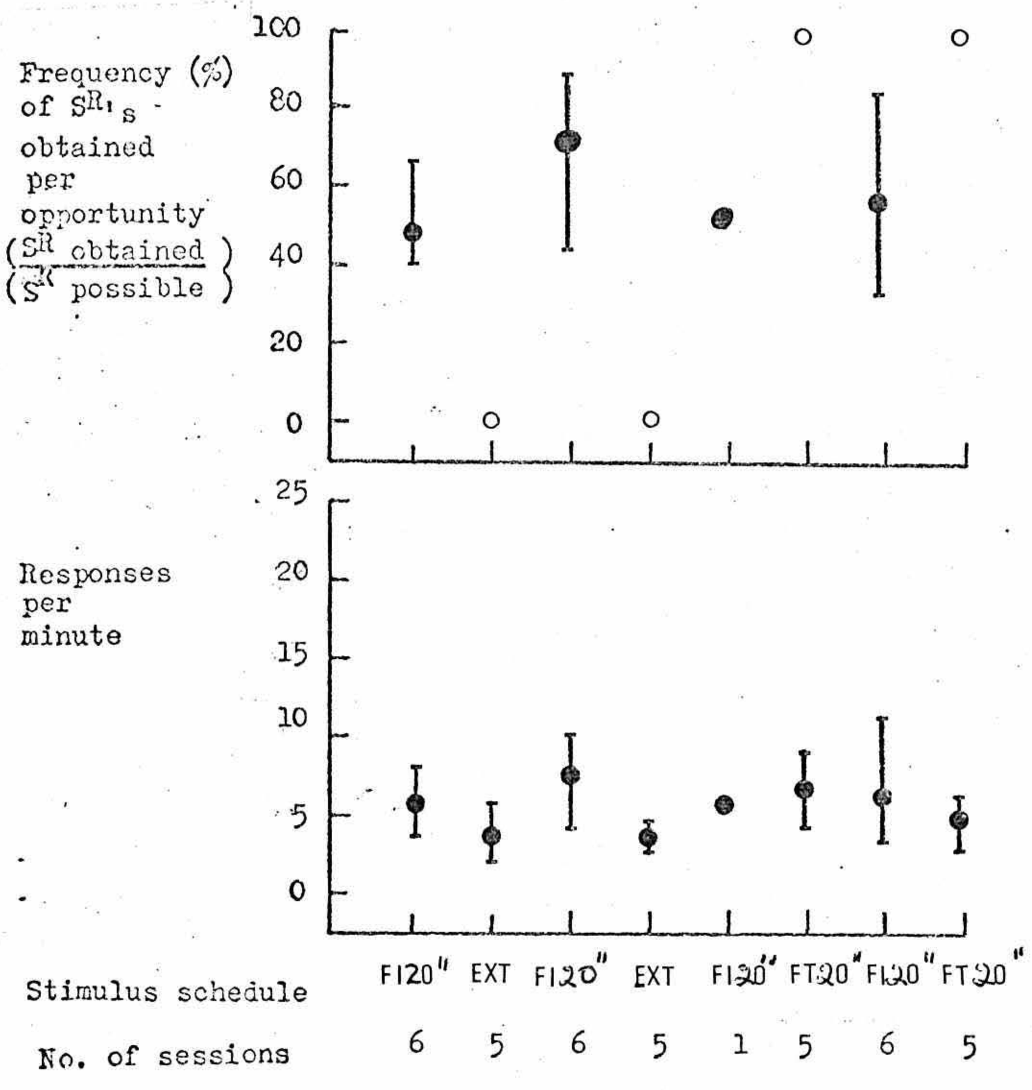


Figure 4 Means and ranges of responses per minute and frequency of stimuli obtained for Subject 26.

Overall rates of lever-pressing did not vary significantly with the changes of experimental conditions for Subject 26. For Subject 1, the range and means of response rates were lower in the extinction conditions than in the fixed-time conditions. Considerable variation was produced in response rates in the fixed-interval conditions by Subject 1.

The durations and frequencies of alternative behaviours are shown in figures 5, 6, 7 and 8. The relationships between the alternative behaviours and the experimental conditions can be summarised as follows:-

(a) For each subject one of the alternative behaviours (AB_1 for Subject 1 and AB_{14} for Subject 26) was not related to maniuplation of experimental conditions. Although in each case there was considerable inter-session variation, the factors that could be related to the variation did not appear to include the experimental conditions which were altered.

(b) For each subject one of the alternative behaviours (AB_2 for Subject 1 and AB_3 for Subject 26) tended to occur with a higher duration in the fixed-time conditions and with a lower duration in the extinction conditions. Durations of these alternative behaviours in the fixed-interval conditions showed considerable inter-session variation ranging between the two extremes.

Figures 9, 10, 11 and 12, show the duration and frequency of occurrence of alternative behaviours in type X and type Y

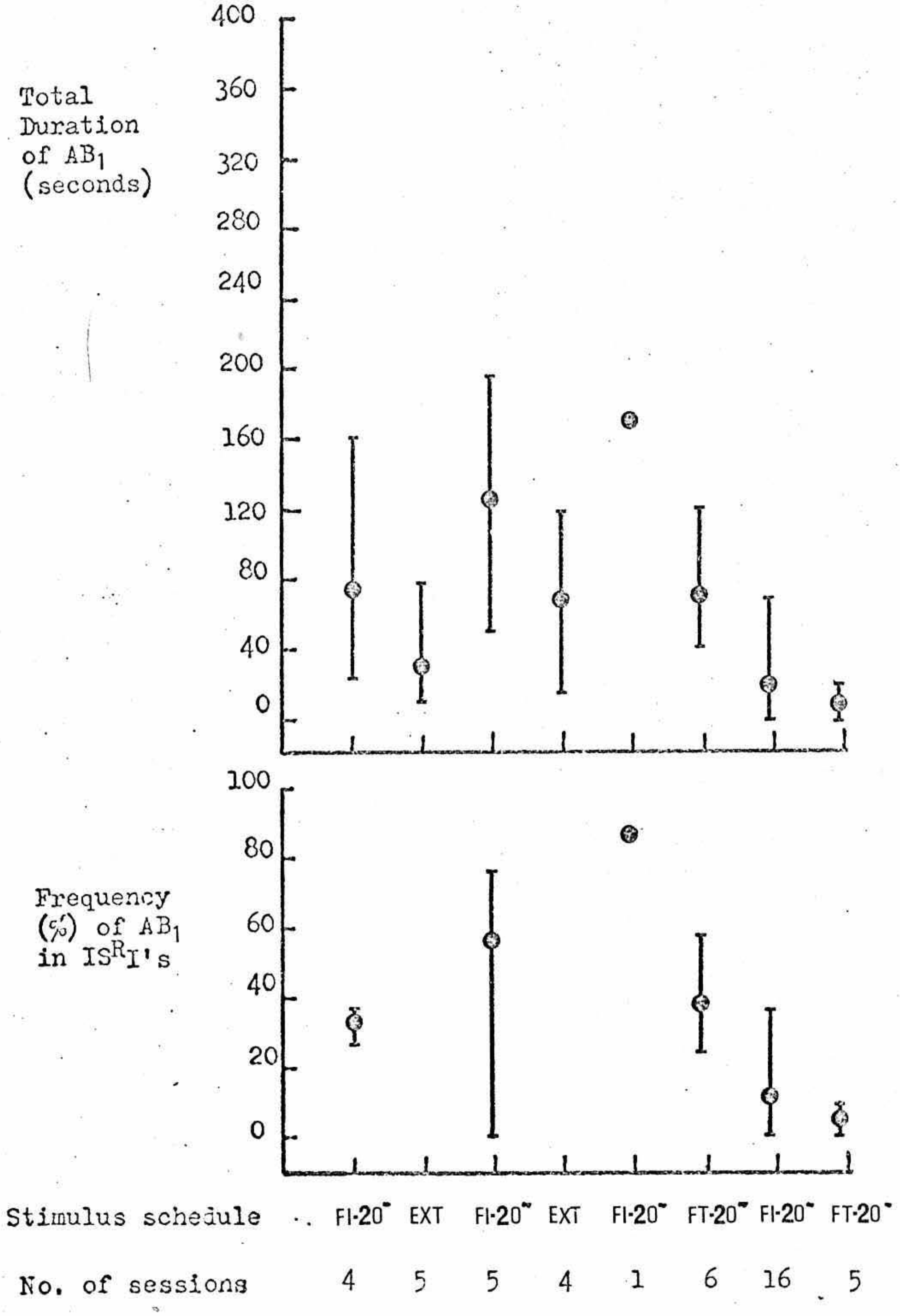


Figure 5 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_1 for Subject 1.

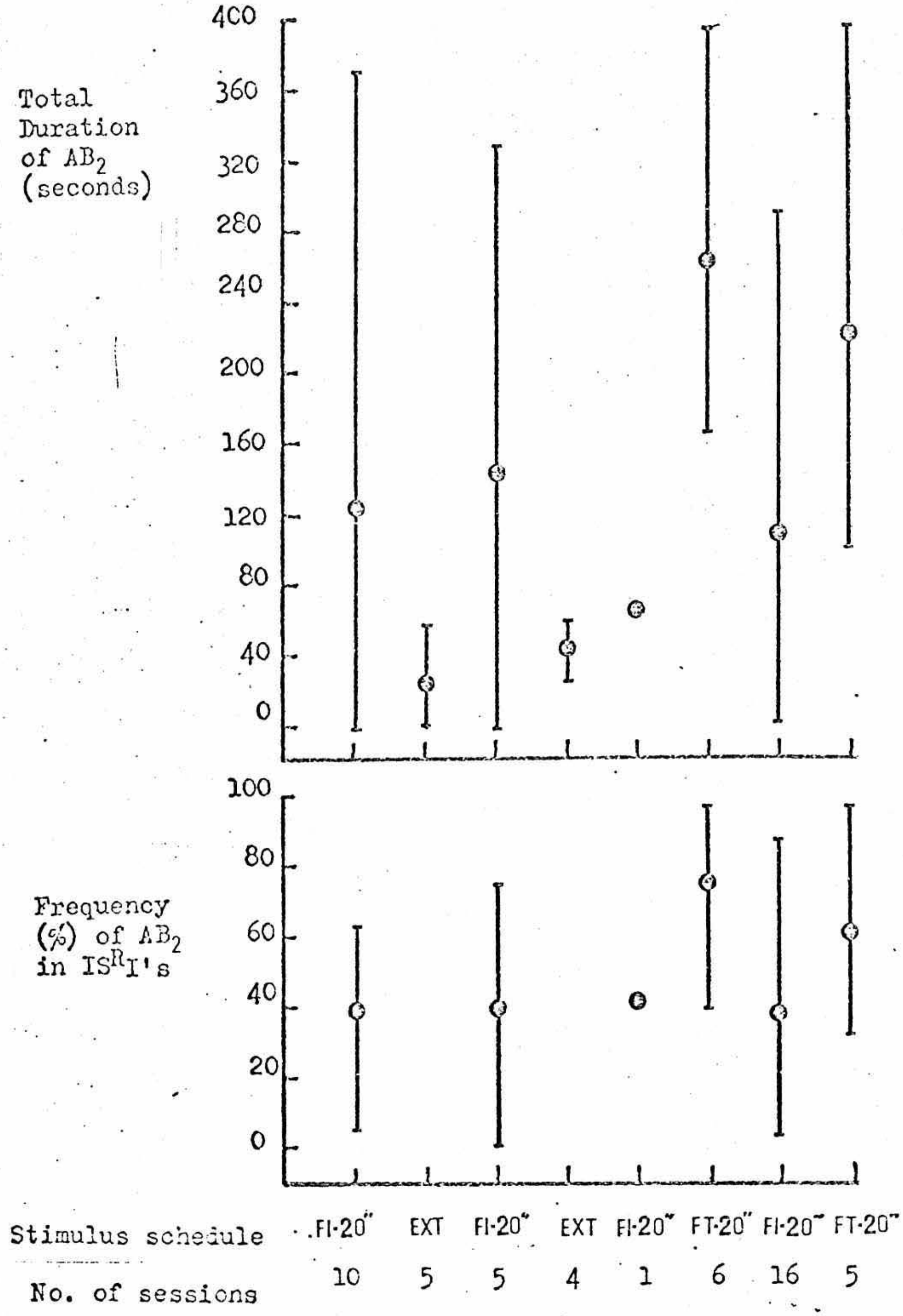


Figure 6 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_2 for Subject 1.

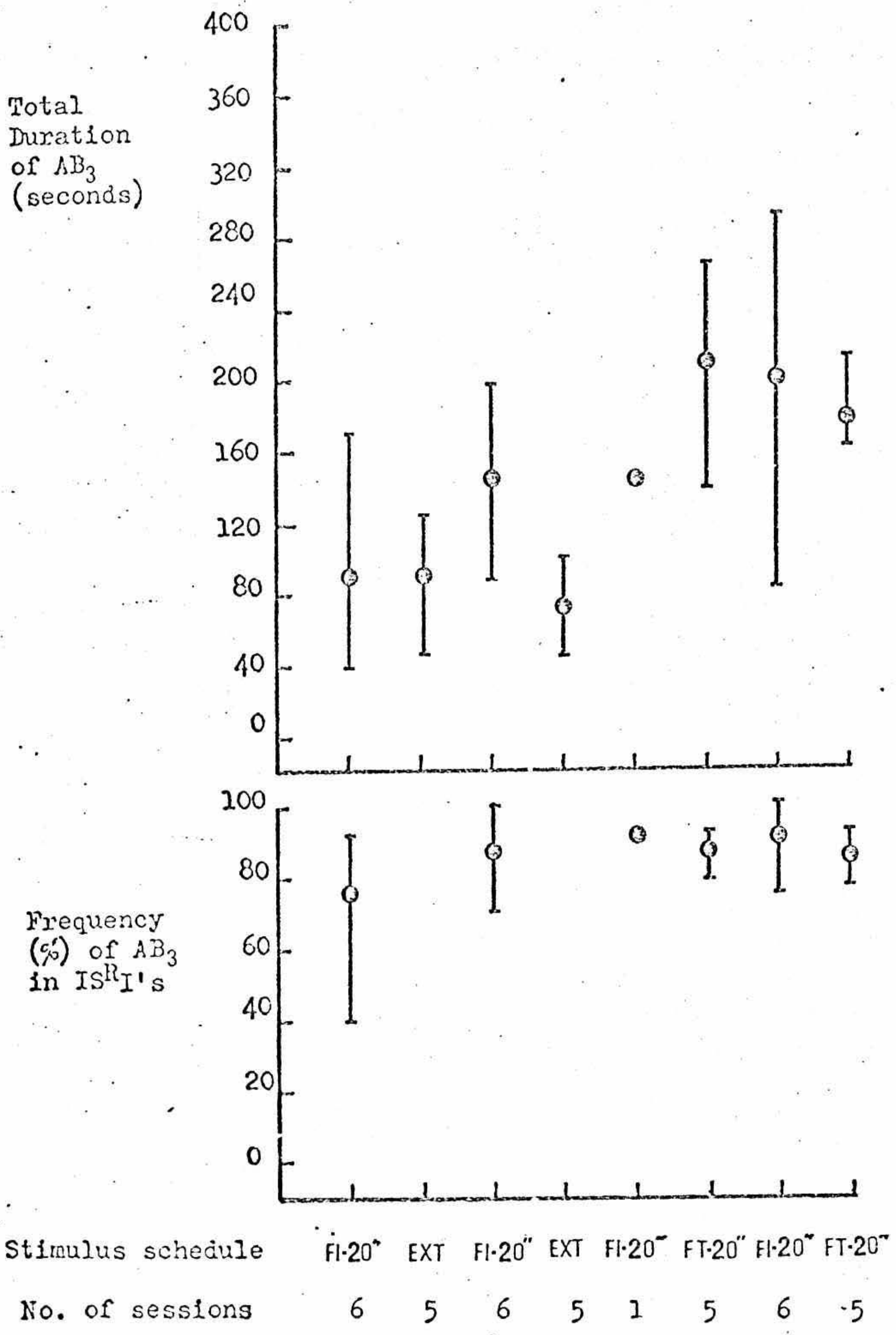


Figure 7 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 26.

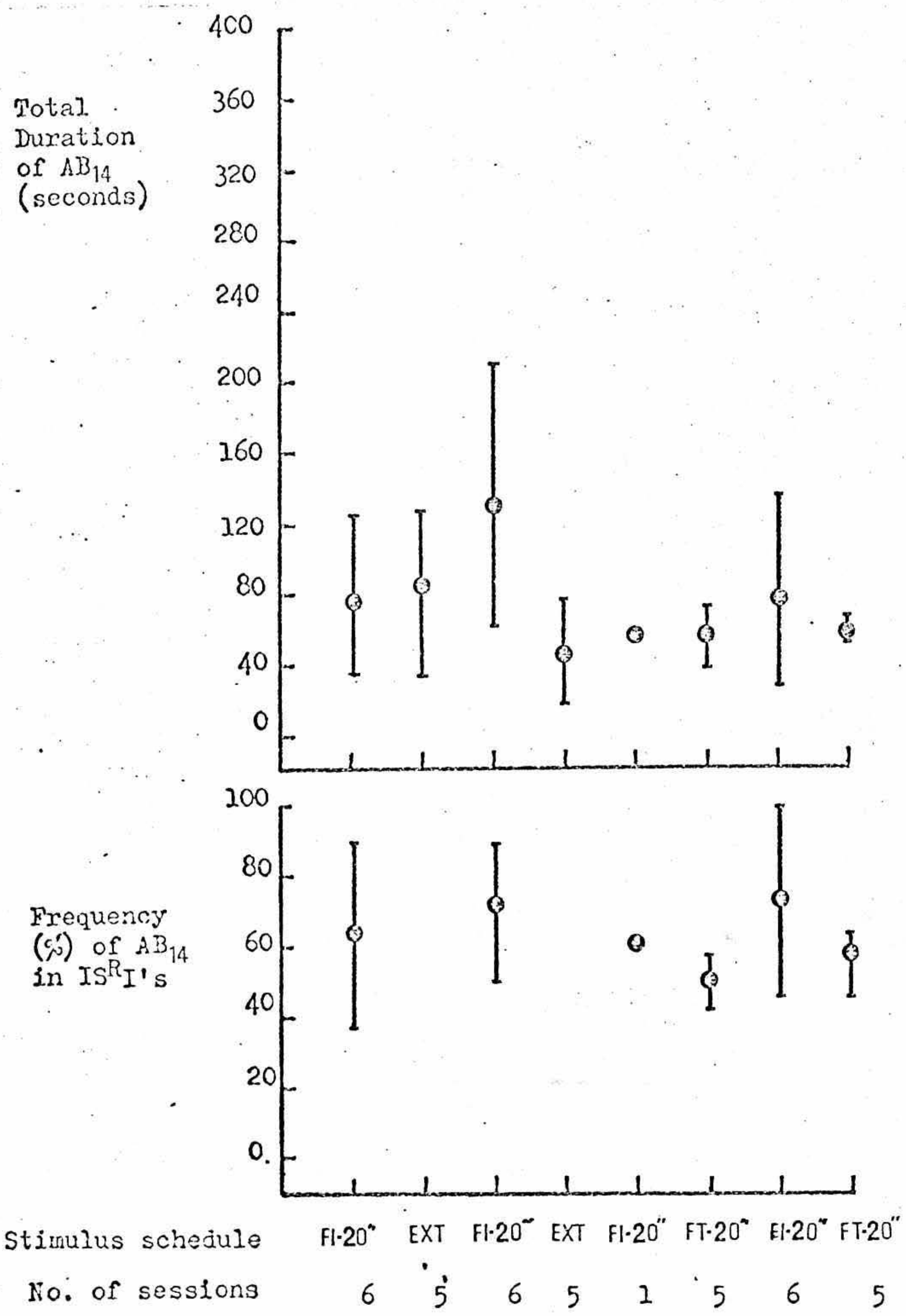
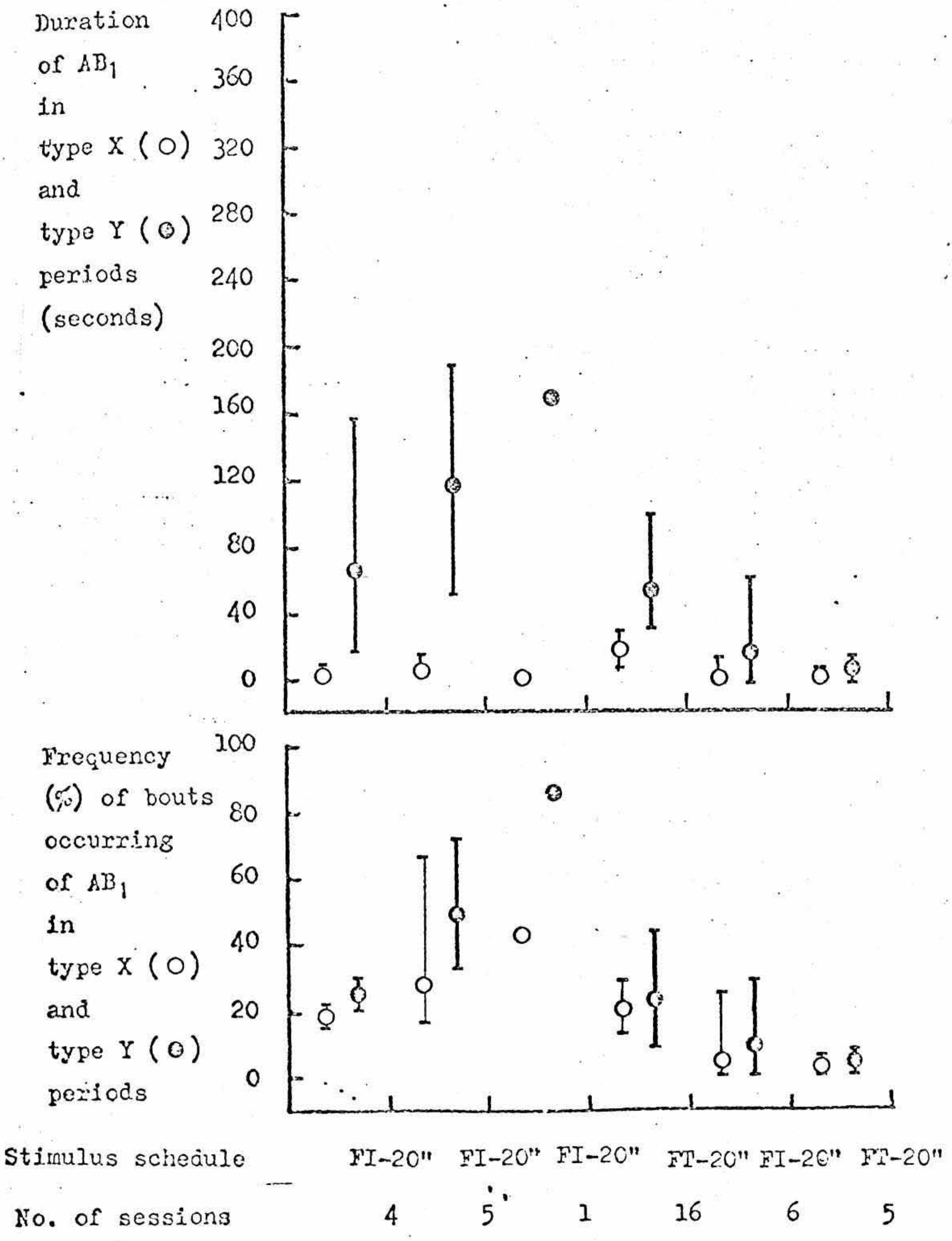


Figure 8 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_{14} for Subject 26.



<u>Figure 9</u> Means and ranges of durations and frequencies of bouts occurring of AB_1 in type X and type Y periods for Subject 1.

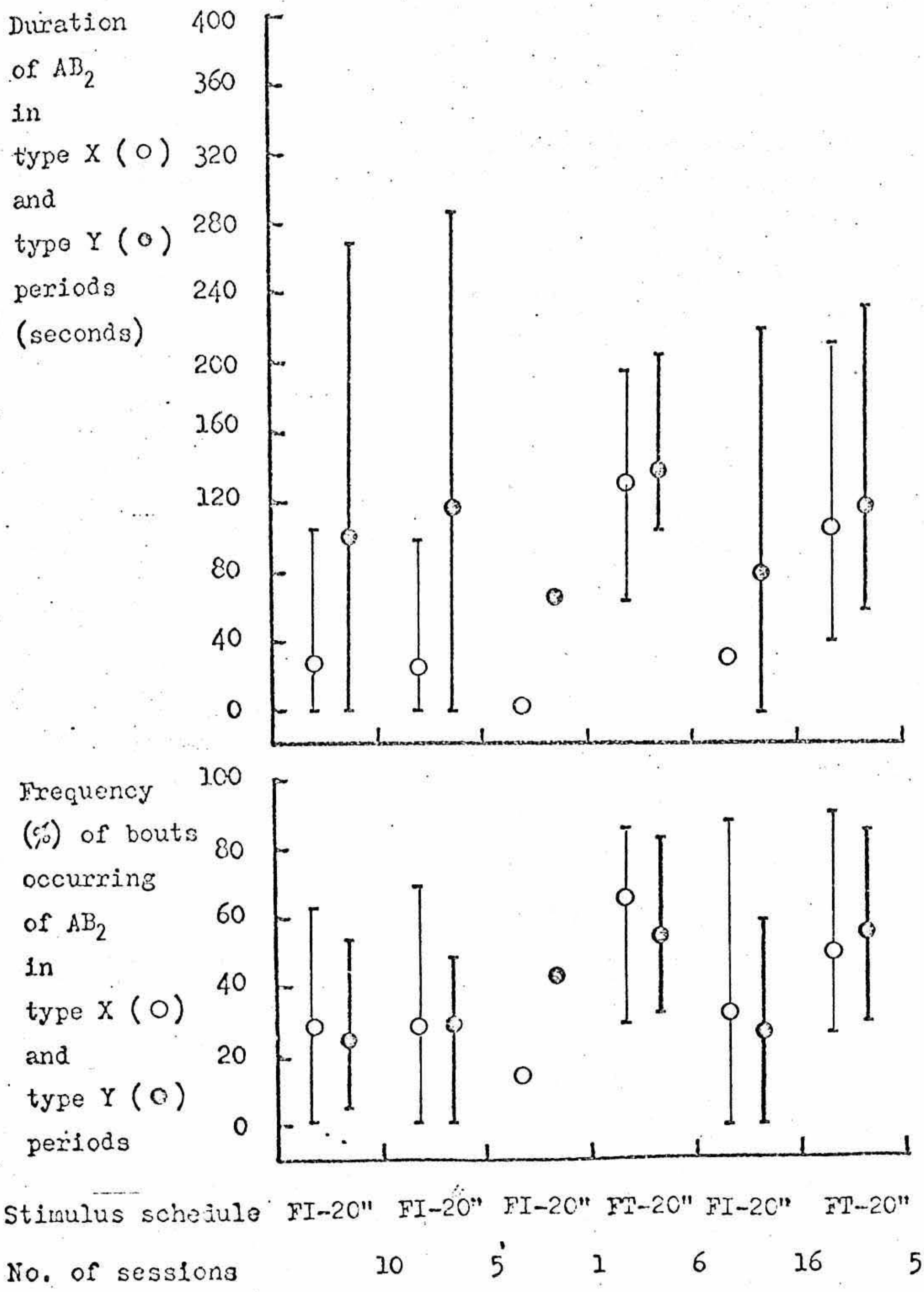


Figure 10 Means and ranges of durations and frequencies of bouts occurring of AB_2 in type X and type Y periods for Subject 1.

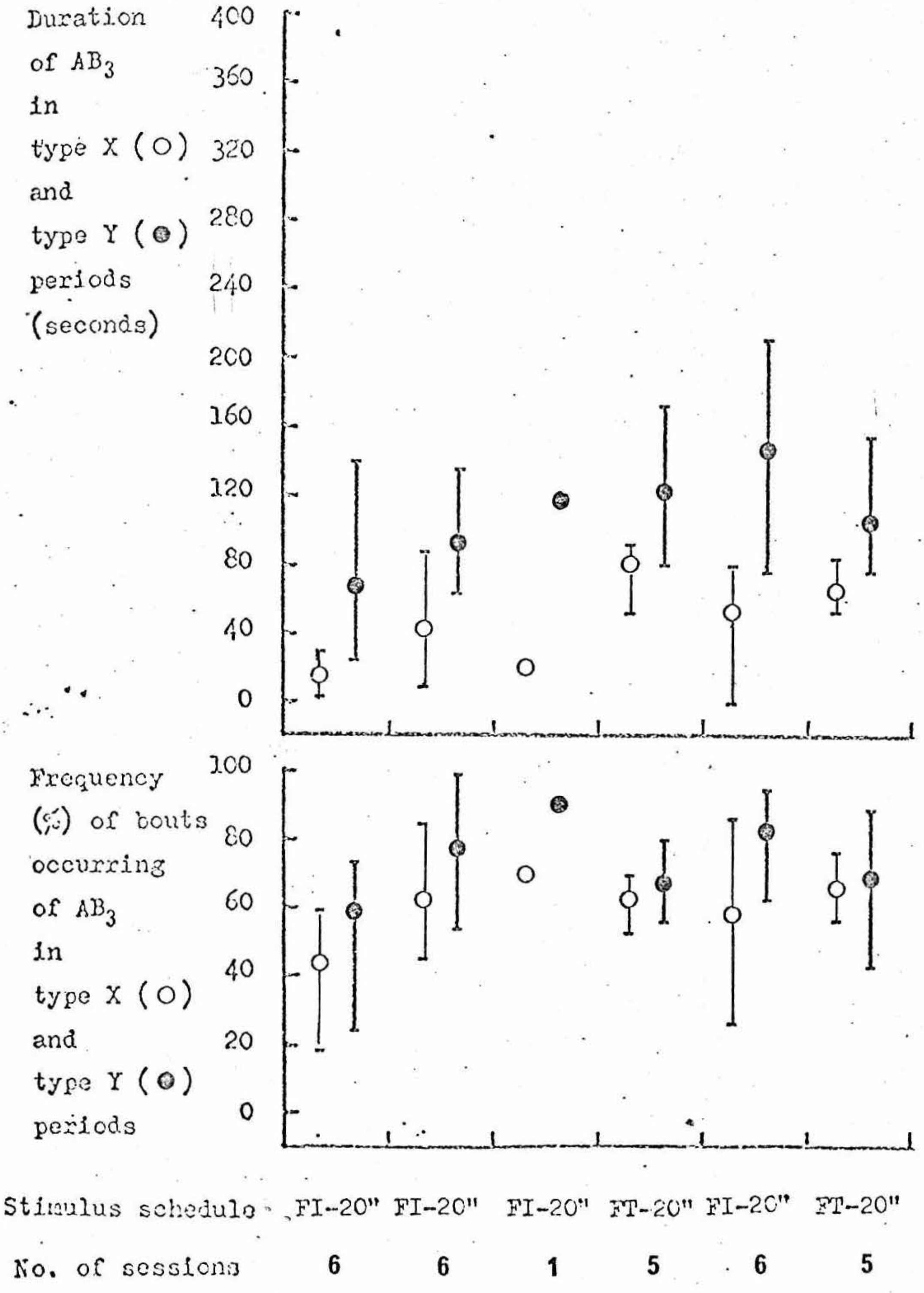


Figure 11 Means and ranges of durations and frequencies of bouts occurring of AB_3 in type X and type Y periods for Subject 26

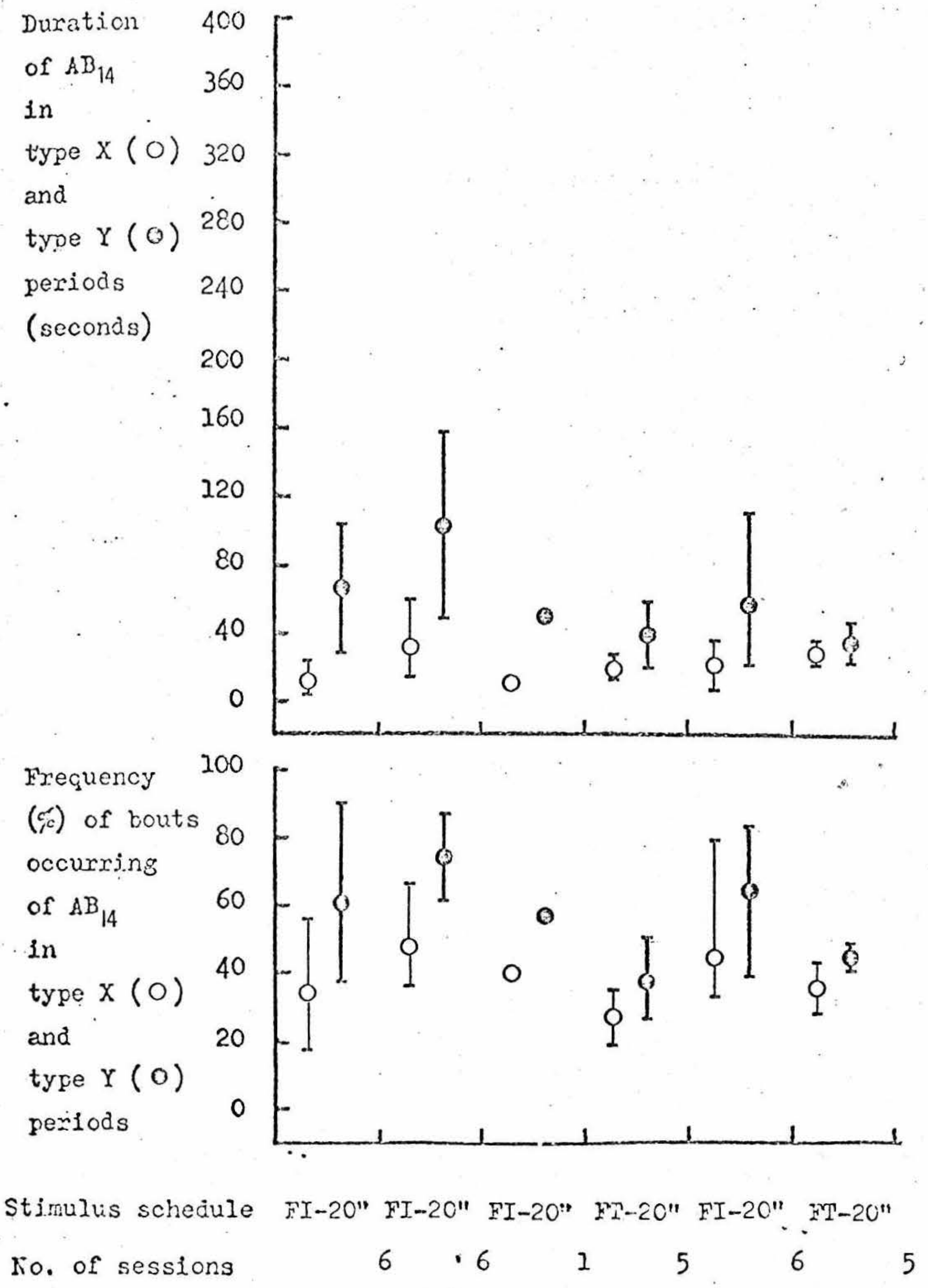


Figure 12 Means and ranges of durations and frequencies of bouts occurring of AB_{14} in type X and type Y periods for Subject 26.

periods for the fixed-interval and fixed-time conditions. For all alternative behaviours examined with both subjects, the highest durations tended to occur in the type Y periods. The frequencies of occurrence (bouts occurring) of alternative behaviours were slightly higher in the type Y periods than type X periods for Subject 26, and for Subject 1, they were almost equivalent. That is, for each subject, the alternative behaviours were equally likely to occur in type X and type Y periods, but the duration of occurrence tended to be longer later in the inter-stimulus intervals.

The mean duration of alternative behaviours in successive three minute intervals for each condition are shown in figures 13, 14 15 and 16. Figure 15 and 16 also show the range of these durations in each condition. In general the changes in duration across sessions did not produce any significant relations with the experimental conditions employed. The only exception to this was AB_3 with Subject 26. The duration of AB_3 was fairly consistent throughout sessions in each condition except extinction. In both the blocks of extinction sessions, there was a gradual decrease in the duration of AB_3 through each session. The ranges indicate that this picture was true for every extinction session.

The bout lengths of AB_1 and AB_2 for Subject 1 and AB_3 for Subject 26 are presented in figures 17, 18 and 19 respectively.

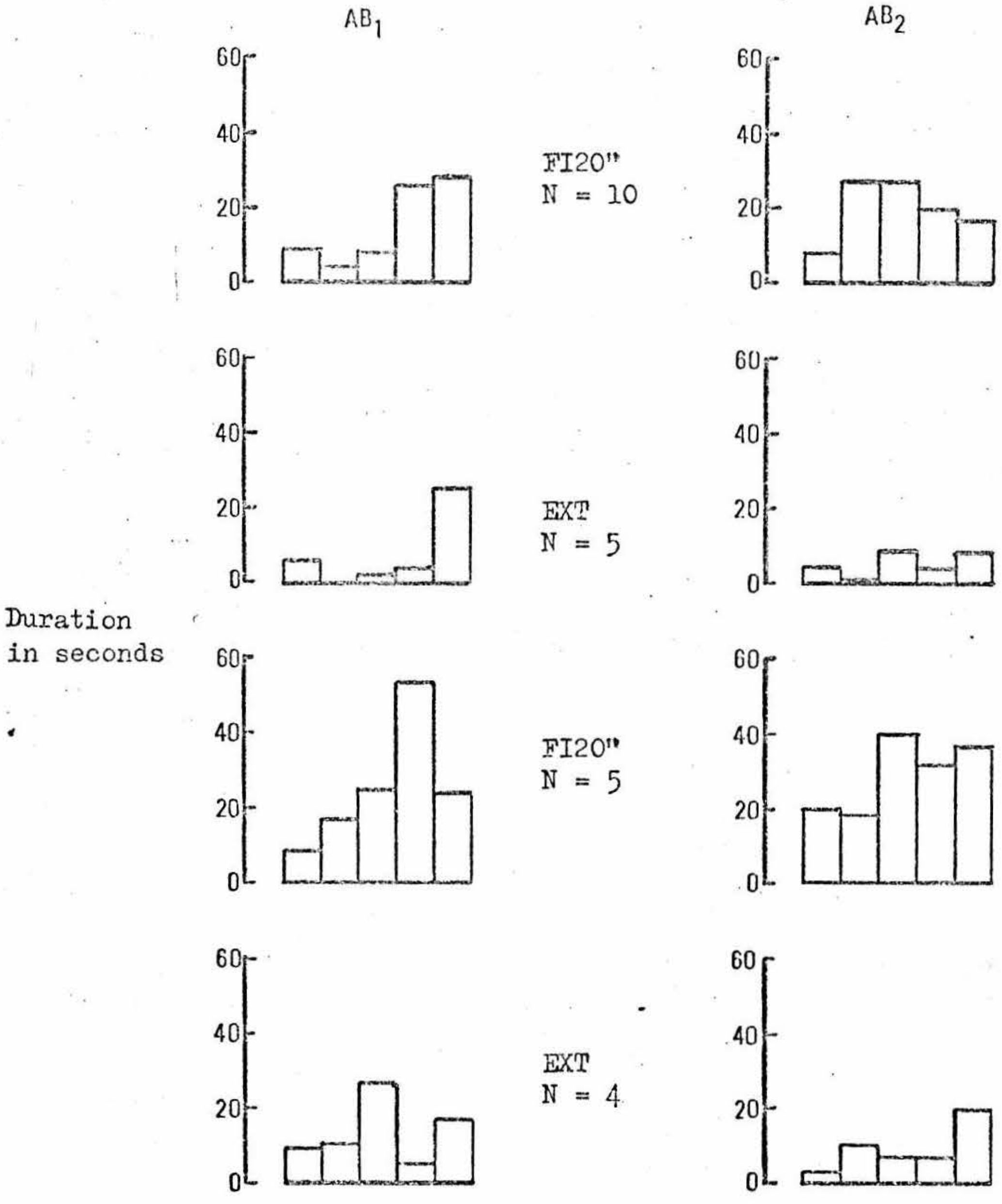
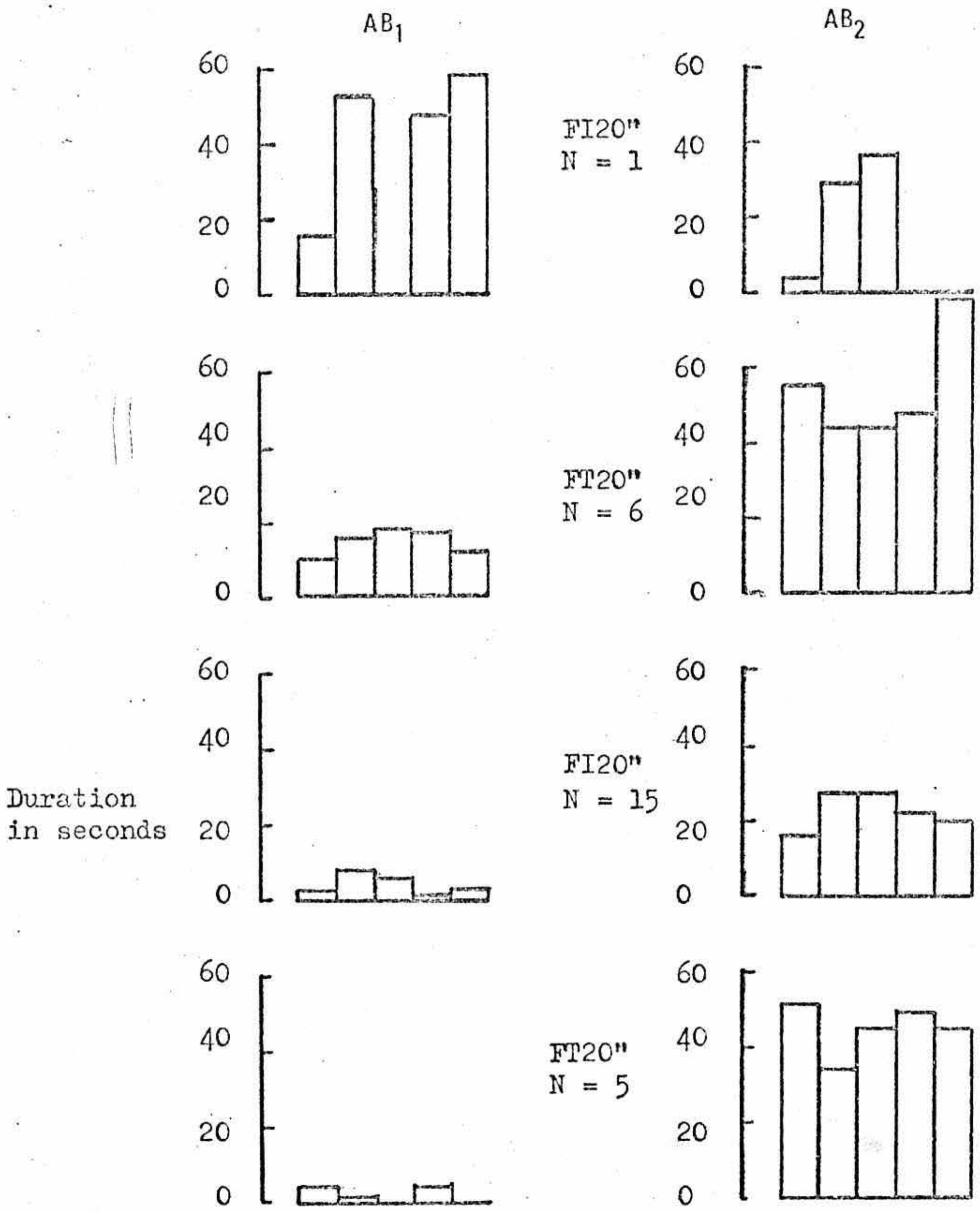


Figure 13 Mean durations of AB$_1$ and AB$_2$ in successive three-minute intervals for Subject 1.



<u>Figure 14</u> Mean durations of AB_1 and AB_2 in successive three-minute intervals for Subject 1 (continued from figure 13).

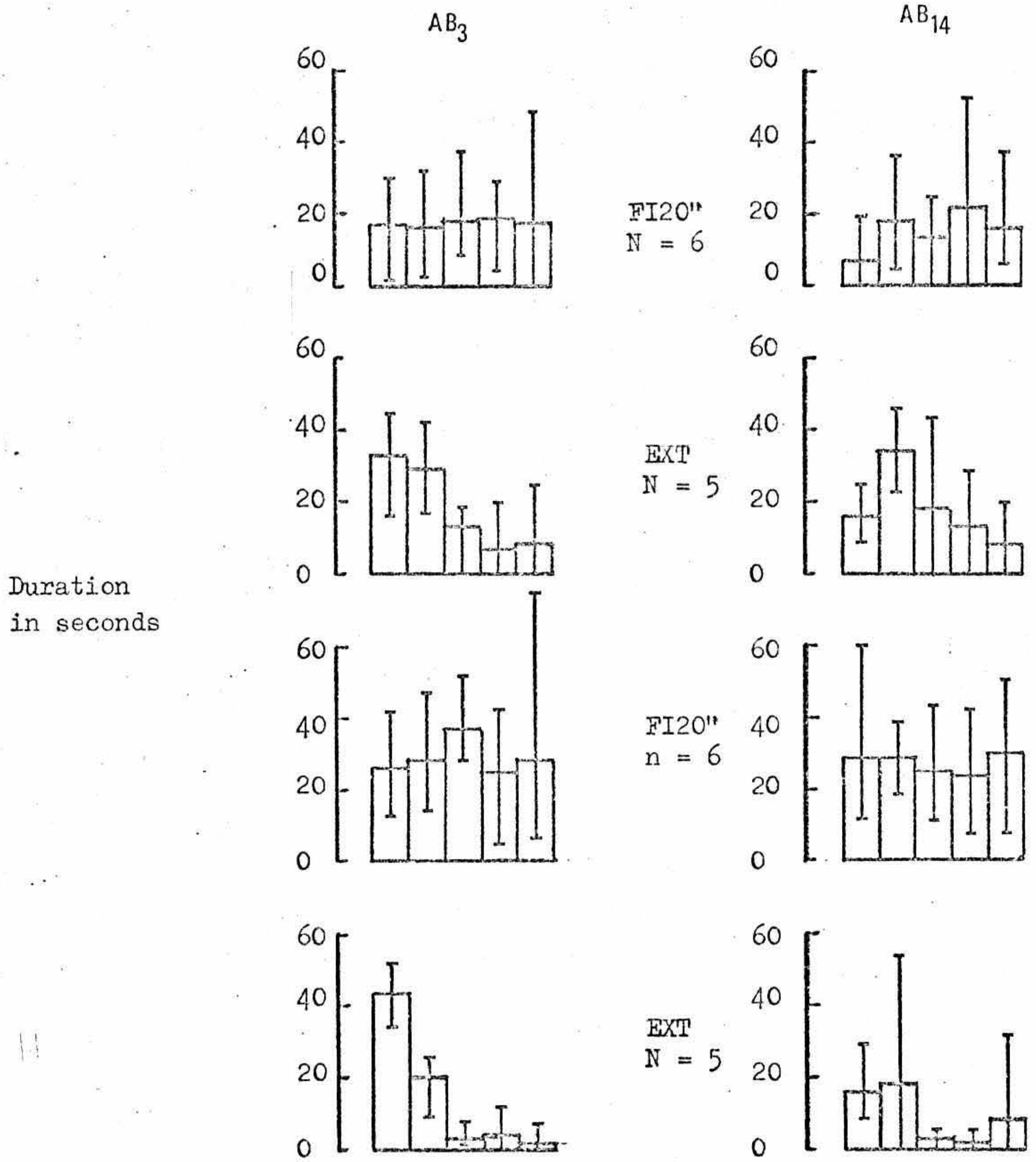


Figure 15. Mean durations and ranges of AB$_3$ and AB$_{14}$ in successive three-minute intervals for Subject 26

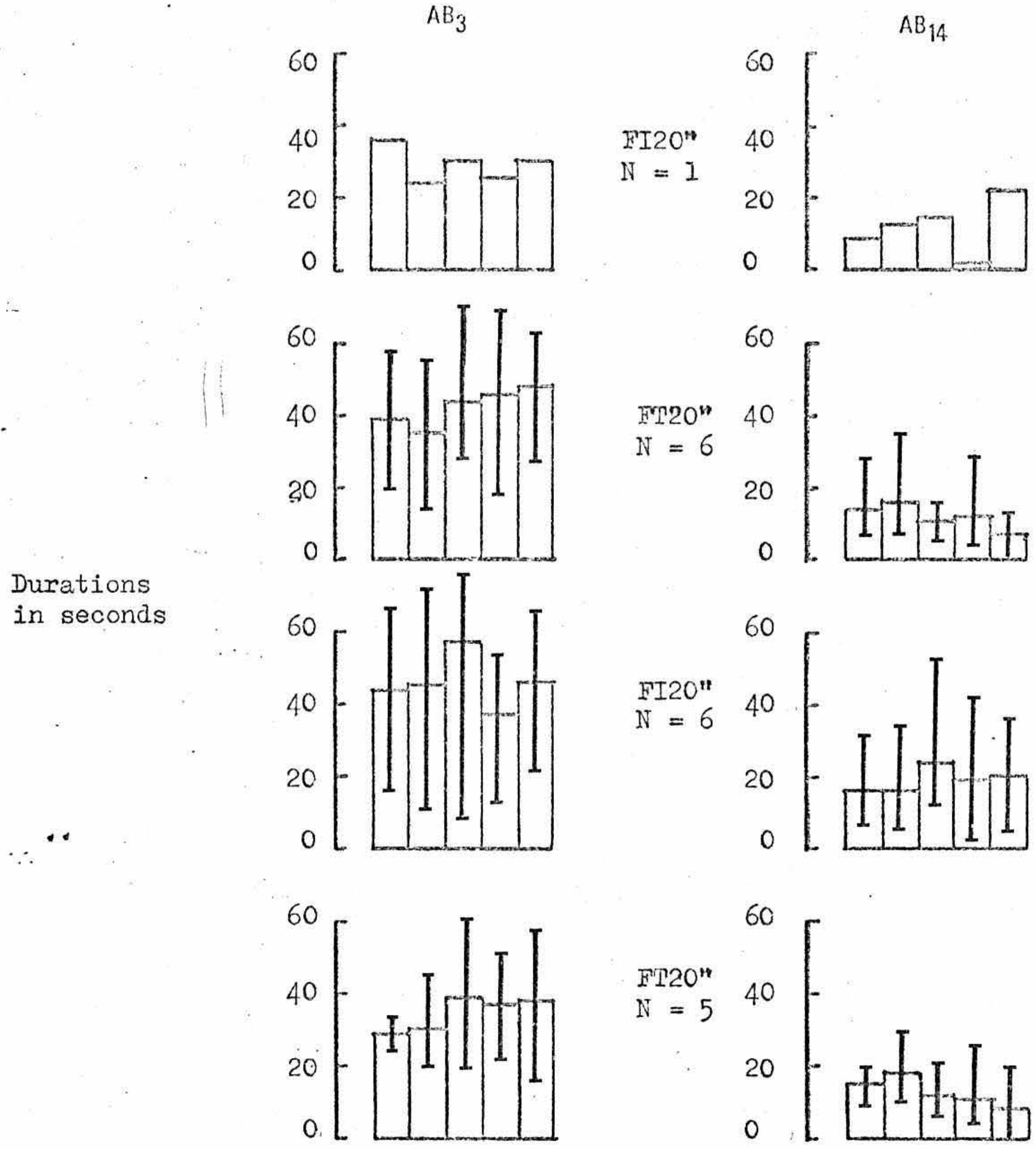


Figure 16 - Mean durations and ranges of AB_3 and AB_{14} in successive three-minute intervals for Subject 26 (continued from figure 15).

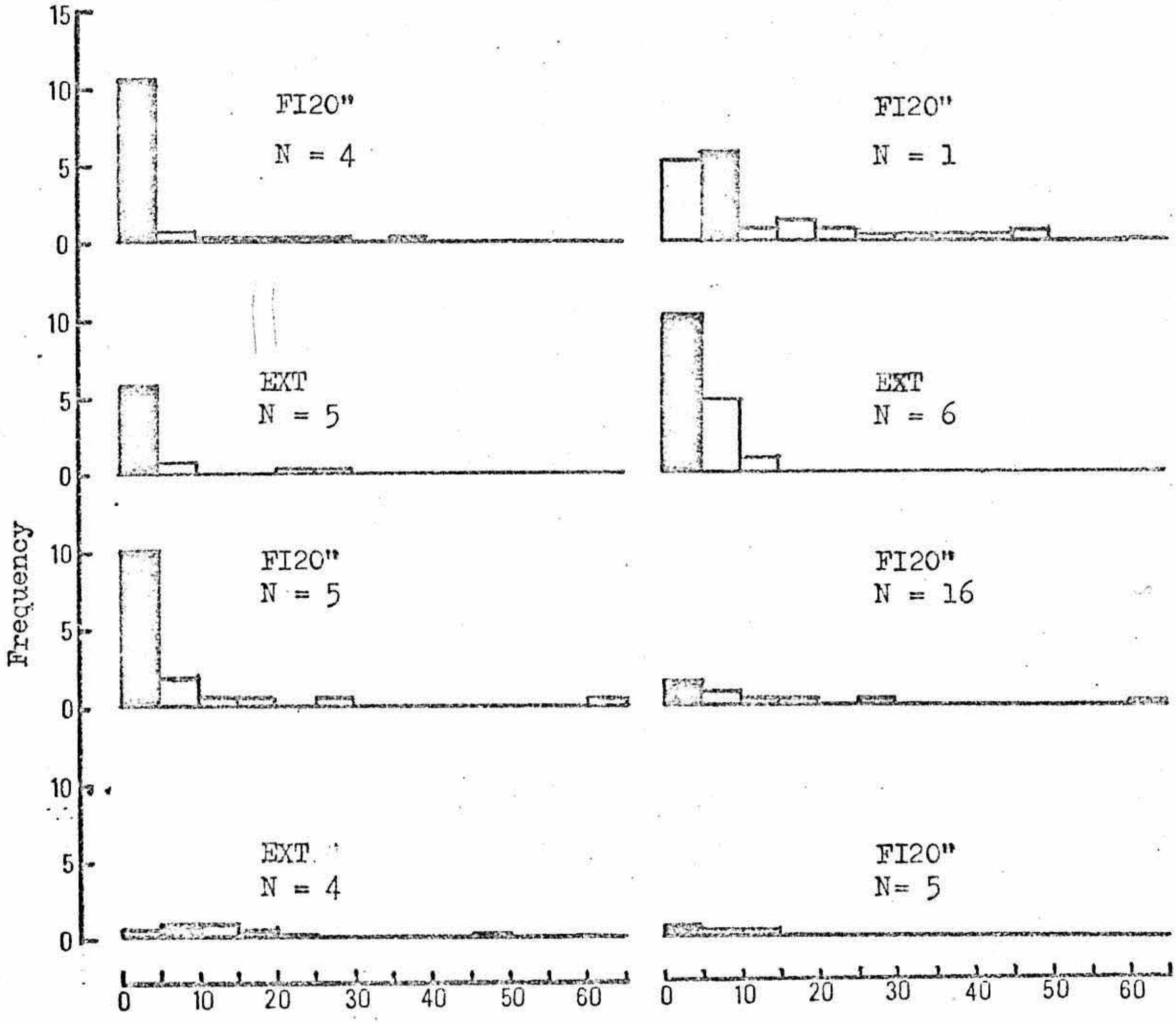


Figure 17 Mean frequency of bout lengths of AB_1 in five-second categories for Subject 1. The median bout-length category is shaded. The last category contains all bout lengths greater than sixty seconds.

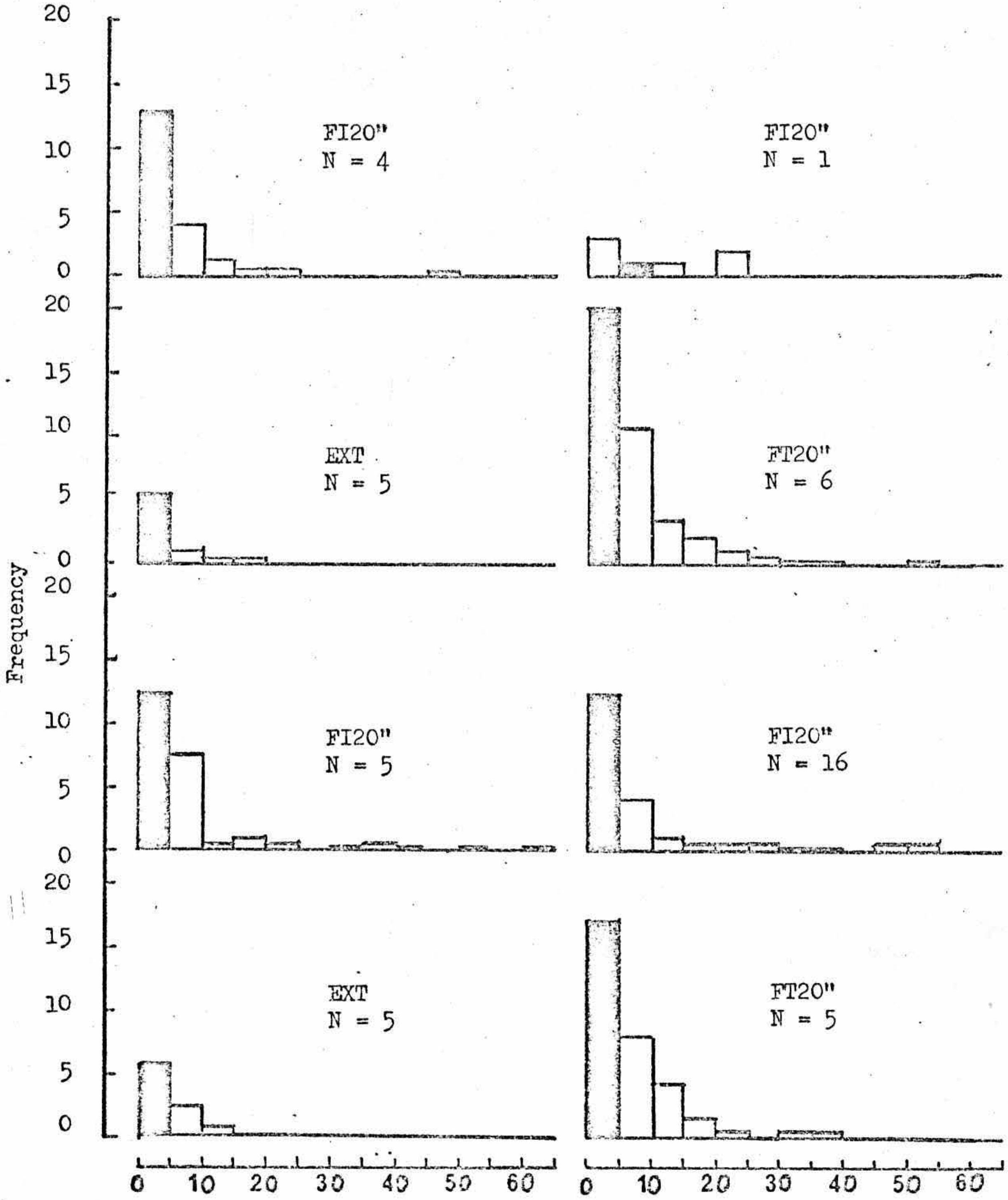
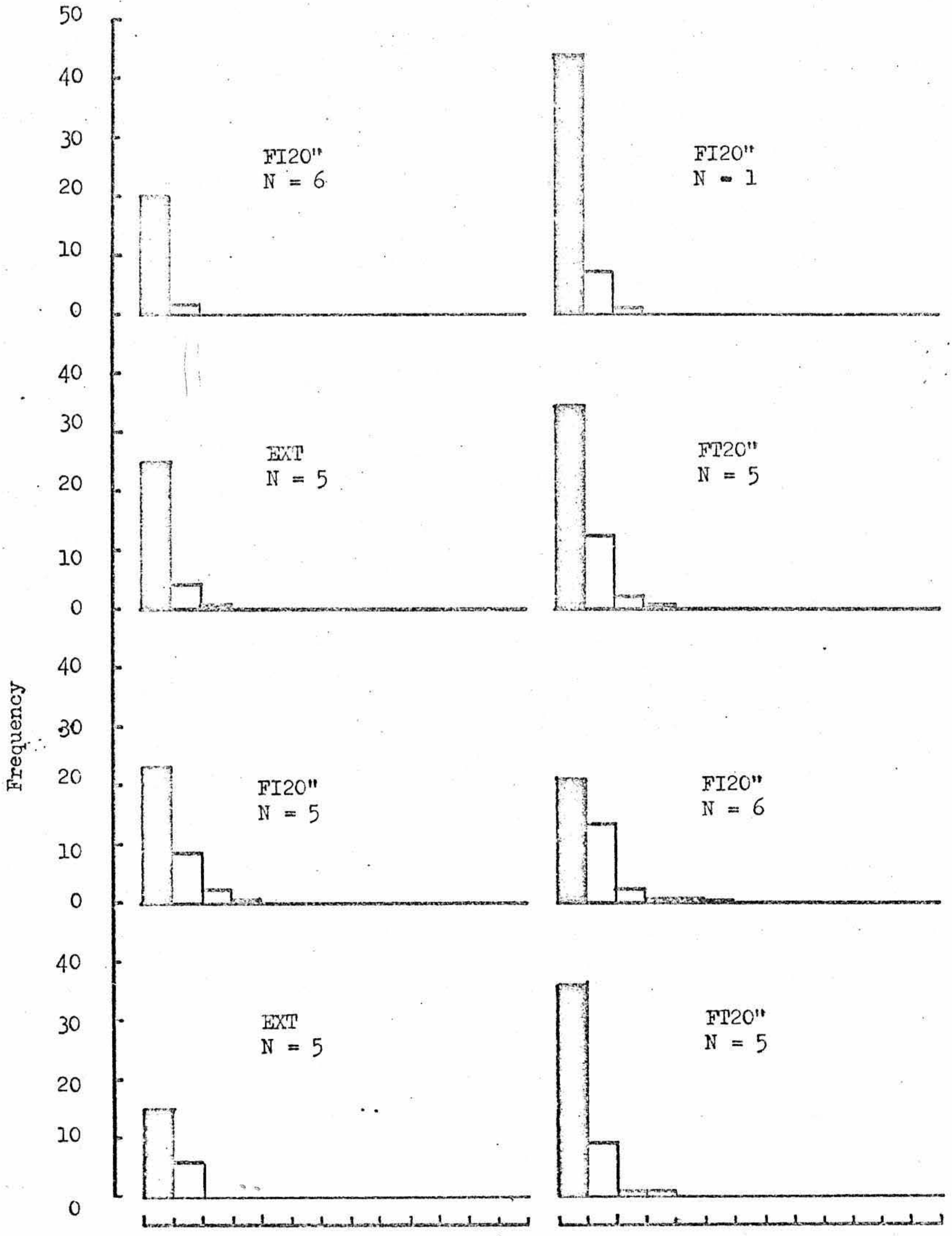


Figure 18 Mean frequency of bout lengths of AB_2 in five-second categories for Subject 1. The median bout length category is shaded. The last category contains all bout lengths greater than sixty-seconds.



<u>Figure 19</u> Mean frequency of bout lengths of AB_3 in five-second categories for Subject 26. The last category contains all bout lengths greater than sixty-seconds The Mediam bout length category is shaded.

The five-second categories in which the median bout lengths occurred are shaded on the histograms. For all three alternative behaviours, the mode and median bout length nearly always fell in the first five-second category and the distributions were mainly exponential in shape. Changes in the distributions of bout lengths were not significantly related to changes in experimental conditions for the parameters examined.

Discussion

For each subject two behaviours appeared to be unrelated to the experimental conditions and two behaviours did vary with the schedule manipulations. Interestingly the two behaviours which did show a relationship with the schedule of stimulation were behaviours that were reported as occurring regularly in the subjects' daily lives. AB_2 ("Waving finger in front of face") has also been described as a self-stimulatory behaviour with retardates (e.g. Kaufman and Levitt, 1965).

The finding of a relatively lower duration of AB_2 (for Subject 1) and AB_3 (for Subject 26) in extinction conditions contrasts with previous findings for self-stimulatory behaviours with retardates (e.g. Hollis, 1968; Baumeister and Forehand, 1971). The result is more like a "schedule-induced" relationship with the schedule of stimulation (e.g. Kachanoff et al, 1973).

For Subject 26, the relationship of AB_3 with the schedule of stimulation could even be interpreted as a "reinforcement" relationship. In studies of "operant" behaviour it is often reported that the rate of occurrence of the operant decreases with respect to time in extinction. Figure 15 showed that the duration of AB_3 decreased through the extinction sessions. AB_3 was more sensitive to changes in the schedule of stimulation than the descriptive operant, lever-pressing.

CHAPTER 10

PRESENCE AND ABSENCE OF A MANIPULANDUM.

CHAPTER 10

PRESENCE AND ABSENCE OF A MANIPULANDUM

Introduction

Staddon and Ayres (1976) reported that, with rats on a fixed-time 30-seconds food schedule, elimination of the opportunity to engage in one or more activities resulted in changes in the other alternative behaviours.

This experiment intended to replicate that reported in Chapter 9, but with an additional condition, a fixed-time component in which the opportunity to engage in the "operant" was not available.

Subjects

Subject 5, 11, 12 and 20 served in this experiment. For

Subject 5 the experiment followed that one reported in Chapter 11 for Subjects 12 and 20, it followed that one reported in Chapter 12. For Subject 11 it followed the experiment reported in Chapter 17.

Apparatus and Procedure

Five second exposures of slides were used as scheduled stimuli for all Subjects, but for Subject 12, this was presented simultaneously with pop-music. With Subject 11 a bowl of smarties was available throughout the sessions. In the experimental conditions in which no manipulandum was available, the panel with the lever attached was replaced with a plain panel which was identical in all respects except that there was no lever in the centre.

Subject 12 had refused to stay more than a few seconds in fixed-interval sessions which followed those reported in Chapter 12. In an attempt to get her to participate further in this experiment she was started on a fixed-time session. This proved to be more effective in getting her to stay in the experimental room for a substantial period of time.

Interval schedules of twenty-seconds were used with Subjects 12 and 20, and interval schedules of thirty-seconds were used with Subjects 5 and 11. Fixed-time schedules, with and without the lever present, and extinction were alternated with fixed-interval conditions. With Subject 11, two extinction conditions were examined; with and without a lever. A lever was always present in extinction for the other three subjects. The sequence of experimental conditons and the number of sessions in each condition are indicated in figures 20, 21, 22 and 23.

Results

Subject 5 and 11 obtained almost every possible stimulus delivery in the fixed-interval sessions. This was not the case for Subjects 12 and 20. Figures 20, 21, 22 and 23 show the mean overall response rates in each schedule condition, the obtained frequency of stimulation in the fixed-interval conditions relative to the fixed-time and extinction conditions, the frequency of pauses in responding greater than ten-seconds and the frequencies of over-runs of responding and responses in stimulus presentations.

Subject 12 did not remain for the full fifteen minutes in every session.The mean and range of session durations for Subject 12 are shown in Table 4. Over-runs, responses in stimulus presentations and pauses greater than ten-seconds are not available for Subject 12 because of the differences in session duration. Subject 5 produced no over-runs of responding.

Response rates for Subjects 11 and 12 were variable and did not appear to be related to the schedule of stimulation. For Subjects 5 and 20, response rates in the fixed-time with lever

Figure 20. Details of lever-pressing for Subject 5. The graphs, in descending order, show :- frequency of pauses greater than ten-seconds, frequency of responses during stimulus presentations, frequency of stimuli obtained per opportunity and response rate. All graphs show means and ranges.

Figure 21. Details of lever-pressing for Subject 11. The graphs, in descending order, show :- frequency of pauses greater than ten-seconds, frequencies of over-runs of responding and responses during stimulus presentations, frequency of stimuli obtained per opportunity and response rate. All graphs show means and ranges.

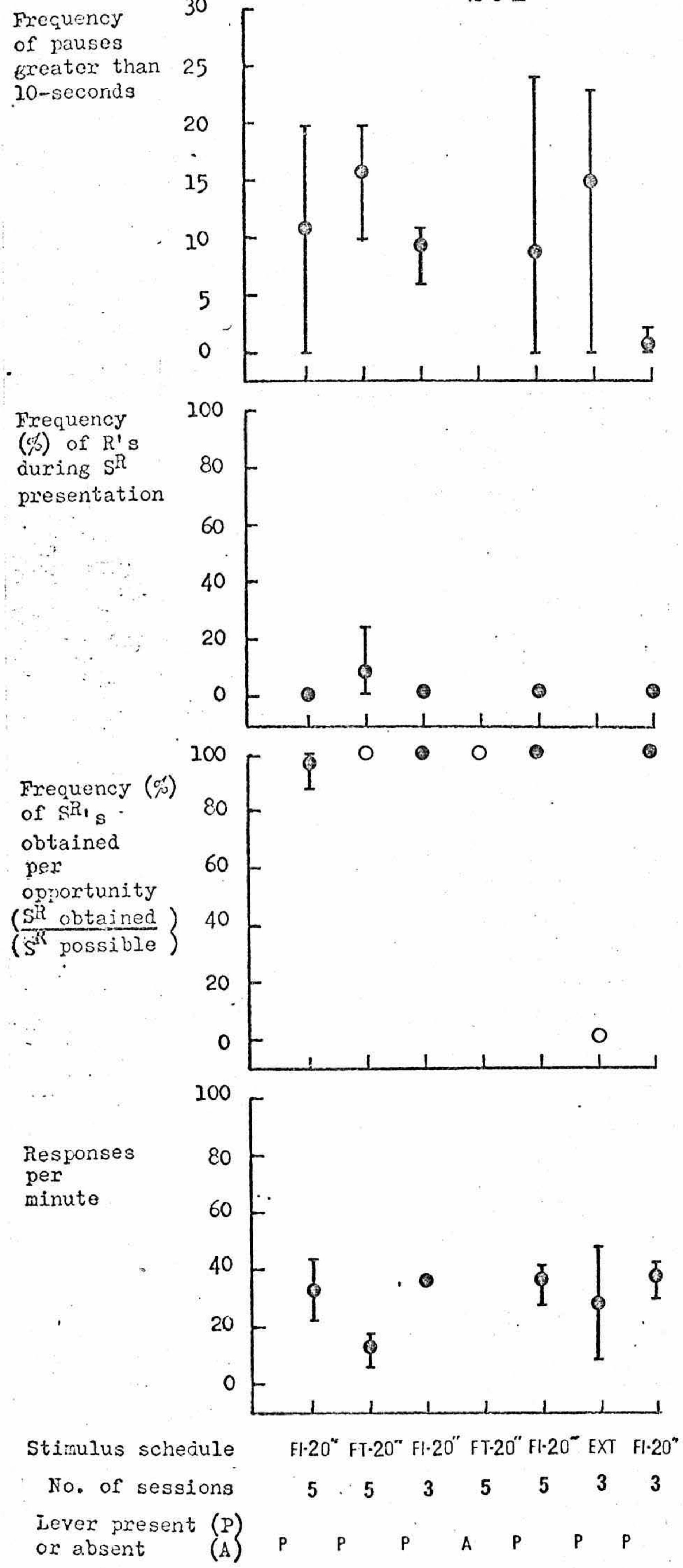

Frequency of pauses greater than 10-seconds
30
25
20
15
10
5
0
Frequency (%) of R's during S^R presentation
100
80
60
40
20
0
Frequency (%) of S^R's obtained per opportunity
($\frac{S^R \text{ obtained}}{S^R \text{ possible}}$)
100
80
60
40
20
0
Responses per minute
100
80
60
40
20
0
Stimulus schedule
FI-20"
FT-20"
FI-20"
FT-20"
FI-20"
EXT
FI-20"
No. of sessions
5
5
3
5
5
3
3
Lever present (P) or absent (A)
P
P
P
A
P
P
P

Figure 20

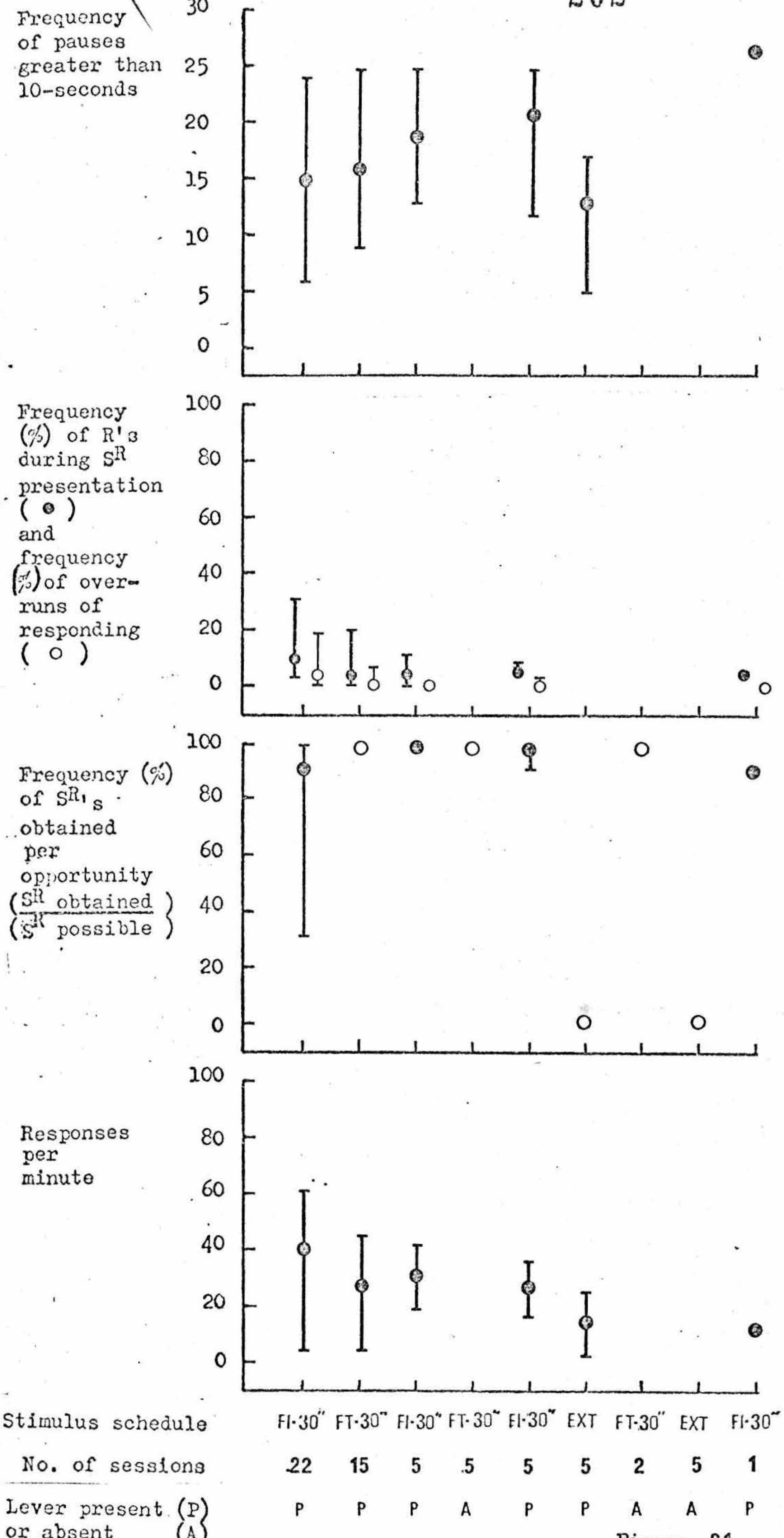

Frequency of pauses greater than 10-seconds
30
25
20
15
10
5
0
Frequency (%) of R's during S^R presentation (●) and frequency (%) of over-runs of responding (○)
100
80
60
40
20
0
Frequency (%) of S^R's obtained per opportunity (S^R obtained / S^R possible)
100
80
60
40
20
0
Responses per minute
100
80
60
40
20
0
Stimulus schedule
FI·30" FT·30" FI·30" FT·30" FI·30" EXT FT·30" EXT FI·30"
No. of sessions
22 15 5 5 5 5 2 5 1
Lever present (P) or absent (A)
P P P A P P A A P

Figure 21

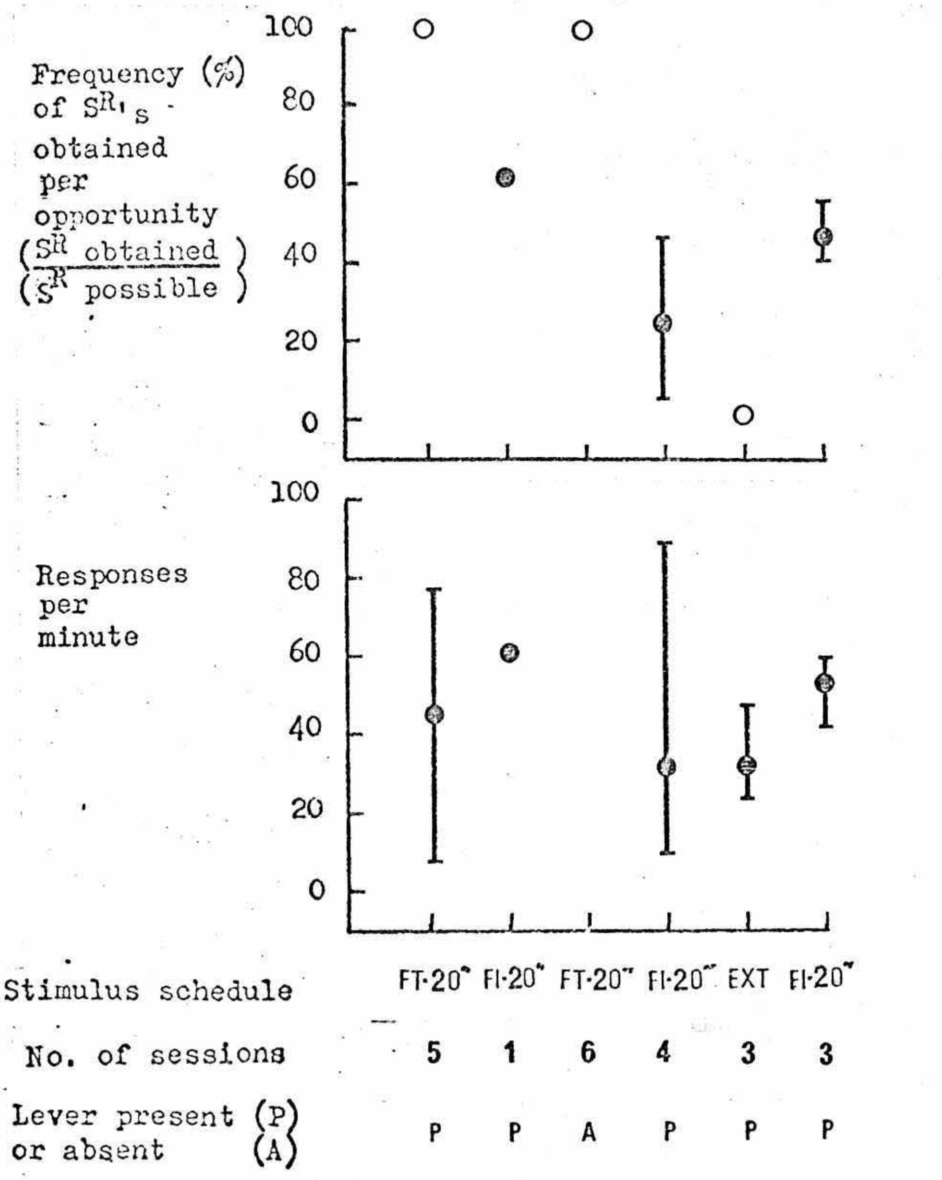


Figure 22 - Frequency of stimuli obtained per opportunity and responses per minute for Subject 12.

Figure 23. Details of lever-pressing for Subject 20. The graphs, in descending order, show :- frequency of pauses greater than ten-seconds, frequencies of overruns of responding and responses during stimulus presentations, frequency of stimuli obtained per opportunity and response rate. All graphs show means and ranges.

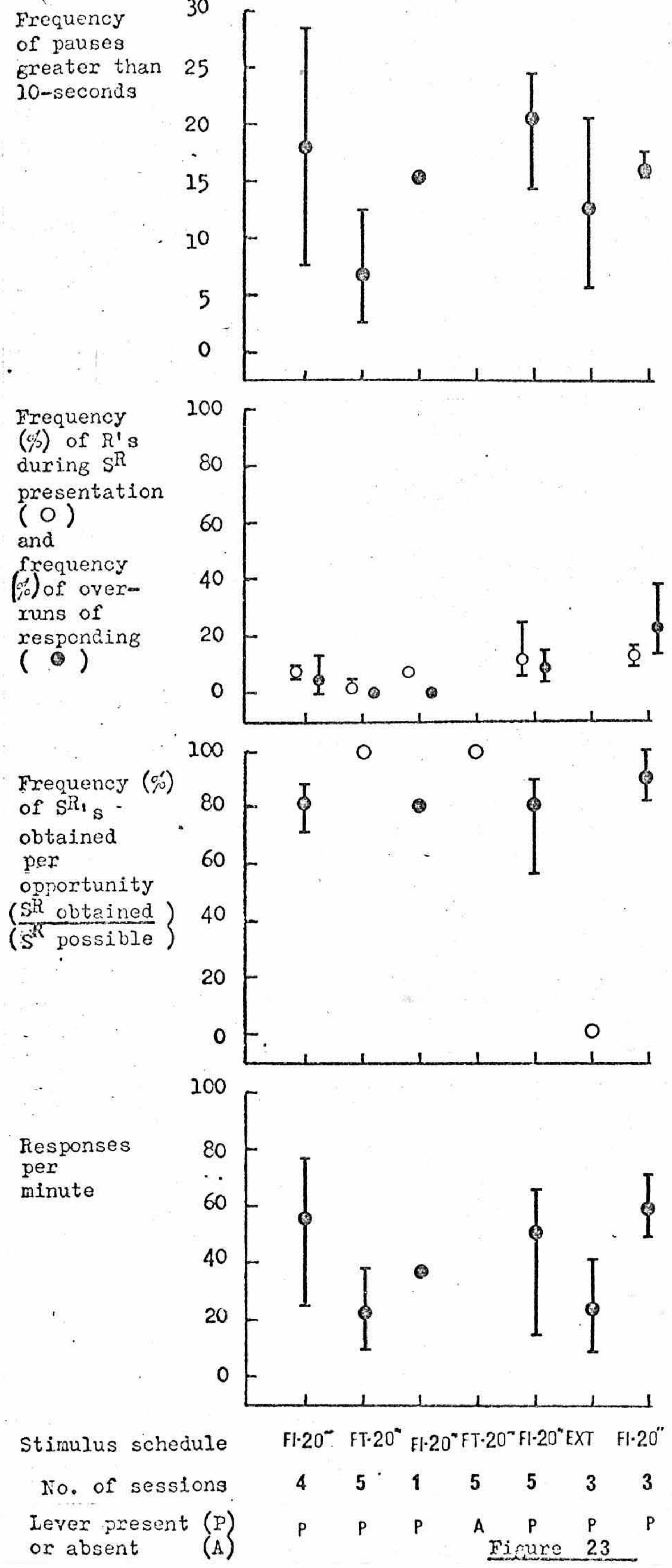

Frequency of pauses greater than 10-seconds
30
25
20
15
10
5
0
Frequency (%) of R's during S^R presentation (○) and frequency (%) of over-runs of responding (●)
100
80
60
40
20
0
Frequency (%) of S^R's obtained per opportunity (S^R obtained / S^R possible)
100
80
60
40
20
0
Responses per minute
100
80
60
40
20
0
Stimulus schedule
FI-20" FT-20" FI-20" FT-20" FI-20" EXT FI-20"
No. of sessions
4 5 1 5 5 3 3
Lever present (P) or absent (A)
P P P A P P P

Figure 23

TABLE 4 - The mean and range of session durations for Subject 12

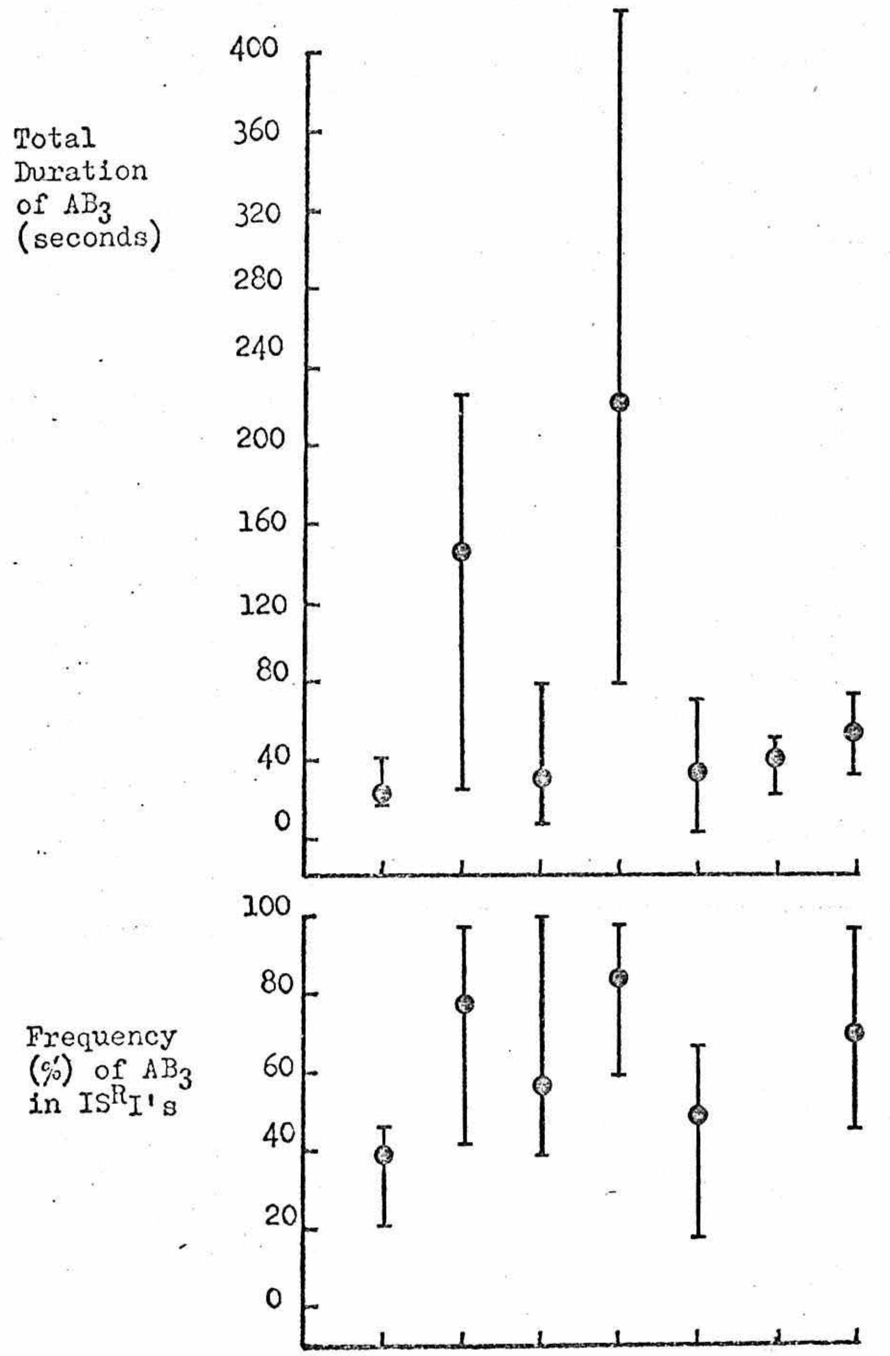
Schedule	No. of sessions	Mean session duration with range in parenthesis
FT 20 - secs (with lever)	5	14.8 mins (14.0 - 15.0 mins)
FI20 - secs	1	15.0 mins
FT20 - secs (without lever)	6	9.1 mins (3.3 - 15.0 mins)
FI20 - secs	4	12.3 mins (10.1 - 15.0 mins
EXT	3	9.0 mins (8.0 - 9.0 mins)
FI20 - secs	3	5.7 mins (3.1 - 10.1 mins)

present condition were relatively lower than in the fixed-interval conditions.

Pauses greater than ten-seconds were variable and did not appear to be related to the schedule of stimulation. The relatively lower frequency in the fixed-time with lever present condition for Subject 20 was mainly the result in a shift to extremely long pauses in responding. Over-runs of responding and the frequency of responses in stimulus presentations were not related to the schedule of stimulation. For Subject 11, both frequencies decreased as a function of the number of sessions, and for Subject 20 both frequencies increased as a function of the number of previous sessions.

The durations and frequencies of alternative behaviours are shown in figures 24, 25, 26, 27, 30, 31, 32 and 33 . Figure 28 shows the number of sweets consumed by Subject 11 in each schedule condition, and figure 29 shows the actual frequency of bouts of AB_6 for Subject 12 in each schedule condition. Since Subject 12's sessions varied in duration, the durations of alternative behaviours have been expressed as a precentage of the total session duration

Relationships between alternative behaviours and the schedules of stimulation varied considerably between subjects and between alternative behaviours. AB_3 for Subject 11 and AB_{10} for Subject 12 did not show any relationships with the experimental conditions



Stimulus schedule	FI-30"	FT-30"	FI-30"	FT-30"	FI-30"	EXT	FI-30"
No. of sessions	5	5	3	5	5	3	3
Lever present (P) or absent (A)	P	P	P	A	P	P	P

Figure 24 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 5

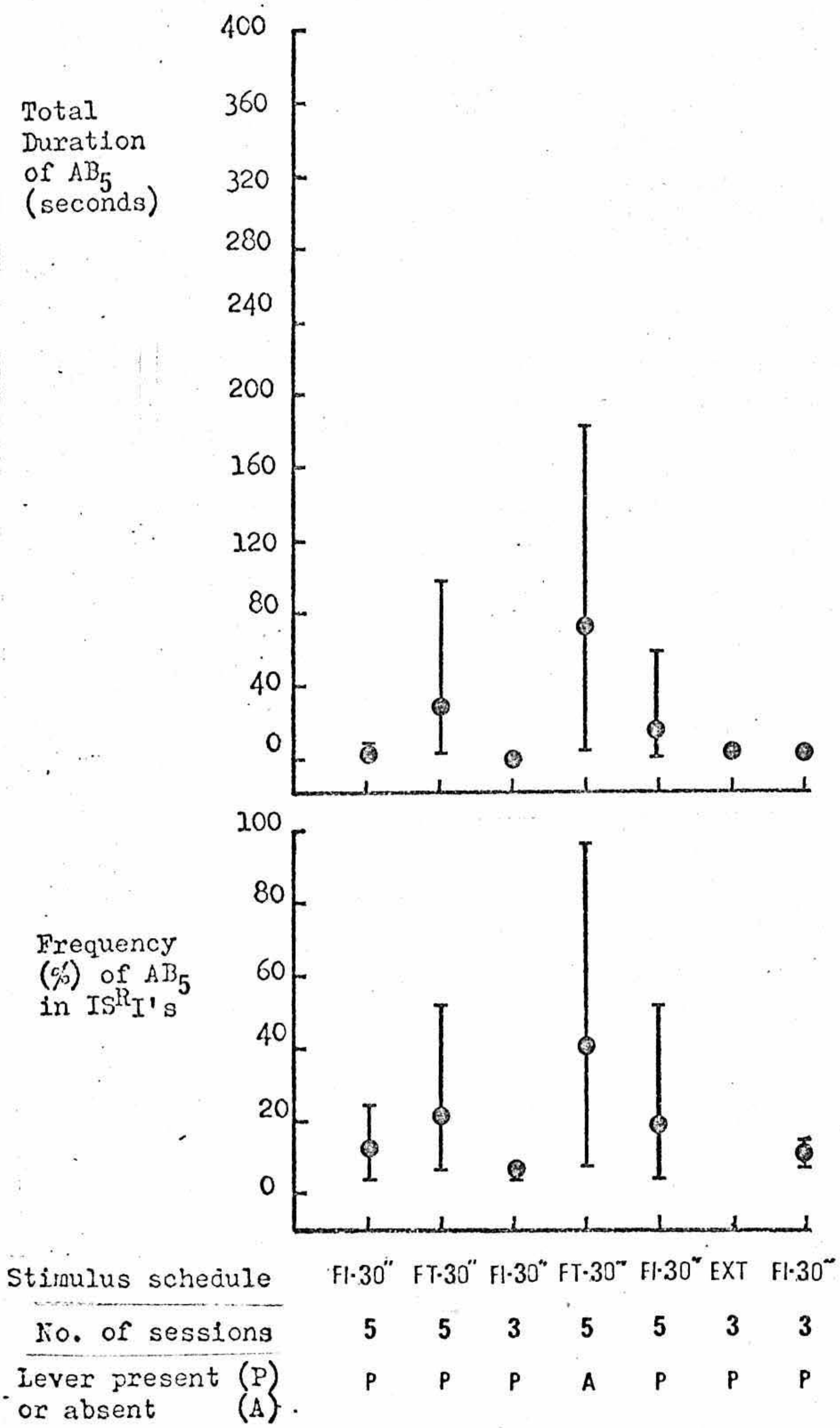


Figure 25 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_5 for Subject 5.

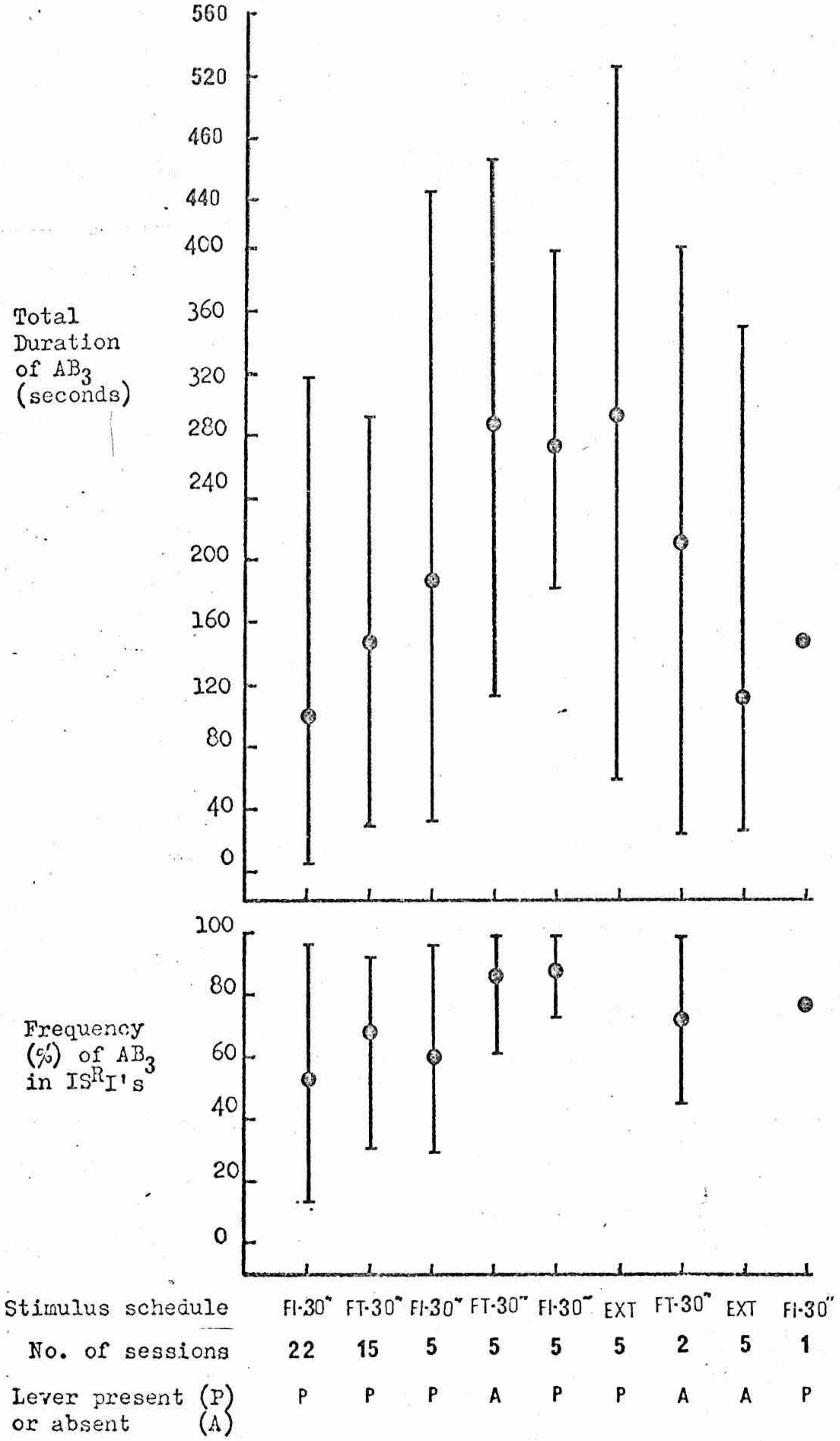


Figure 26 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 11

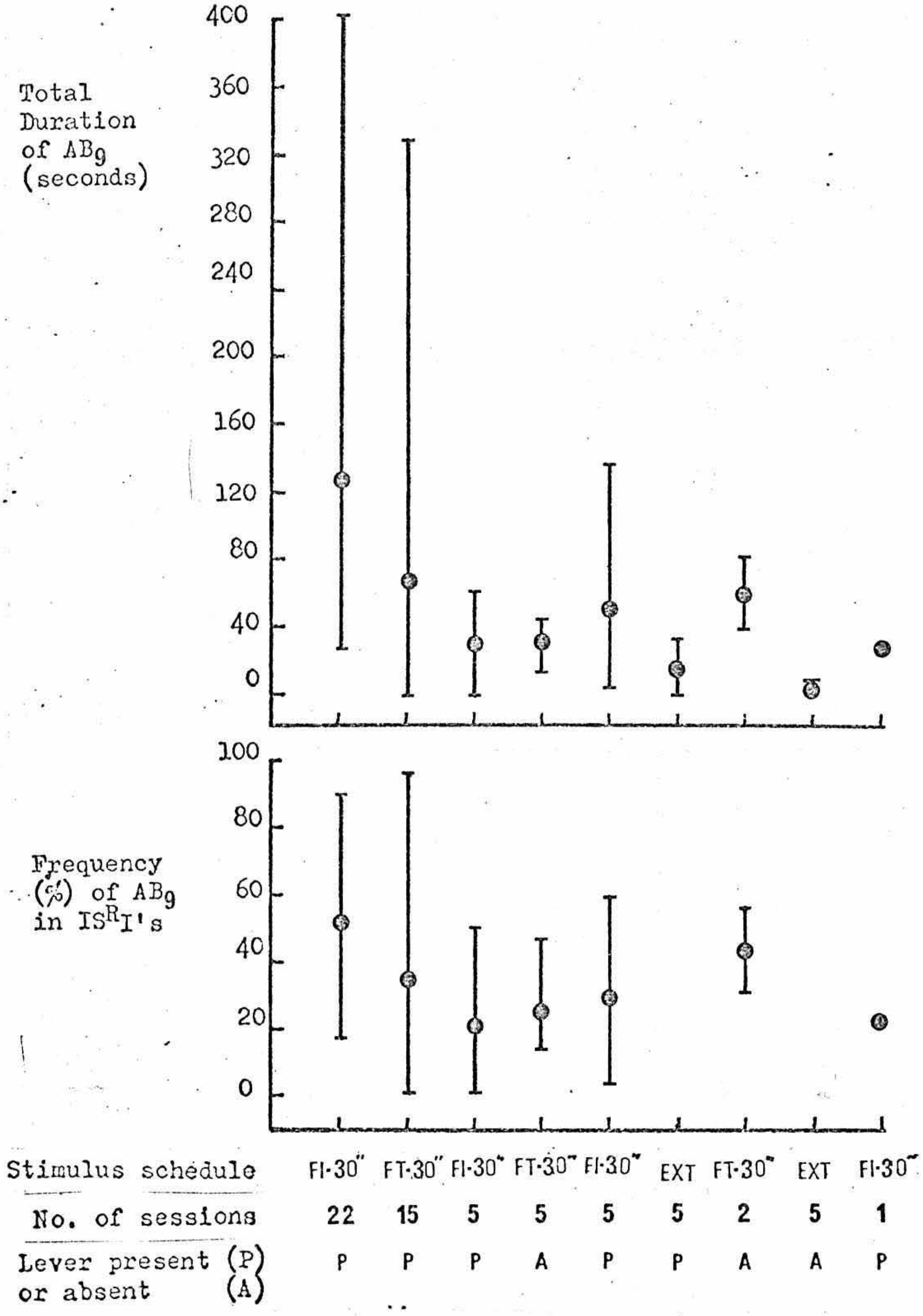


Figure 27 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_9 for Subject 11

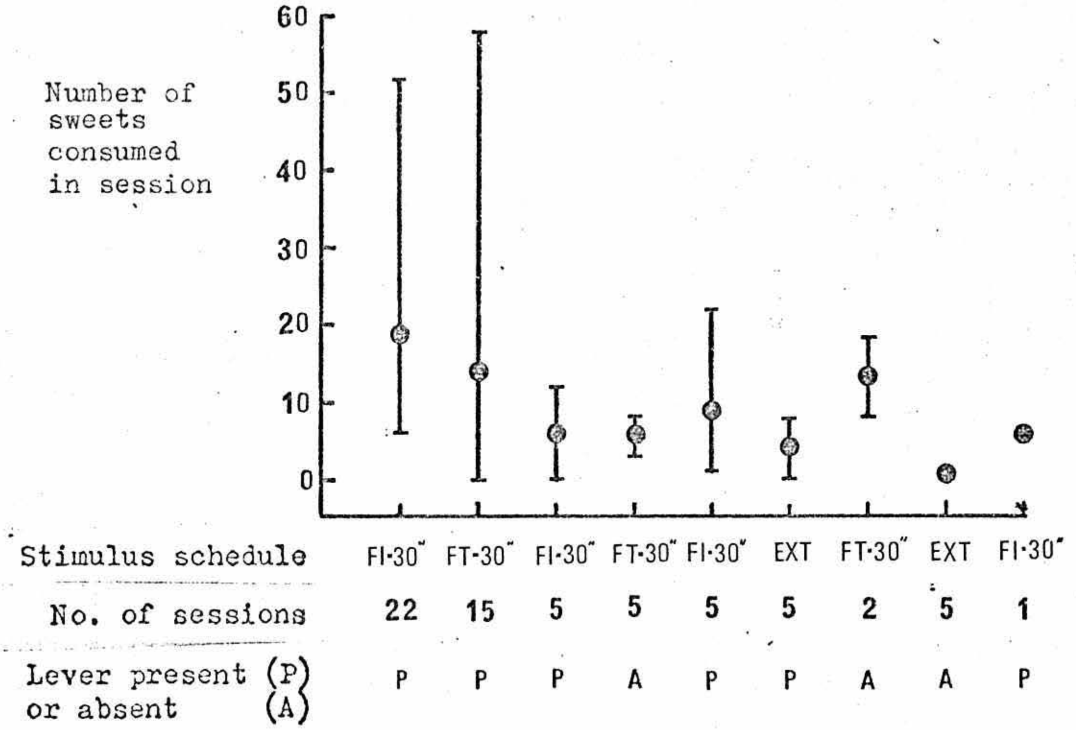
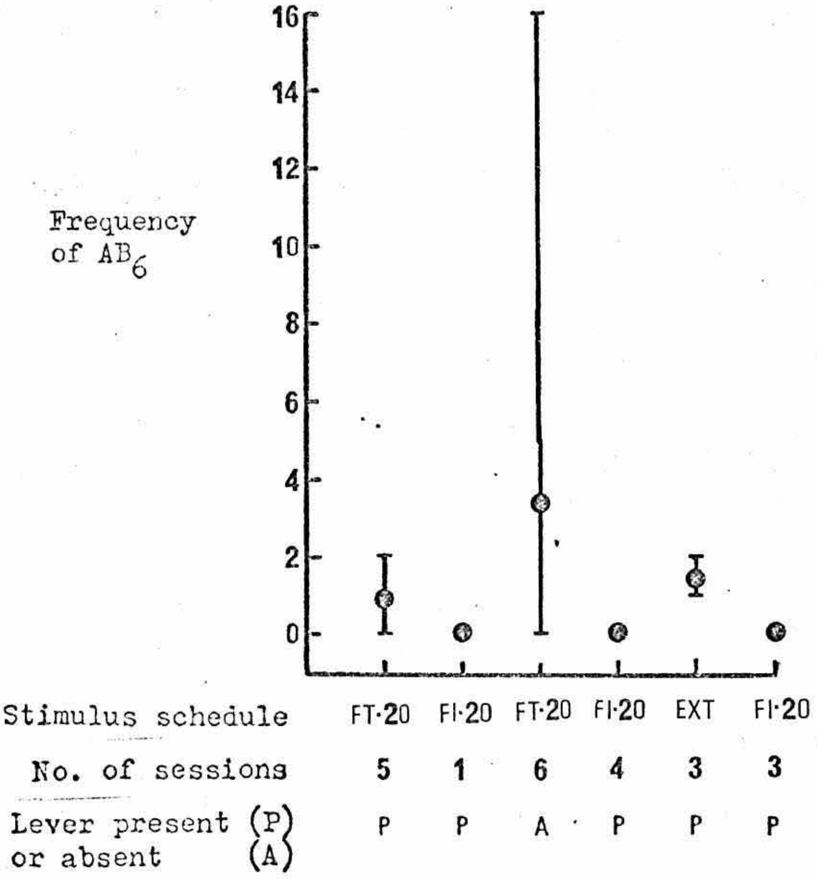


Figure 28 Means and ranges of number of sweets consumed by Subject 11 in each session.

Figure 29 Means and ranges of frequency of AB_6 for Subject 12.



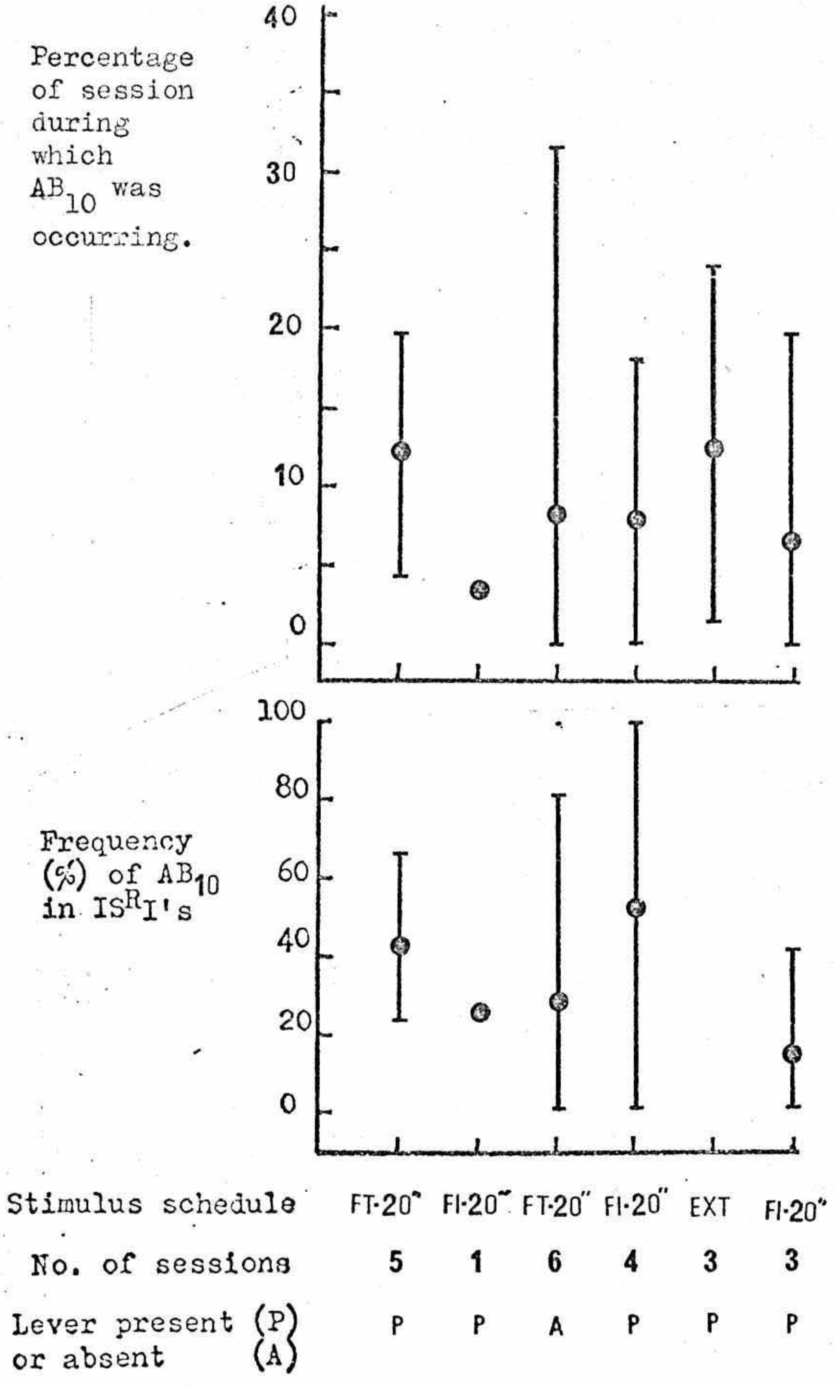


Figure 30 Means and ranges of percentage duration and frequency of AB_{10} in inter-stimulus intervals for Subject 12.

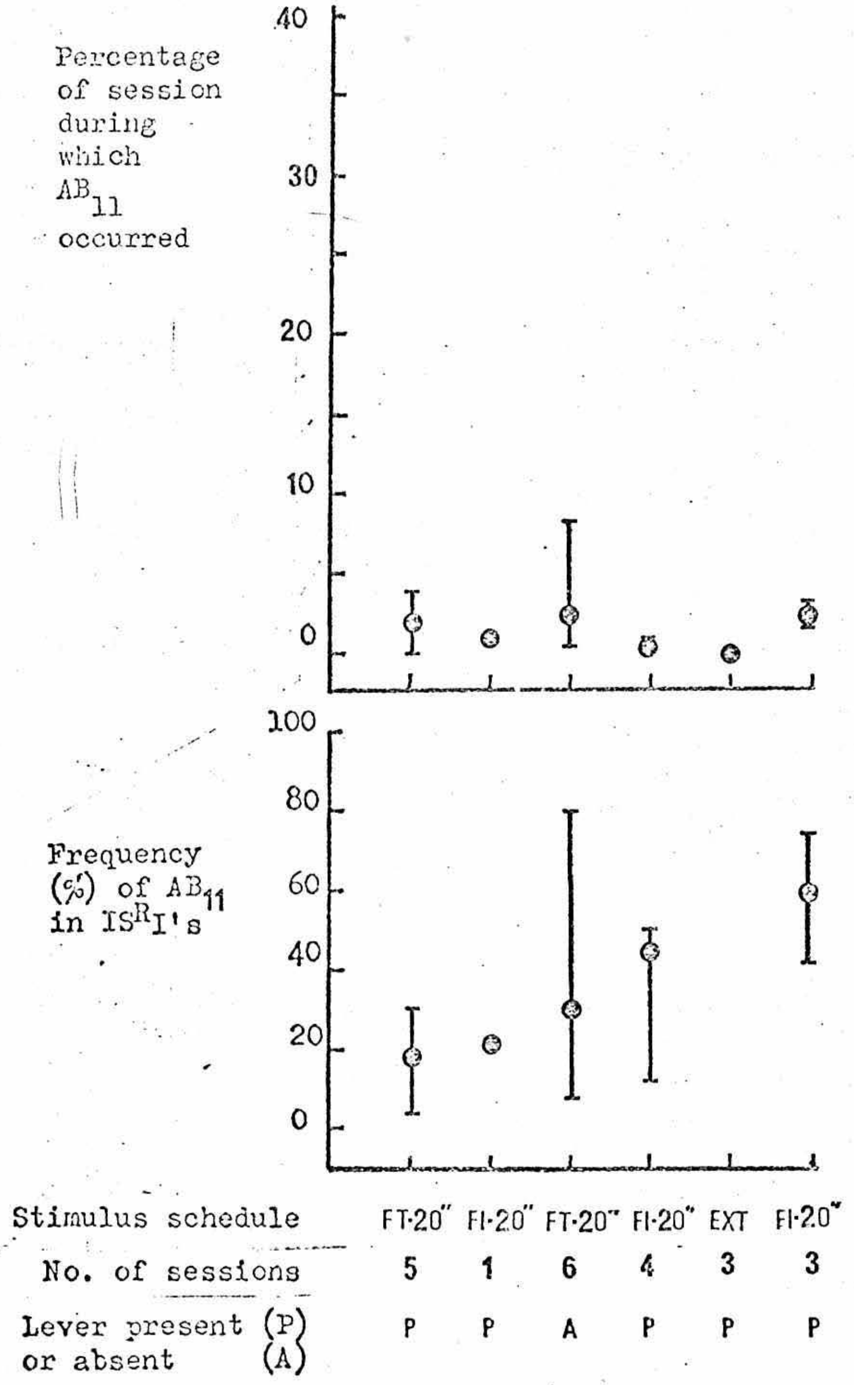
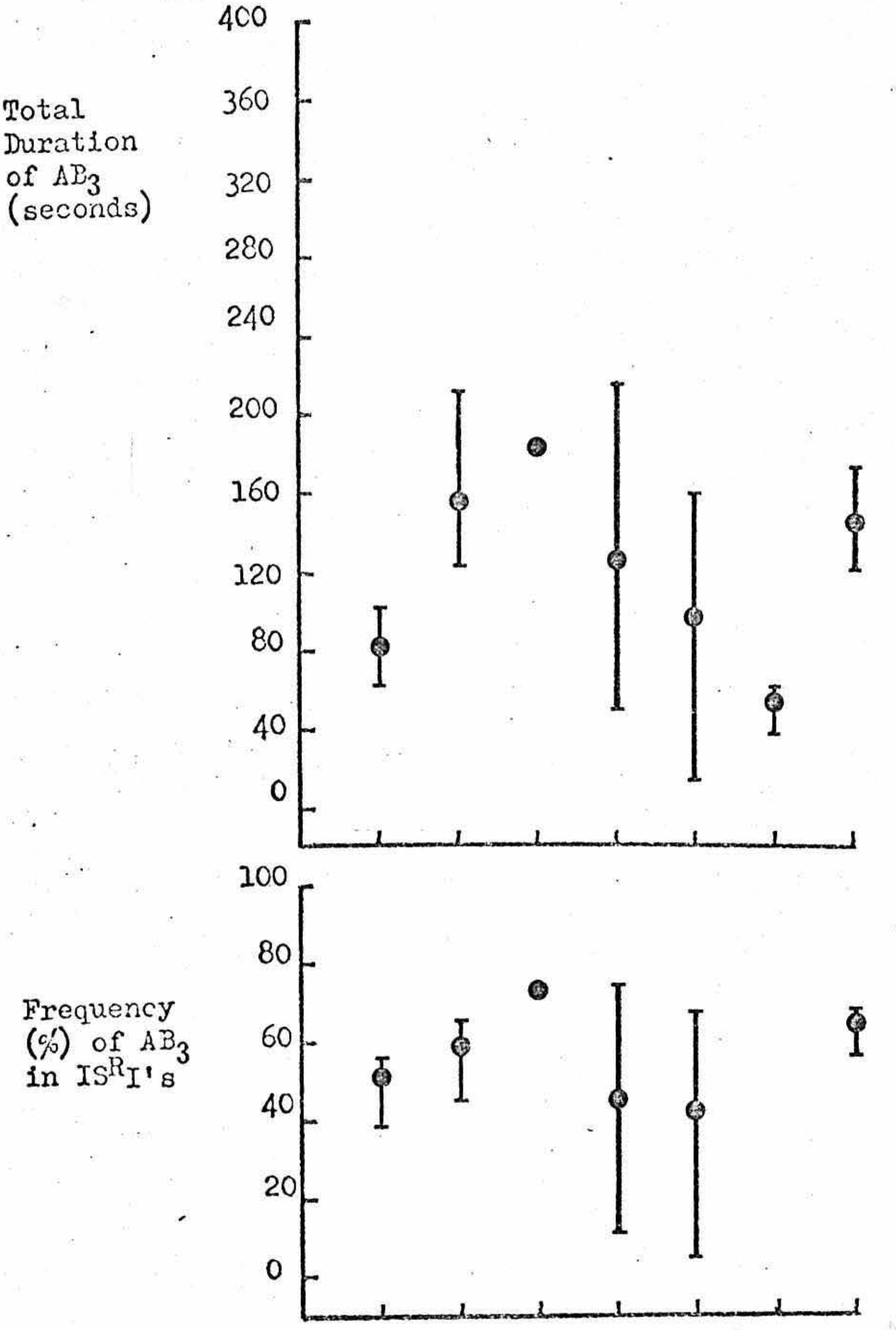


Figure 31 Means and ranges of percentage duration and frequency of occurrence of AB_{11} in inter-stimulus intervals for Subject 12.



Stimulus schedule	FI·20"	FT·20"	FI·20"	FT·20"	FI·20"	EXT	FI·20"
No. of sessions	4	5	1	5	5	3	3
Lever present (P) or absent (A)	P	P	P	A	P	P	P

Figure 32 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB$_3$ for Subject 20

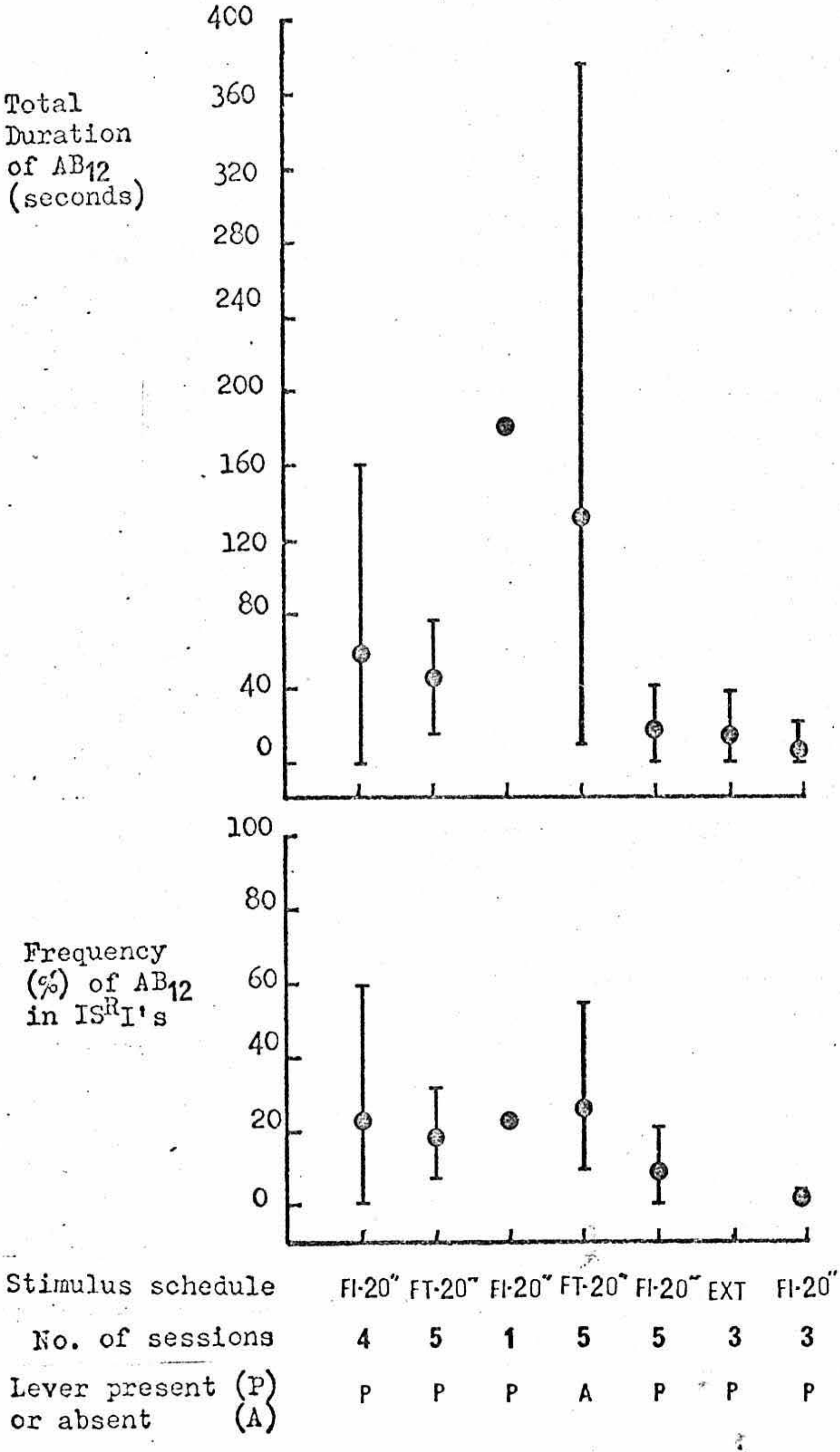


Figure 33 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_{12} for Subject 20

and showed a wide scatter of durations in each condition. AB_{12} for Subject 20 showed the highest durations in the fixed-time without a lever condious and the durations in the fixed-time conditions, although widely scattered, were generally higher than in extinction. AB_{11} for Subject 12 never occurred in extinction but otherwise was unrelated to the schedule of stimulation.

The durations and frequehcies of both AB_3 and AB_5 for Subject 5, although widely scattered, were relatively higher in the fixed-time conditions; the fixed-time without a lever condition producing the highest. Both durations and frequencies were low in the extinction condition. AB_3 for Subject 20 showed higher durations in the fixed-time than the extinction conditions with durations in fixed-interval conditions ranging between these two extremes.

AB_6 for Subject 12 occurred only in the fixed-time and extinction conditions, and never occurred in the fixed-interval sessions. Although there was a large scatter between sessions, the highest frequencies occurred in the fixed-time without a lever condition.

For Subject 11, the durations, frequencies and number of sweets eaten (AB_9) tended to decrease with the number of sessions rather than relative to the experimental conditions. However, the lowest figures were recorded in the extinction conditions, especially in the extinction with no lever condition. A slight increase in all parameters of AB_9

resulted in the final fixed-interval session which suggested that the absence of a schedule of stimulation (extinction) was related to this behaviour.

Figures 34, 35, 36, 37, 38, 39, 40 and 41 show the durations and frequencies of bouts occurring and start times of alternative behaviours in type X and type Y periods for the fixed-interval and fixed-time conditions. Because Subject 12's sessions varied in duration, the durations of alternative behaviours in type X and type Y periods have been expressed as a percentage of the total session duration.

AB_3 for Subject 11 and AB_{12} for Subject 20 showed wide scatter but were about equal in each period for each parameter and were not related in this respect to the experimental conditions. Durations of AB_{10} for Subject 12 were widely scattered within experimental conditions but were nearly always longer in type Y periods. Frequencies of start times and bouts occurring were either equal or slightly longer in type Y periods, but were not related to the experimental conditions.

For Subject 12, AB_{11} occurred almost exclusively in the type X periods. Start times were always in the type X periods but bouts sometimes persisted to type Y periods. Durations and frequencies of start times and bouts occurring for AB_3 with Subject 20 were all higher in the type X periods in the fixed-interval conditions. In the fixed-time with a lever condition, there was relatively more of each parameter in the type Y periods but type X periods

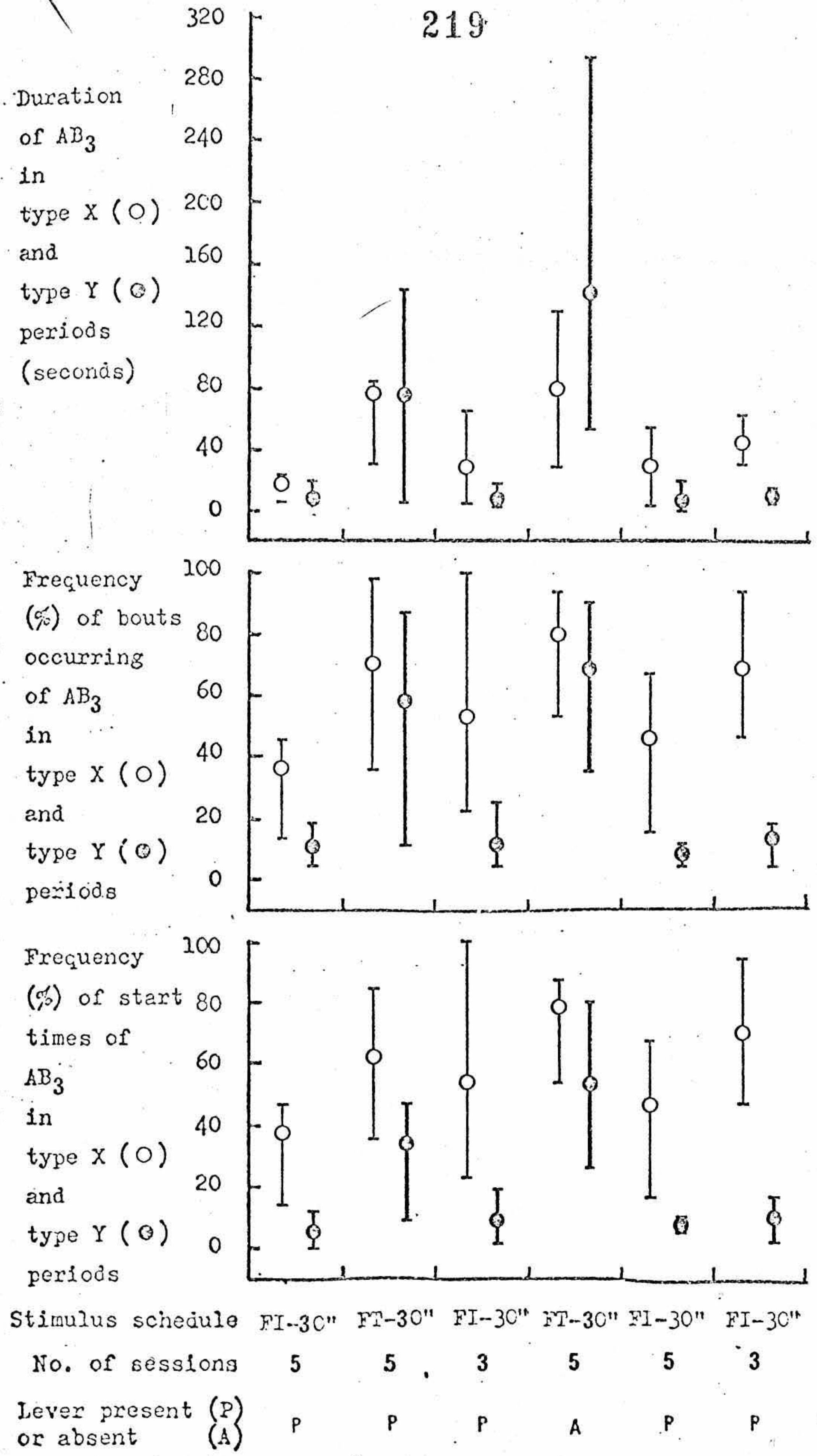


Figure 34 Means and ranges of durations and frequencies of bouts occurring and start times of AB$_3$ in type X and type Y periods for Subject 5

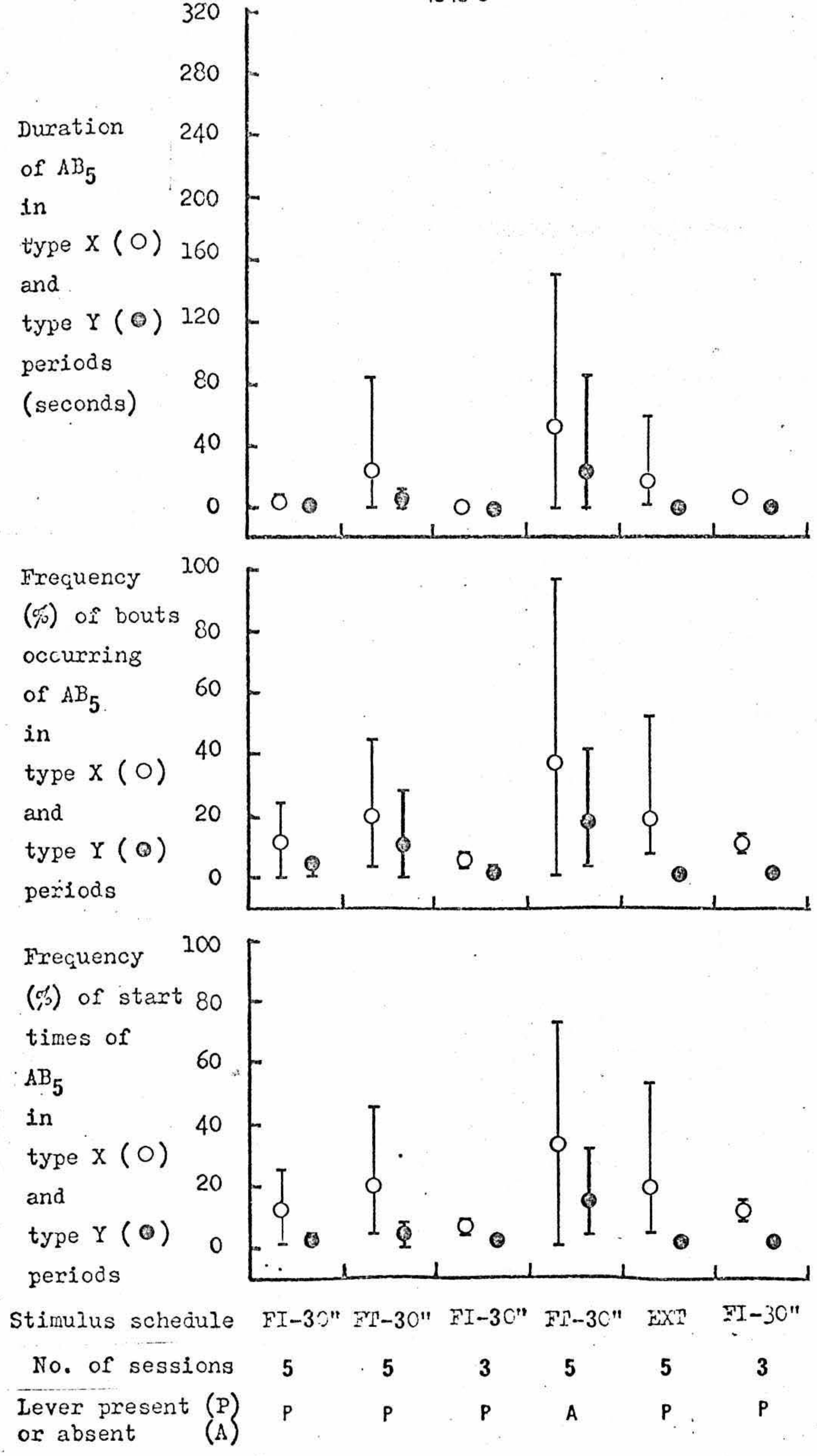
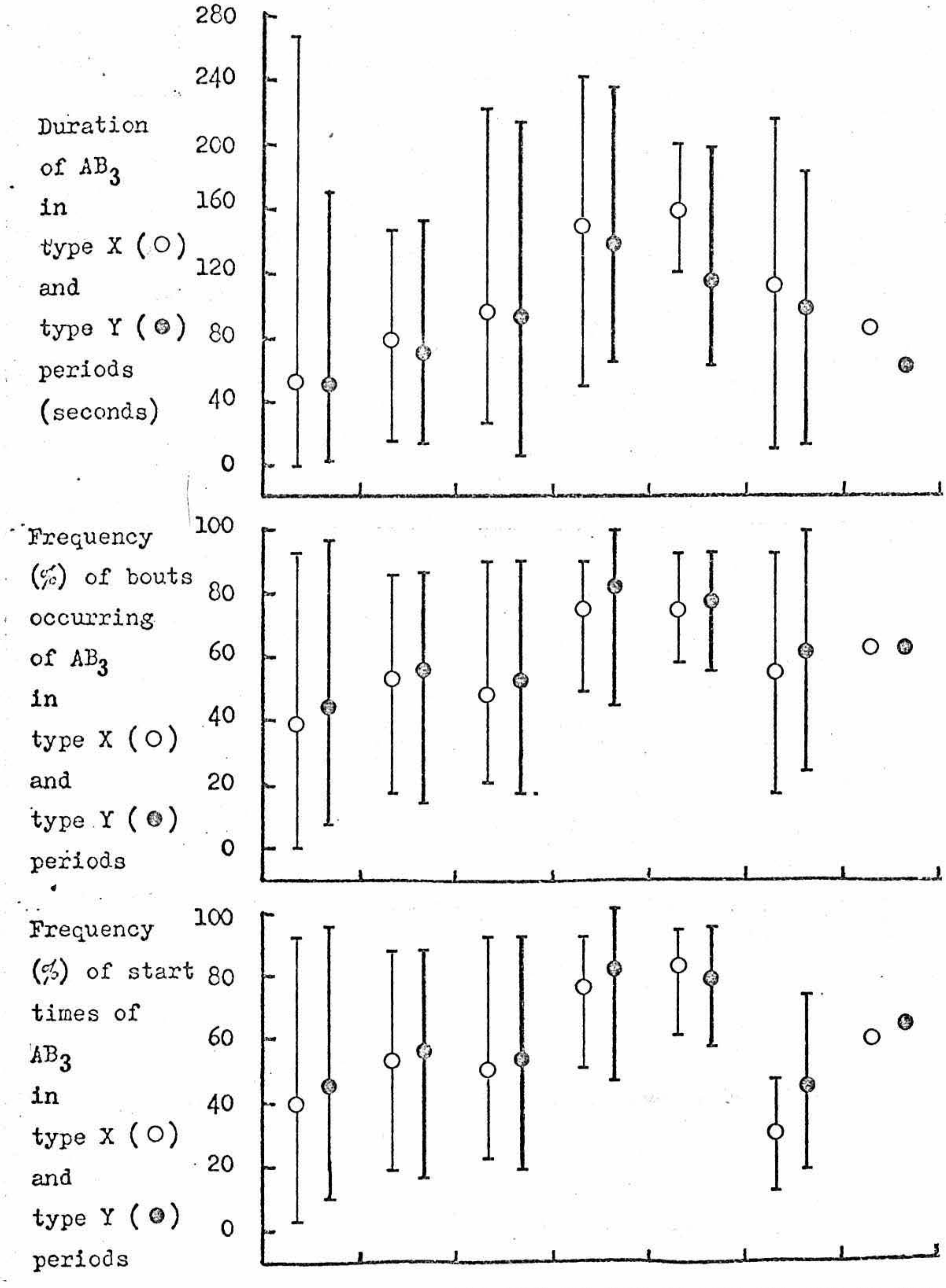


Figure 35 Means and ranges of durations and frequencies of bouts occurring and start times of AB_5 in type X and type Y periods for Subject 5



Stimulus schedule	FI-30"	FT-30"	FI-30"	FT-30"	FI-30"	FT-30"	FI-30"
No. of sessions	22	15	5	5	5	2	1
Lever present (P) or absent (A)	P	P	P	A	P	A	P

Figure 36 Means and ranges of durations and frequencies of bouts occurring and start times of AB_3 in type X and type Y periods for Subject 11

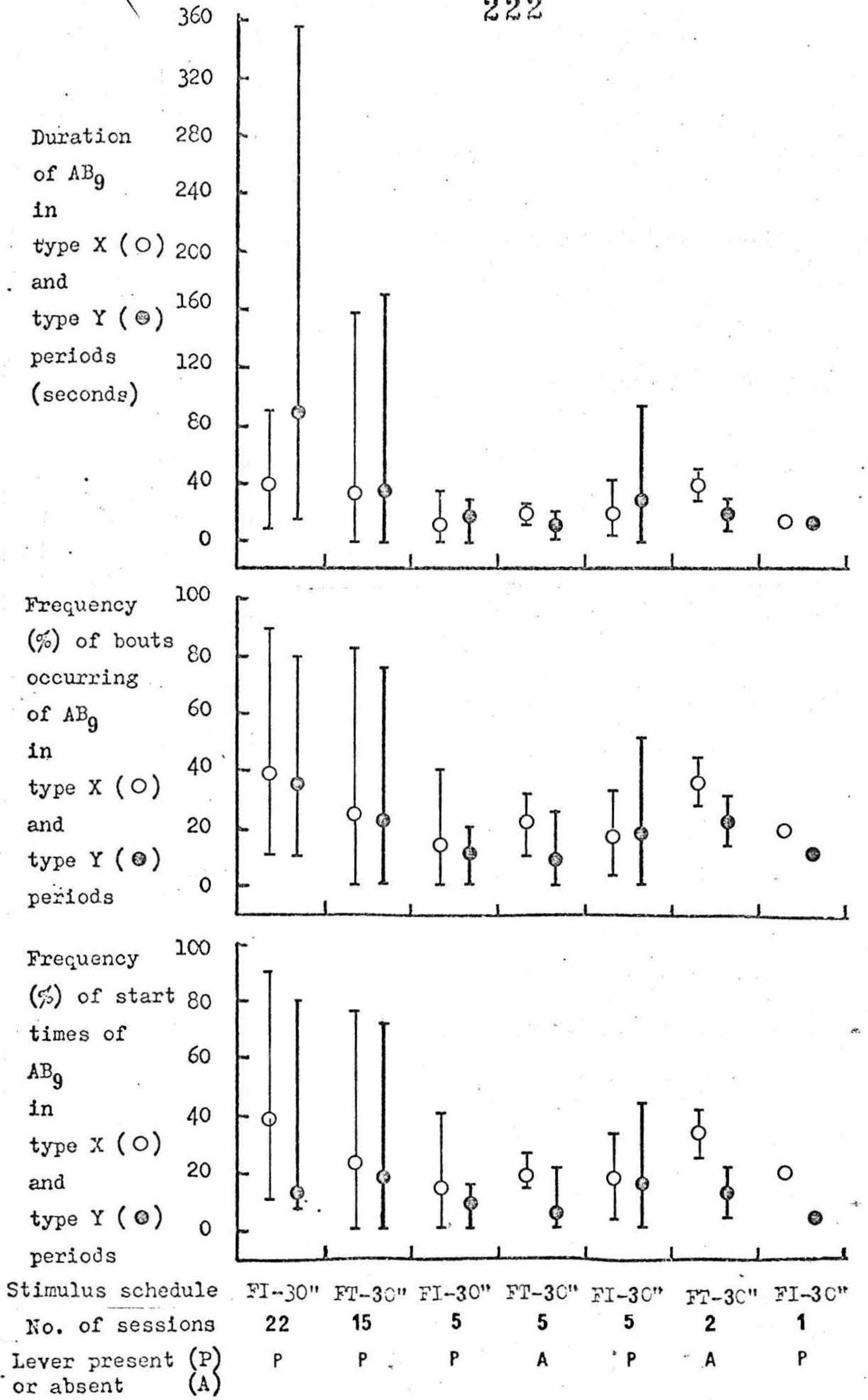


Figure 37 Means and ranges of durations and frequencies of bouts occurring and start times of AB_9 in type X and type Y periods for Subject 11

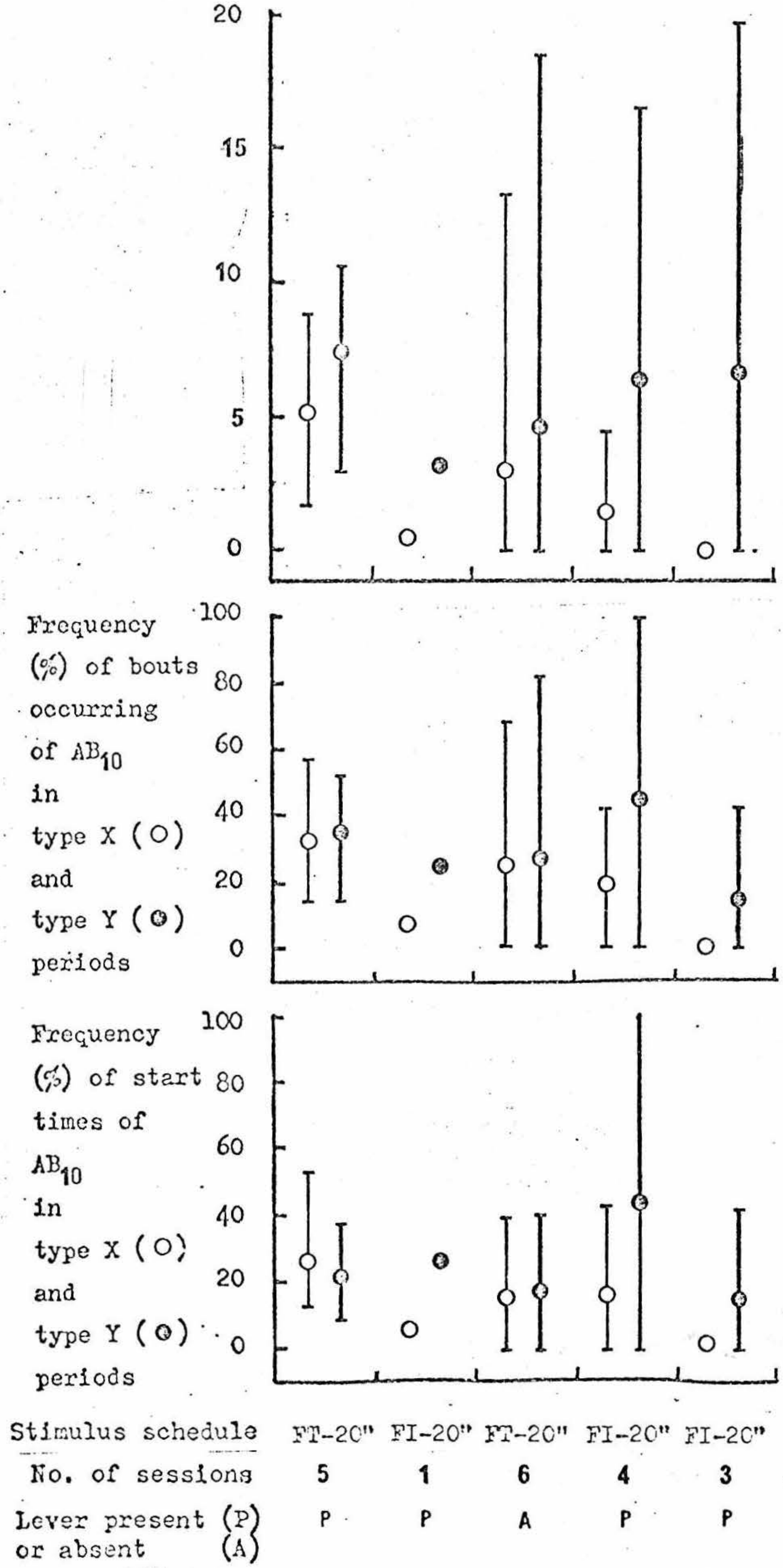


Figure 38 Means and ranges of durations and frequencies of bouts occurring and start times of AB_{10} in type X and type Y periods for Subject 12

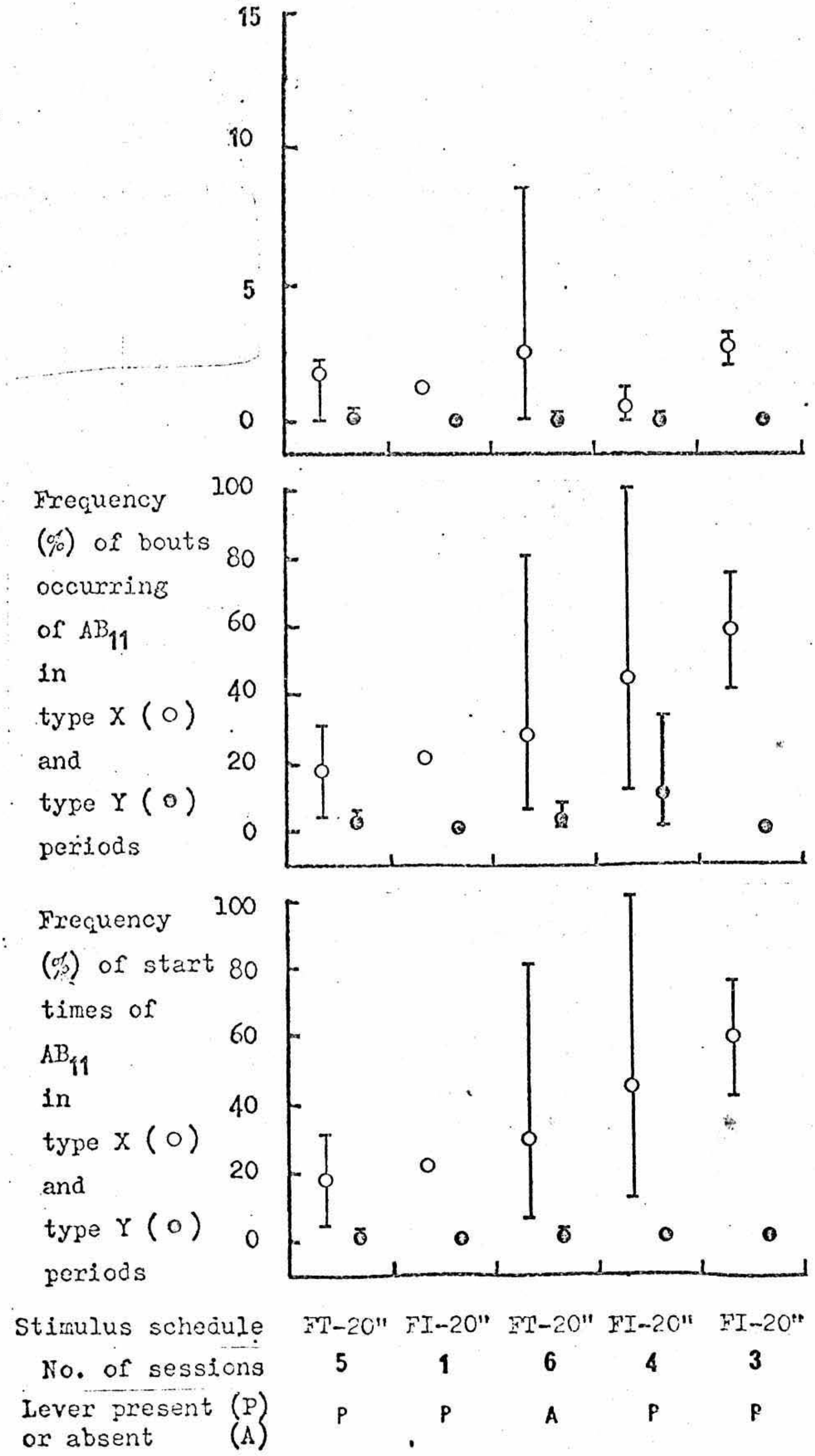


Figure 39 Means and ranges of durations and frequencies of bouts occurring and start times of AB_{11} in type X and type Y periods for Subject 12

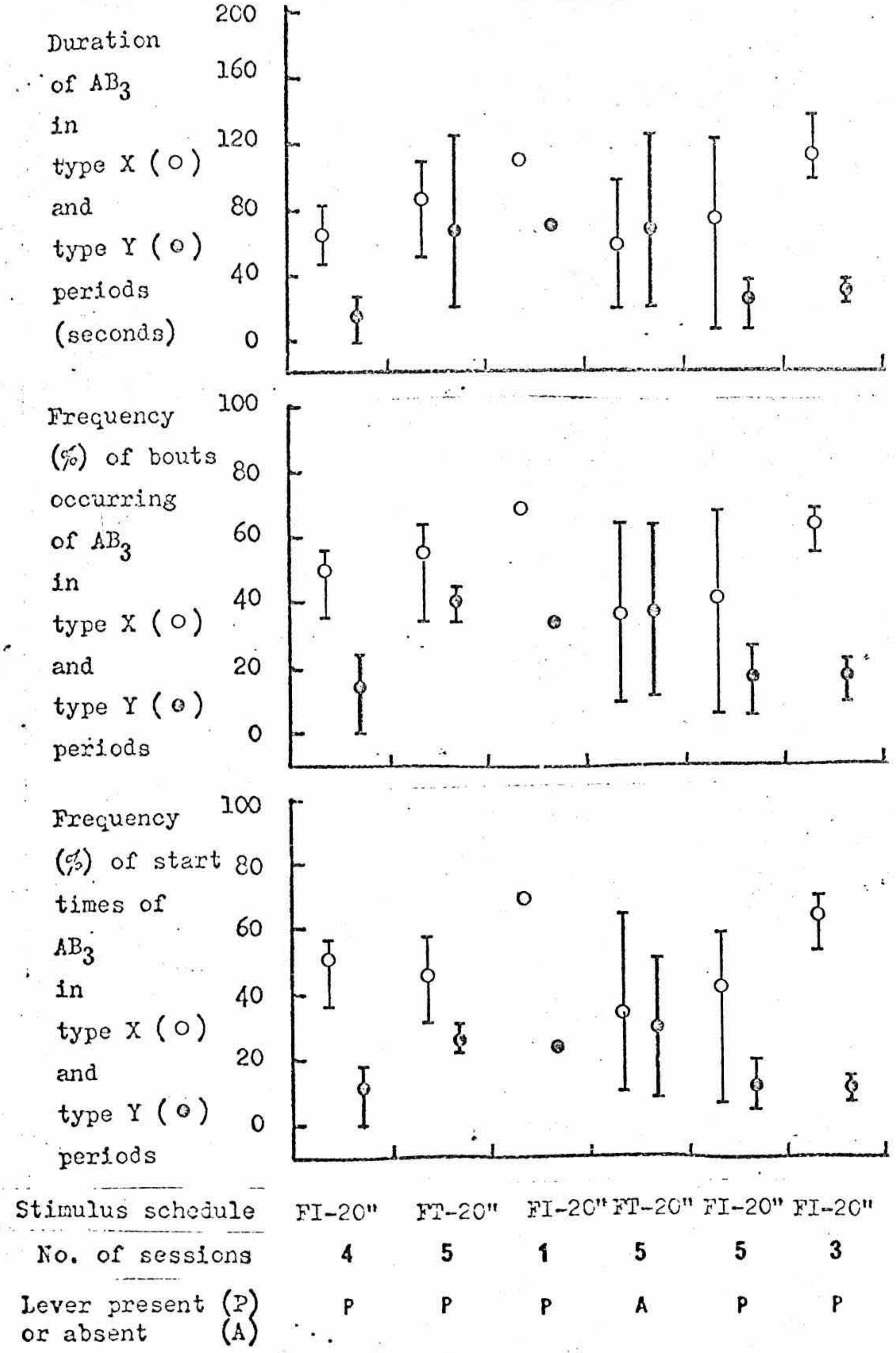


Figure 40 Means and ranges of durations and frequencies of bouts occurring and start times of AB_3 in type X and type Y periods for Subject 20

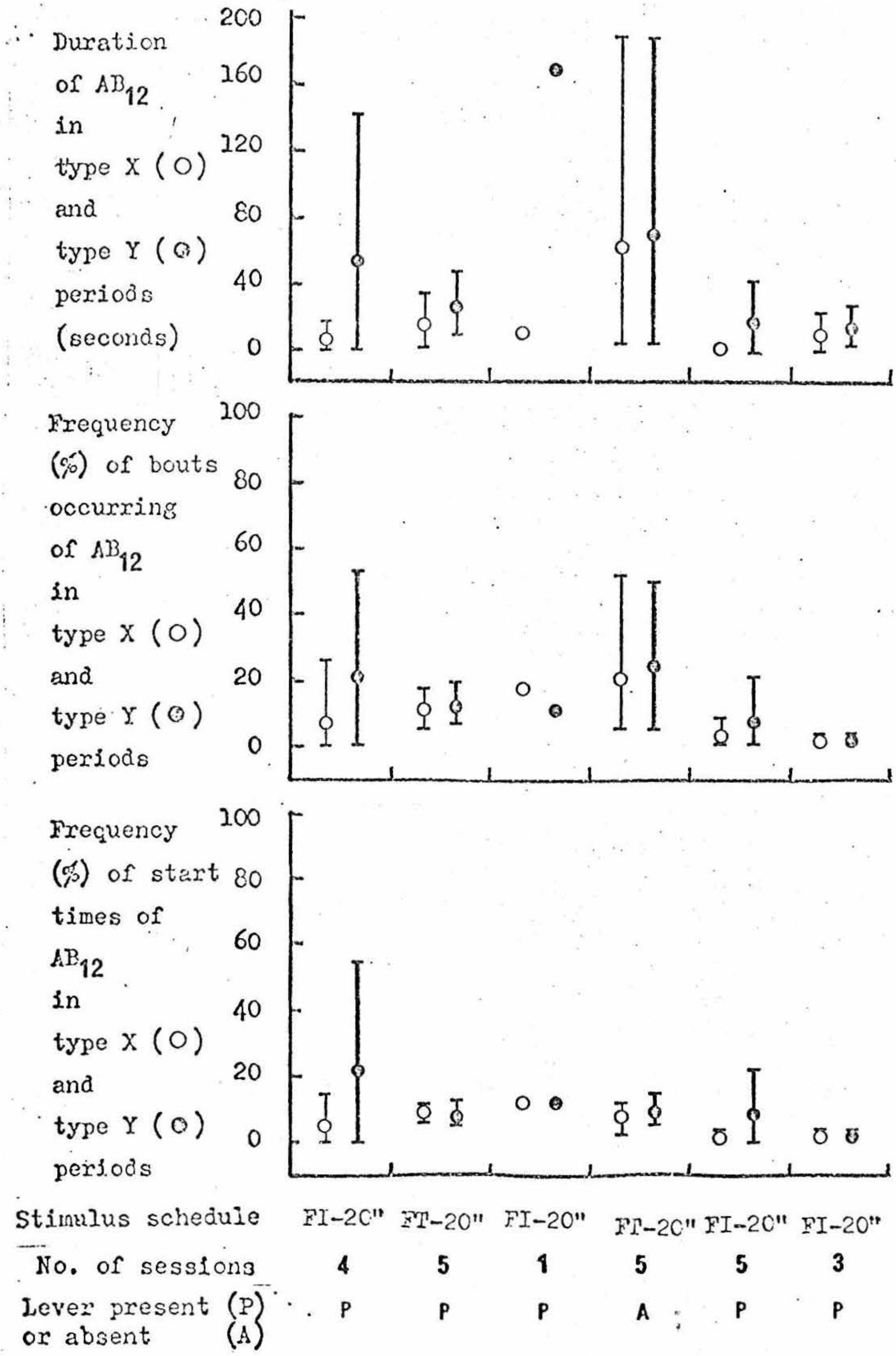


Figure 41 Means and ranges of durations and frequencies of bouts occurring and start times of AB_{12} in type X and type Y periods for Subject 20

were still higher and in the fixed-time without a lever condition, all parameters of AB_3 were about equal in type X and type Y periods.

The frequencies of start times and bouts occurring were always higher in the type X periods for both AB_3 and AB_5 with Subject 5. Durations and frequencies were extremely low (almost zero) in the type Y periods during fixed-interval sessions for both alternative behaviours. The durations of AB_3 were longer in type X periods in the fixed-interval sessions and longer in the type Y periods in the fixed-time sessions, the discrepancy being greater in the fixed-time without a lever condition. For AB_5 the durations were always longer in type X periods. Although they were very low in type Y periods in the fixed-interval sessions, there was some occurrence in the fixed-time sessions.

Figures 42, 43 and 44 show the mean bout lengths of AB_3 and AB_5 for Subject 5 and AB_3 for Subject 11, respectively. The five-second categories in which the median bout lengths occurred are shaded on the histograms. Bout lengths of AB_{11} for Subject 12 were all of less than five seconds duration and so are not shown graphically. The mode and median bout length fell in the nought to five seconds category for both AB_3 and AB_5 in all conditions for Subject 5. With Subject 11, the modal bout length of AB_3 always fell in the first category but the median shifted to the five-to ten-second category in the second block of fixed-interval 30-seconds sessions. The median bout length remained in the second category for all the

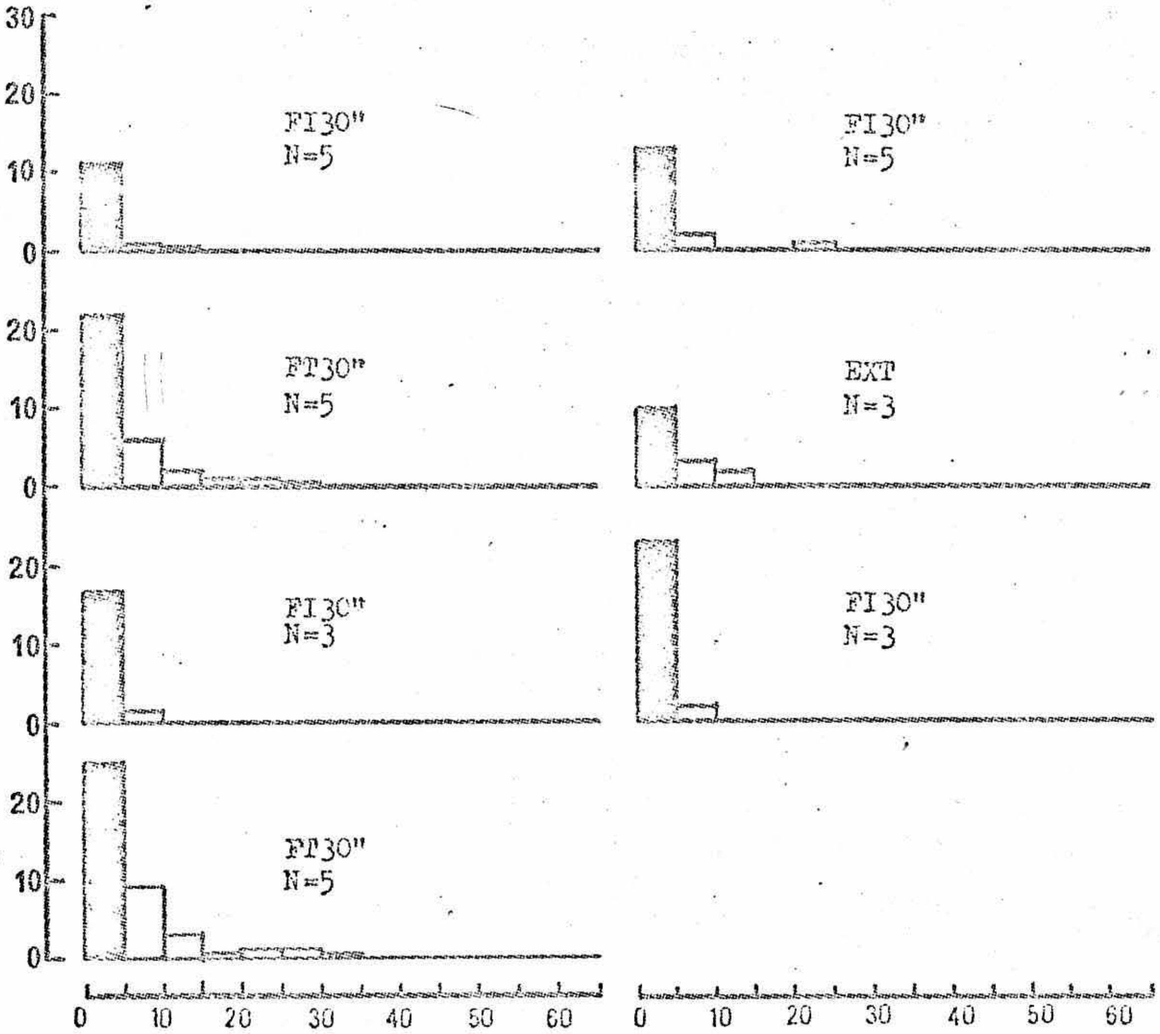


Figure 42 Mean bout lengths of A B_3 for Subject 5 in five-second categories. The last category contains all bout lengths of greater than sixty-seconds. The category in which the medium bout length fell have been shaded in each condition.

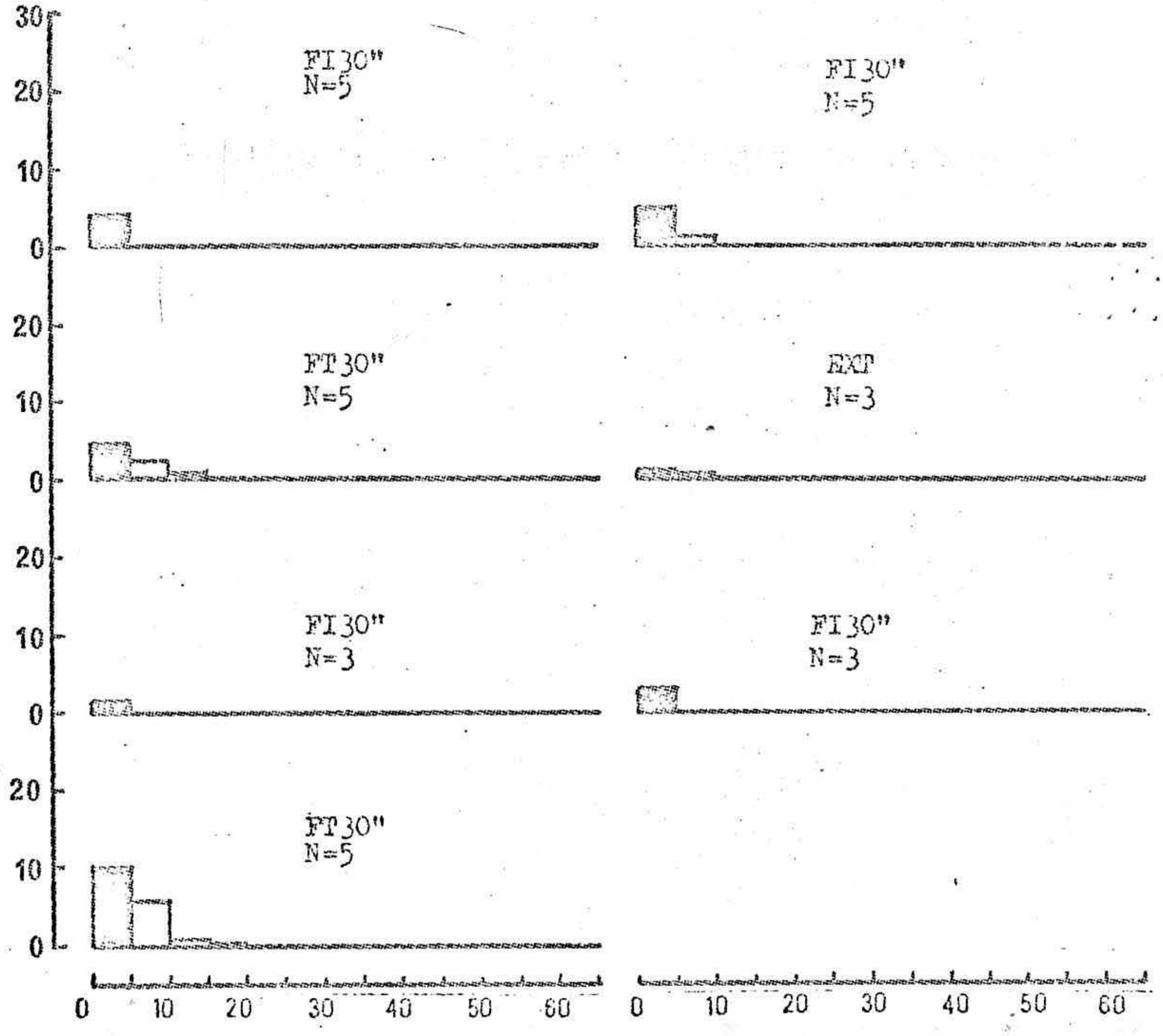


Figure 43 Mean bout lengths of A B_5 for Subject 5 in five-second categories. The last category contains all bout lengths of greater than sixty-seconds. The category in which the medium bout length fell have been shaded in each condition.

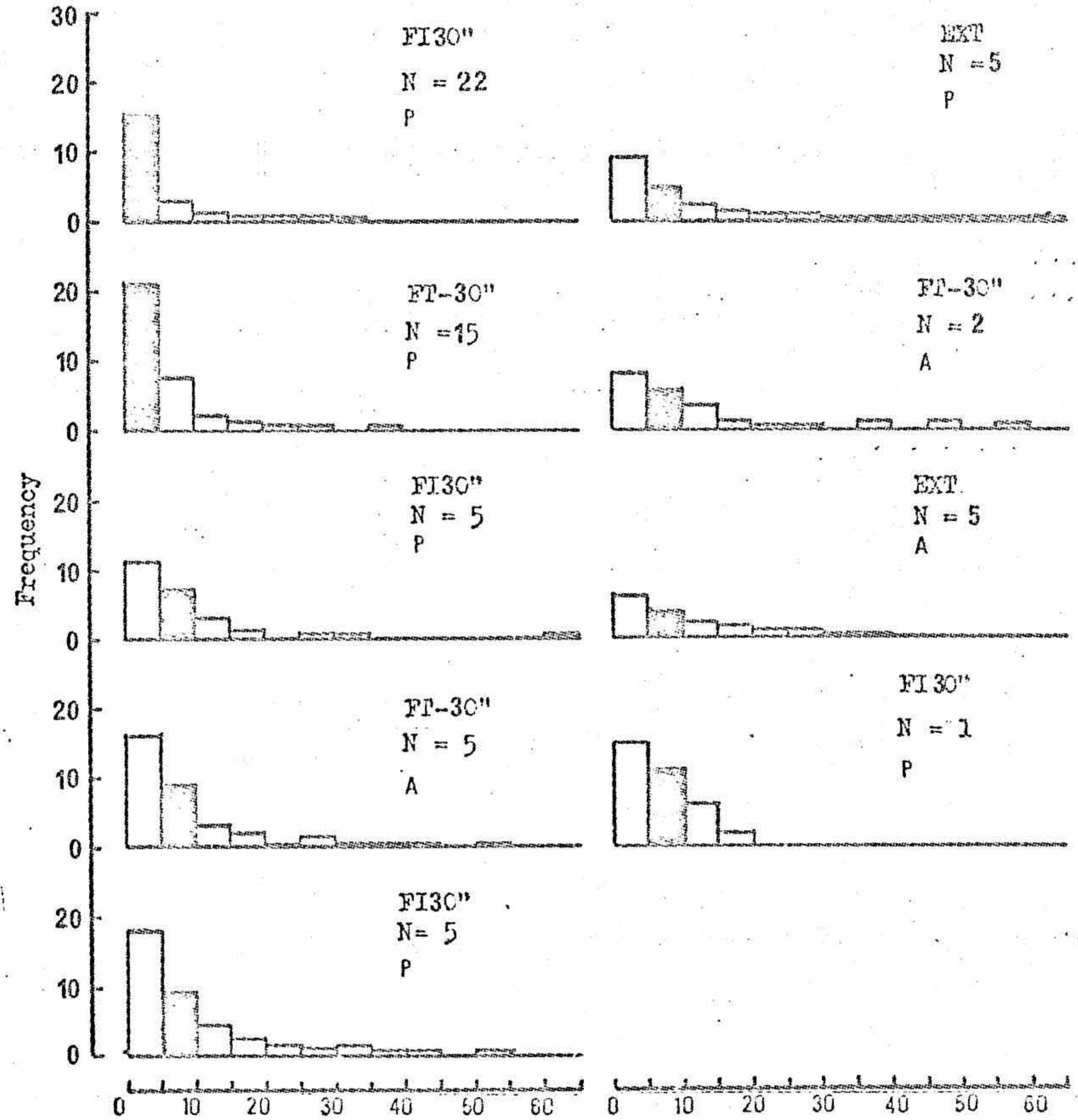


Figure 44 Mean bout lengths of A B_3 for Subject 11 in five-second categories. The last category contains all bout lengths of greater than sixty-seconds. The category in which the medium bout length fell have been shaded in each condition.

conditions that followed.

Discussion

The relationship of lever-pressing to the schedule of stimulation for Subjects 5 and 20 concur with Herrnstein's (1966) findings with pigeons under similar schedules. However, these results, and the unrelated response rates for Subjects 11 and 12, contrast with those for Subjects 1 and 26, reported in chapter 9, who showed higher rates of responding in the fixed-time conditions

Differences in the relationships between alternative behaviours and the schedule of stimulation were not predictable in terms of arbitrary, topographically specified categories. AB_3 ("vocalising") was examined in Subjects 5, 11 and 20. For Subject 11 this behaviour showed no relationship with the schedule of stimulation, but for Subjects 5 and 20 there was such a relationship. This relationship was similar to that of AB_3 with the schedules of stimulation for Subject 25, reported in chapter 9. However, the temporal loci of AB_3 was predominantly in type X periods for Subjects 5 and 20, equally distributed for Subject 11, and predominantly in type Y periods for Subject 26 (reported in chapter 9). Clearly, the same descriptive class, AB_3 for these subjects was functionally different with respect to the schedules of stimulation in the type X.

A predominance of alternative behaviour in the type X periods was found with AB_3 and AB_5 for Subject 5, AB_{11} for Subject 12,

AB_3 for Subject 20, and tended to be so with AB_9 for Subject 11. This relationship with the points of occurrence of stimulation is similar to those that have been discussed under the rubric of adjunctive behaviour (Falk, 1971) or interim activities (Staddon 1976) with animal studies.

A particularly significant finding for those who would study the "effectiveness" of reinforcers on a descriptive operant was that although manipulations of schedules of stimulation sometimes appeared to produce relatively little change in the rate of lever-pressing (Subjects 11 and 12) the stimuli showed definite functional relationships with other behaviours in the behaviour stream.

Also of note was the finding that some alternative behaviours (AB_3 and AB_5 for Subject 5, AB_6 for Subject 12 and AB_{12} for Subject 20) showed higher durations in the fixed-time without a lever relative to the fixed-time with a lever condition. This finding concurs with Staddon and Ayres (1976) report of increases in some alternative behaviours when the opportunity to engage in a previously available activity is eliminated.

Bout lengths were unrelated to the experimental conditions for Subjects with which this dimension was examined. With Subject 11, most dimensions of AB_3 remained unaltered through the experimental conditions, but the median bout length increased with the number of sessions.

CHAPTER 11

CHANGES IN FIXED-RATIO VALUES

CHAPTER 11

CHANGES IN FIXED-RATIO VALUES

Introduction

Human performance on fixed-ratio schedules has proved to be more comparable with that of animals than any other schedule of stimulation. The behaviour of retardates on fixed-ratio schedules has often been found to resemble the break-and-run pattern of lower organisms. A study by Wallace and Mulder (1973) with retarded adult subjects replicated animal findings by demonstrating that the size of the ratio requirement was directly related to the length of the post-stimulus pause. However, conflicting findings were reported by Ellis et al (1960) in which there was no increase in post-stimulus pausing at higher fixed ratio values.

Boren (1953) with rats, noted an increase in response rate when fixed-ratio values were increased up to fixed-ratio 35 followed by a decrease with higher fixed-ratio values. Hutchinson and Azrin (1961) reported increases in response rates with schixophrenics when fixed-ratio values were increased up to fixed-ratio 200, at which point reponse rates became erratic. Long et al (1958) found a decrease in response rate with increases from fixed-ratio 15 to fixed-ratio 90 in young children. Schroeder (1972) reported that work rates of retardates on fixed-ratio schedules of token presentation were directly related to fixed-ratio values with two subjects, and inversely related to fixed-ratio values with athird.

Although some fixed-ratio studies with retardates have reported "good schedule control" (e.g. Orlando and Bijou, 1960), others have reported considerable variability involving long pauses distributed unpredictably between runs of responding, (e.g. Spradlin et al, 1965; Woods and Pryce, 1974). The latter findings are said to resemble those for lower organisms with a "weak reinforcer" as when satiation or minimal deprivation is evident (Sidman and Stebbins, 1954; Ferster and Skinner, 1957).

A characteristic peculiar to fixed-ratio schedules is known as "ratio strain". This is where the fixed-ratio value is increased rapidly, resulting in a breakdown of typical fixed-ratio performance with responding interspersed with long, unpredictable pauses. Ellis et al (1960) reported "ratio strain"when the fixed-ratio of lever-pressing for candies and cigarrettes was rapidly increased from fixed-ratio 20 to fixed-ratio 1024 with retardates.

The present study to investigate the changes in various aspects of lever-pressing and alternative behaviours when the fixed-ratio value was manipulated with two retardates.

Subjects

Subjects 3 and 5 served in this experiment and prior to this had participated in a previous study (Woods and Pryce, 1974)

Apparatus and Procedure

Five-second slide presentations were used as stimuli with both subjects and this was accompanied with pop-music for Subject 3. The standard experimental procedure was employed. The fixed-ratio values were manipulated as indicated in figures 45 and 46.

Results

Data relating to lever-pressing are presented in figures 45 and 46. The sequence of ratio manipulations and the number of sessions in each condition are shown in these figures. There were no over-runs of responding or runs through consecutive stimuli without a pause for Subject 3. For Subject 5, these two frequencies decreased to zero with an increase in the number of sessions. Figure 47 shows the median and inter-quartile range of post-stimulus pauses for both subjects.

Mean rates of responding showed different trends as the ratio values were increased for each Subject. Subject 3 showed

Figure 45 Details of lever-pressing for Subject 3.

Figure 46 Details of lever-pressing for Subject 5.

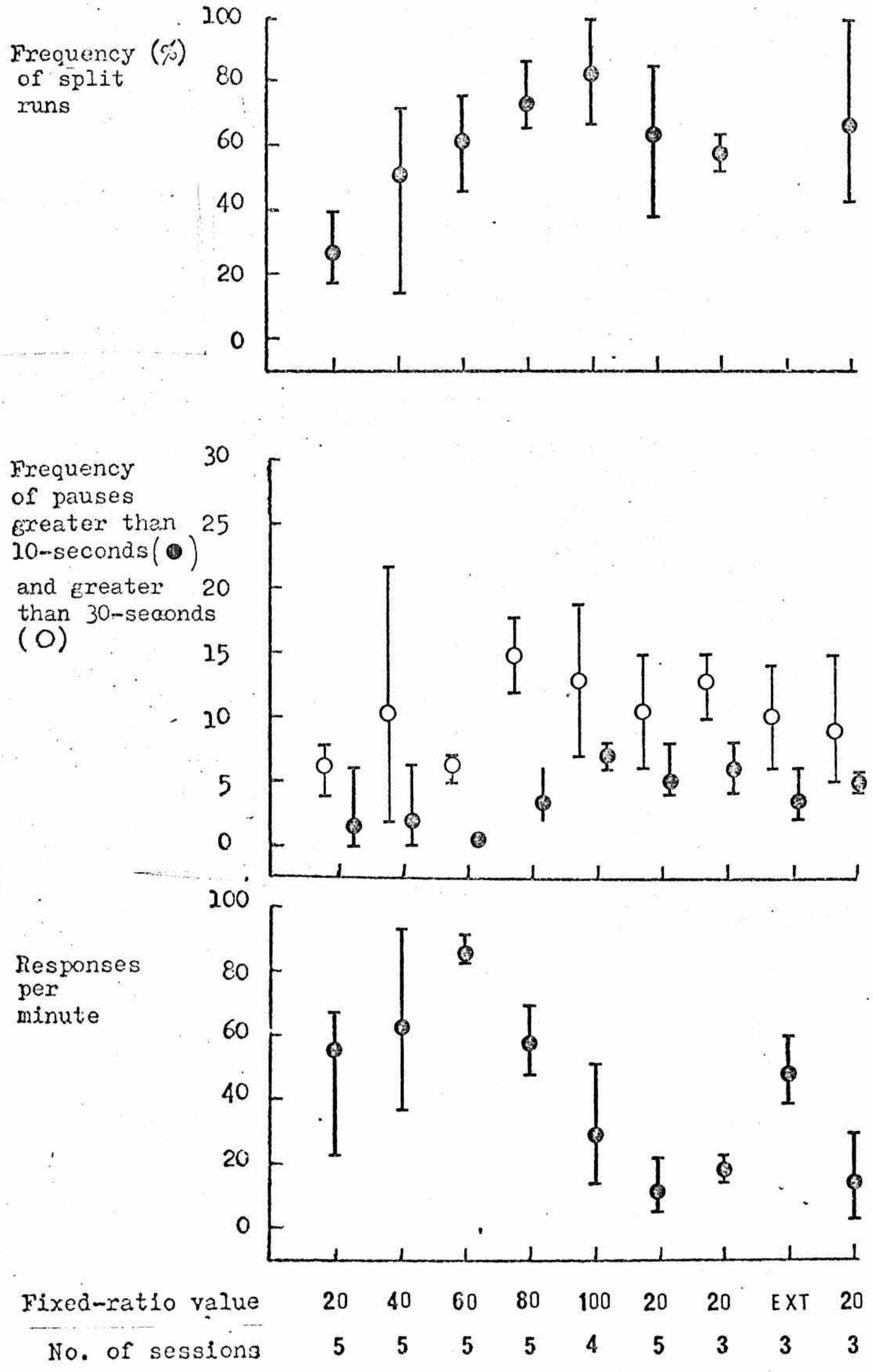

Frequency (%) of split runs
100
80
60
40
20
0
Frequency of pauses greater than 10-seconds (●) and greater than 30-seconds (○)
30
25
20
15
10
5
0
Responses per minute
100
80
60
40
20
0
Fixed-ratio value
20
40
60
80
100
20
20
EXT
20
No. of sessions
5
5
5
5
4
5
3
3
3

Figure 45

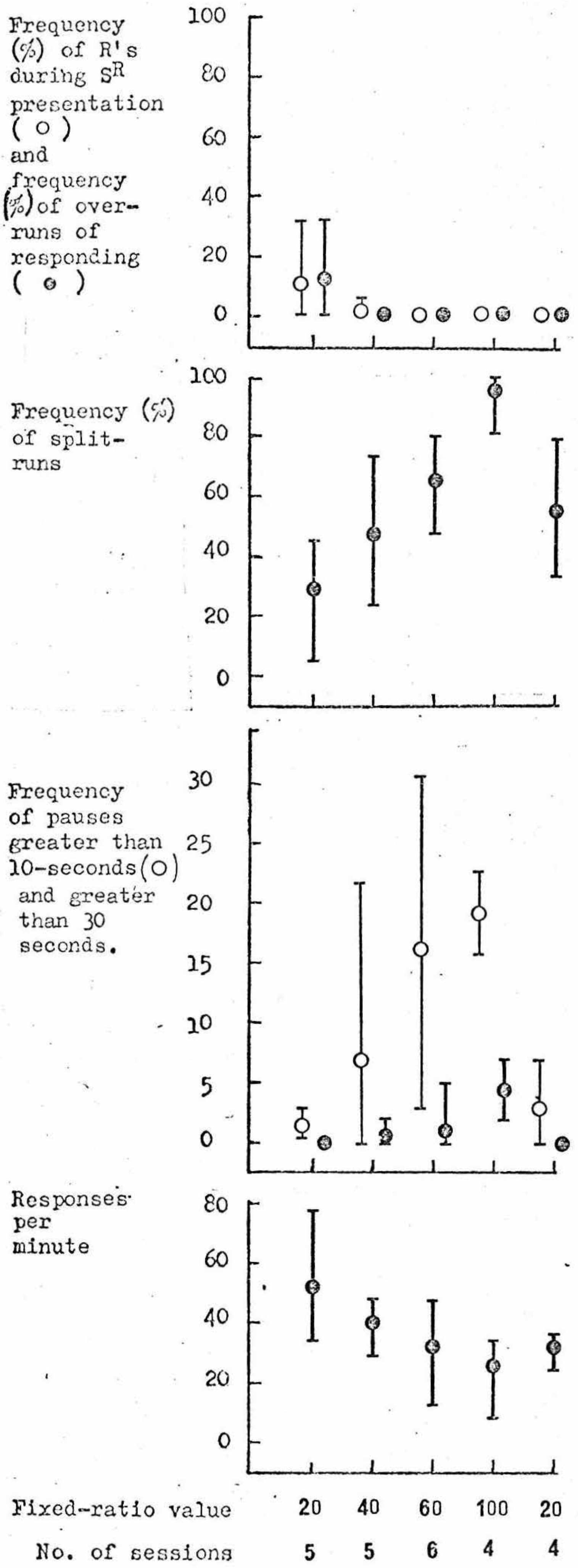

Frequency (%) of R's during S^R presentation (○) and frequency (%) of over-runs of responding (●)
100
80
60
40
20
0
Frequency (%) of split-runs
100
80
60
40
20
0
Frequency of pauses greater than 10-seconds (○) and greater than 30 seconds.
30
25
20
15
10
5
0
Responses per minute
80
60
40
20
0
Fixed-ratio value
20
40
60
100
20
No. of sessions
5
5
6
4
4

Figure 46

an increase in mean response rate up to fixed-ratio 60 and then a steady decrease through fixed-ratio 80 to fixed-ratio 100. Subject 5 on the other hand showed a steady decrease from fixed-ratio 20 to fixed-ratio 100. When fixed-ratio 20 was reintroduced, both subjects produced lower response rates relative to the initial fixed-ratio 20 sessions, but this was particularly so for Subject 3.

An extra long inter-session interval (one-hundred and five days) was interspersed between two blocks of fixed-ratio sessions with Subject 3, but still the responding did not increase to its initial higher rate. Three extinction sessions were then introduced which resulted in a higher rate of responding, but when fixed-ratio 20 was again reintroduced the original higher response rates were still not recovered.

The frequency of long pauses was not related to fixed-ratio value for Subject 3, but the frequencies of pauses greater than ten-seconds and greater than thirty seconds were both directly related to the fixed-ratio value for Subject 5. Frequencies of split-runs increased as a function of fixed-ratio value for both subjects and decreased slightly when fixed-ratio 20 was reintroduced, but not to the original frequencies in each case.

For both subjects the median and inter-quartile range of post-stimulus pauses increased as a function of increases in fixed-ratio values. When fixed-ratio 20 was reintroduced, the median post-stimulus pause returned to the value of the initial fixed-ratio 20 sessions for Subject 5. This was not so for Subject 3, however, for whom the median and inter-quartile range of post-stimulus pauses remained at high values when fixed-ratio 20 was reintroduced.

Total durations and frequencies of bouts occurring in inter-stimulus intervals of AB_3 and AB_4 with Subject 3 and AB_3 and AB_5 with subject 5, are shown in figures 48, 49, 50 and 51 respectively.

For both subjects, AB_3 ranged considerably between sessions at each fixed-ratio value and seemed to be unrelated to the schedule in this respect. The duration of AB_4 for Subject 3 showed a slight decrease as the fixed-ratio value was increased and increased slightly when fixed-ratio 20 was reintroduced. However, the frequency of AB_4 bouts occurring in inter-stimulus intervals was not related to the fixed-ratio value and ranged considerably between sessions at each ratio value.

The duration and frequency of AB_5 despite considerable range seemed to be related to the fixed-ratio value with both increasing linearly. On reintroduction of fixed-ratio 20, both duration and frequency of AB_5 returned to a lower value.

Durations and frequencies of start times and bouts occurring in type X and type Y periods are shown in figures 52, 53, 54, 55 and 56. As the fixed-ratios were increased, the average inter-stimulus intervals also increased. The mean inter-stimulus

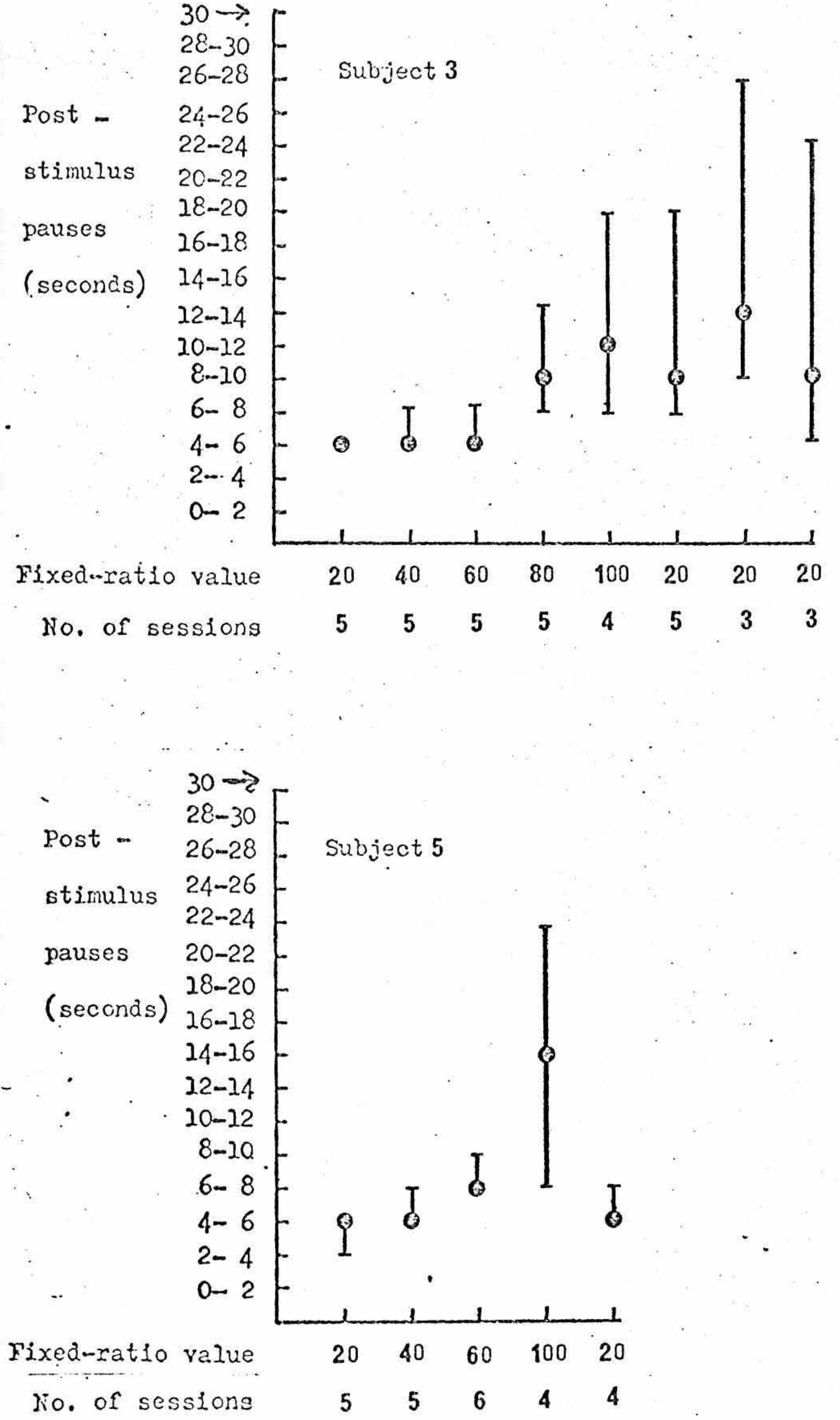


Figure 47 Medians and inter-quartile ranges of post-stimulus pauses in two-second categories. All post stimulus pauses of thirty-seconds or more were placed in the final category.

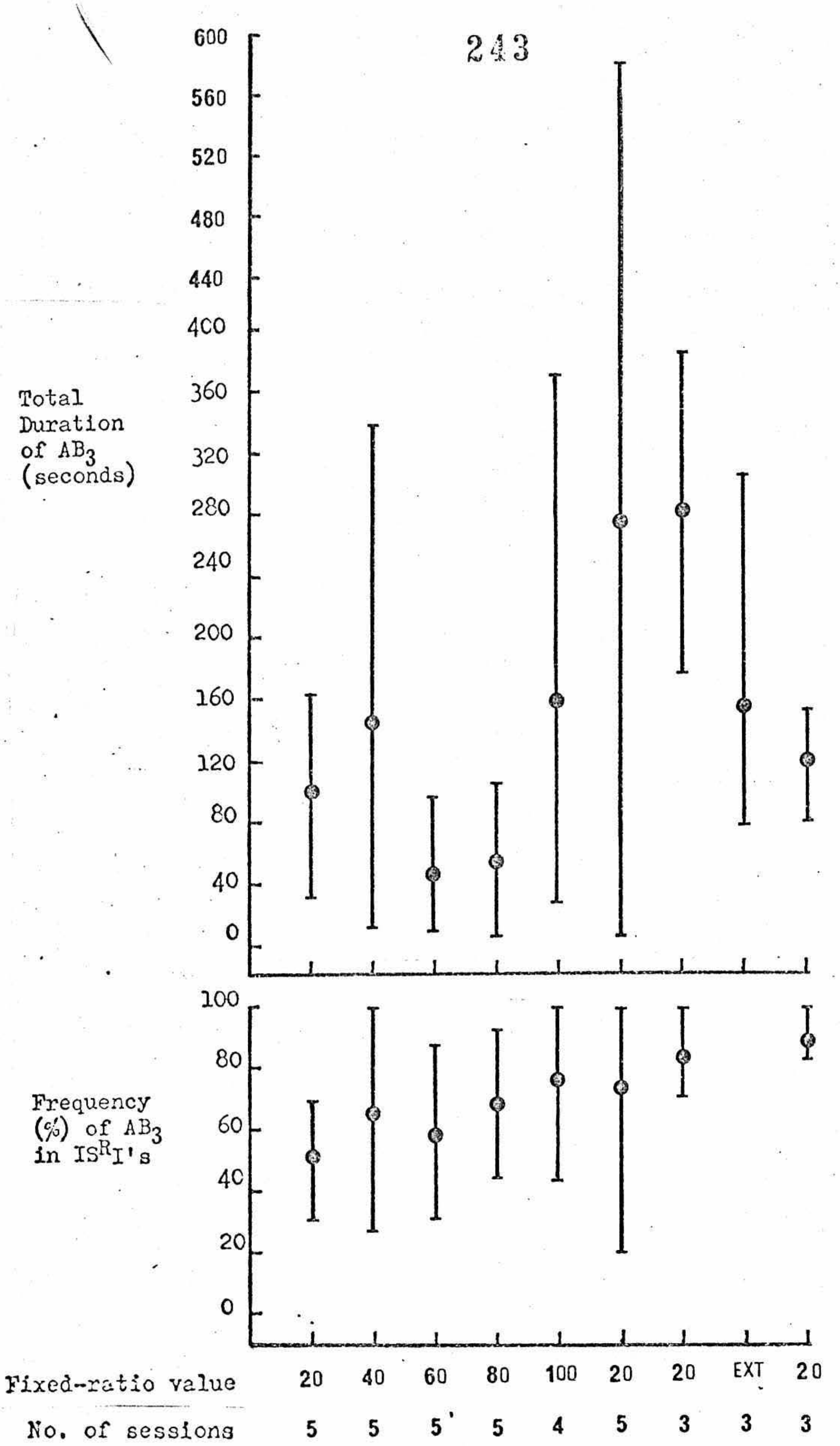


Figure 48 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 3

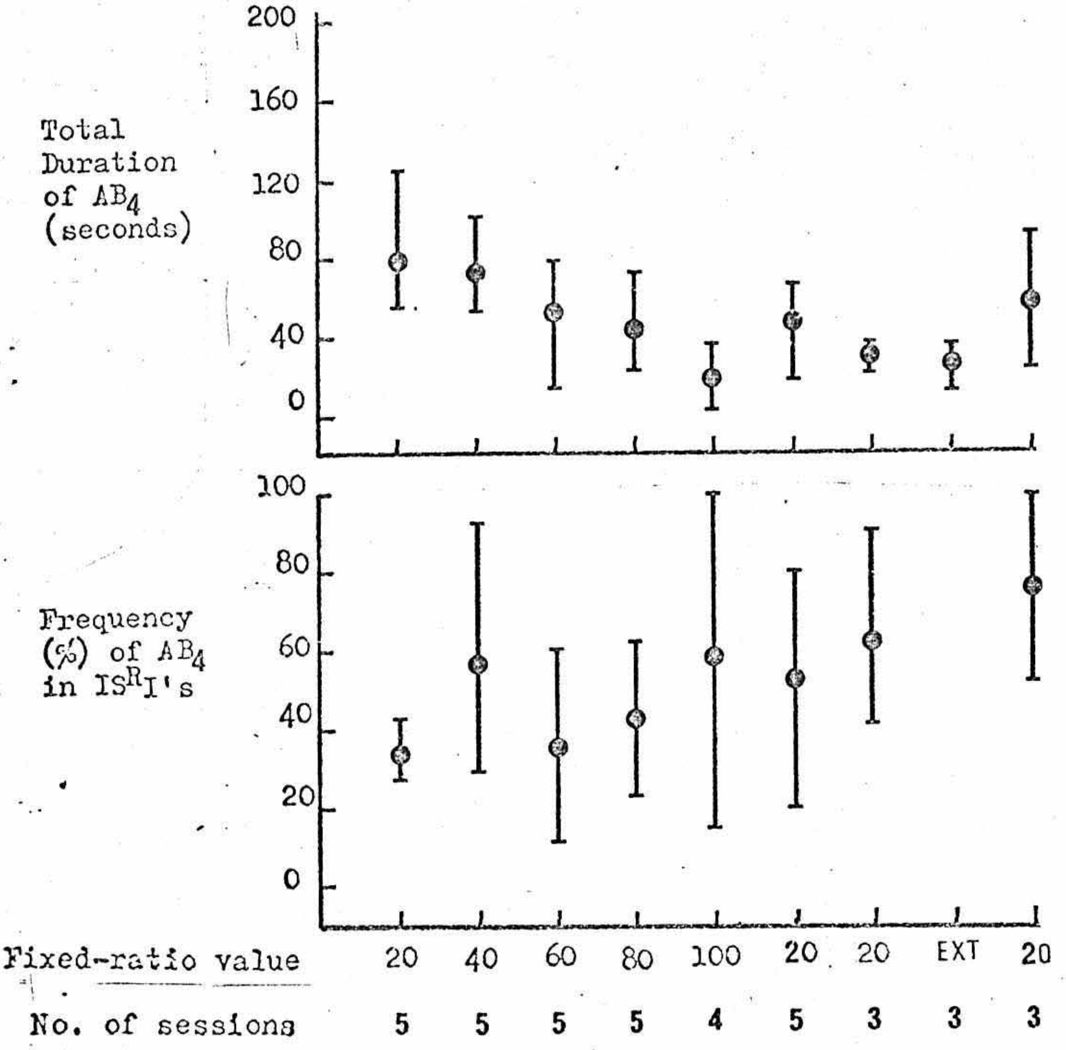


Figure 49 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_4 for Subject 3

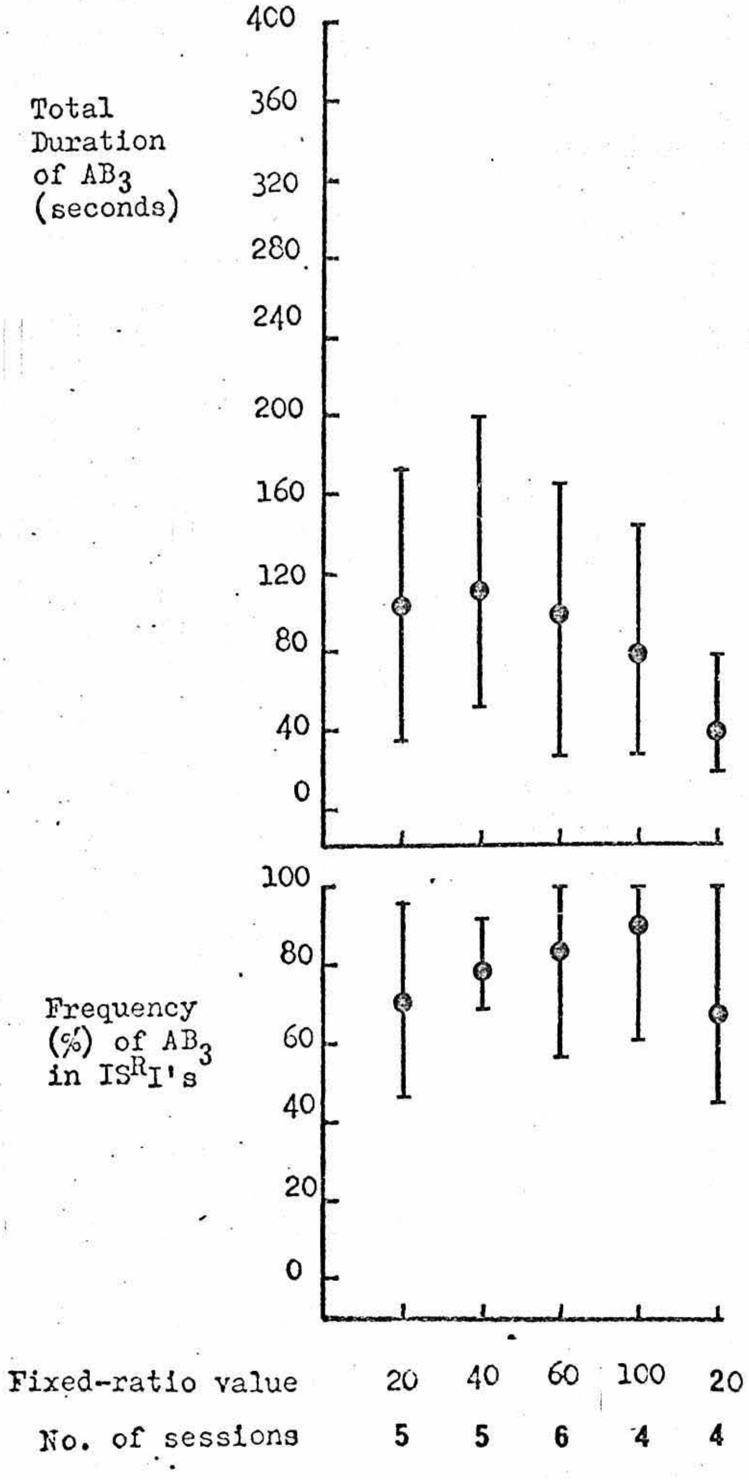


Figure 50 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 5

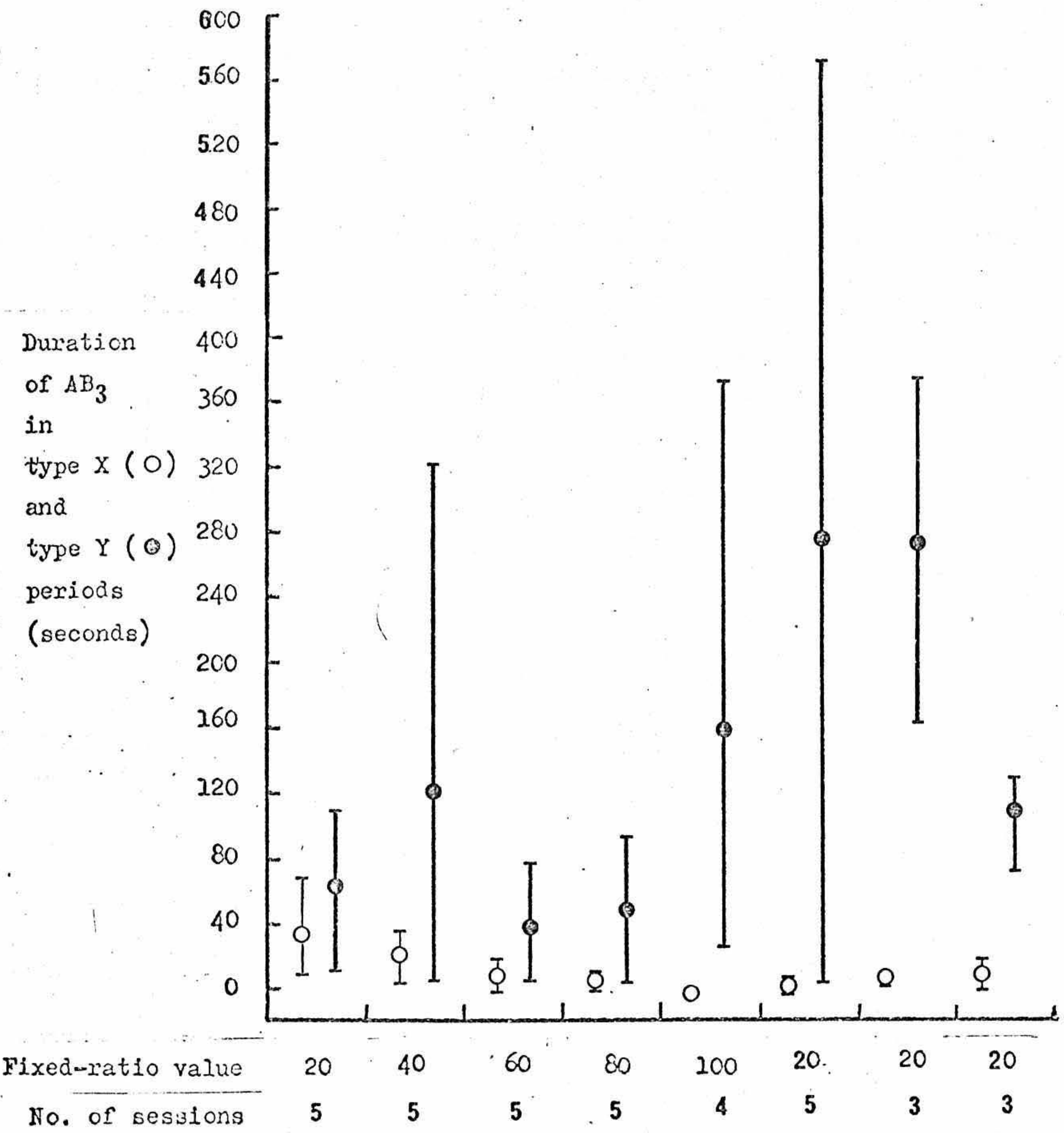


Figure 52 Means and ranges of durations of AB_3 in type X and type Y periods for Subject 3

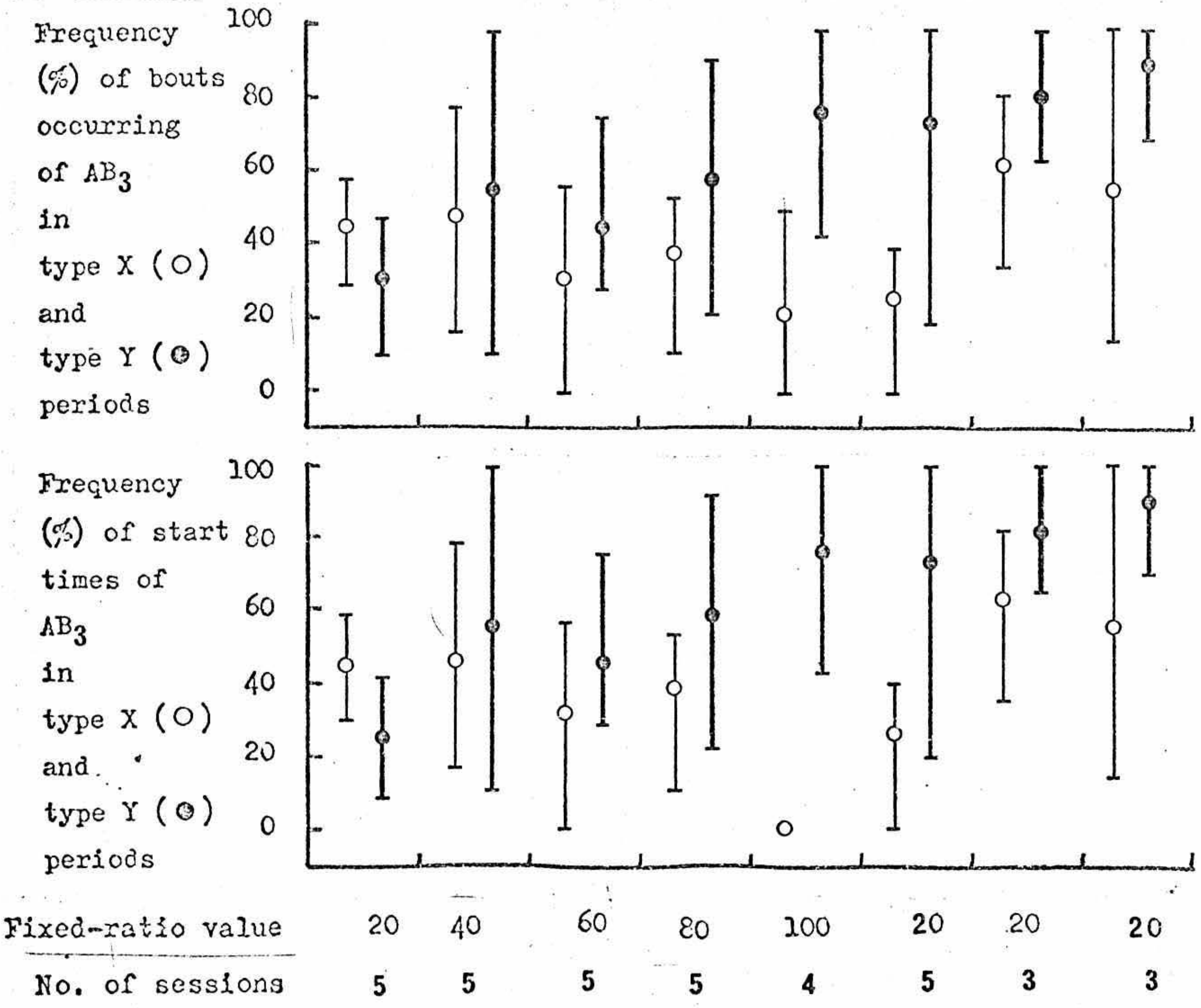


Figure 53 Means and ranges of frequencies of bouts occurring and start times of AB_3 in type X and type Y periods for Subject 3

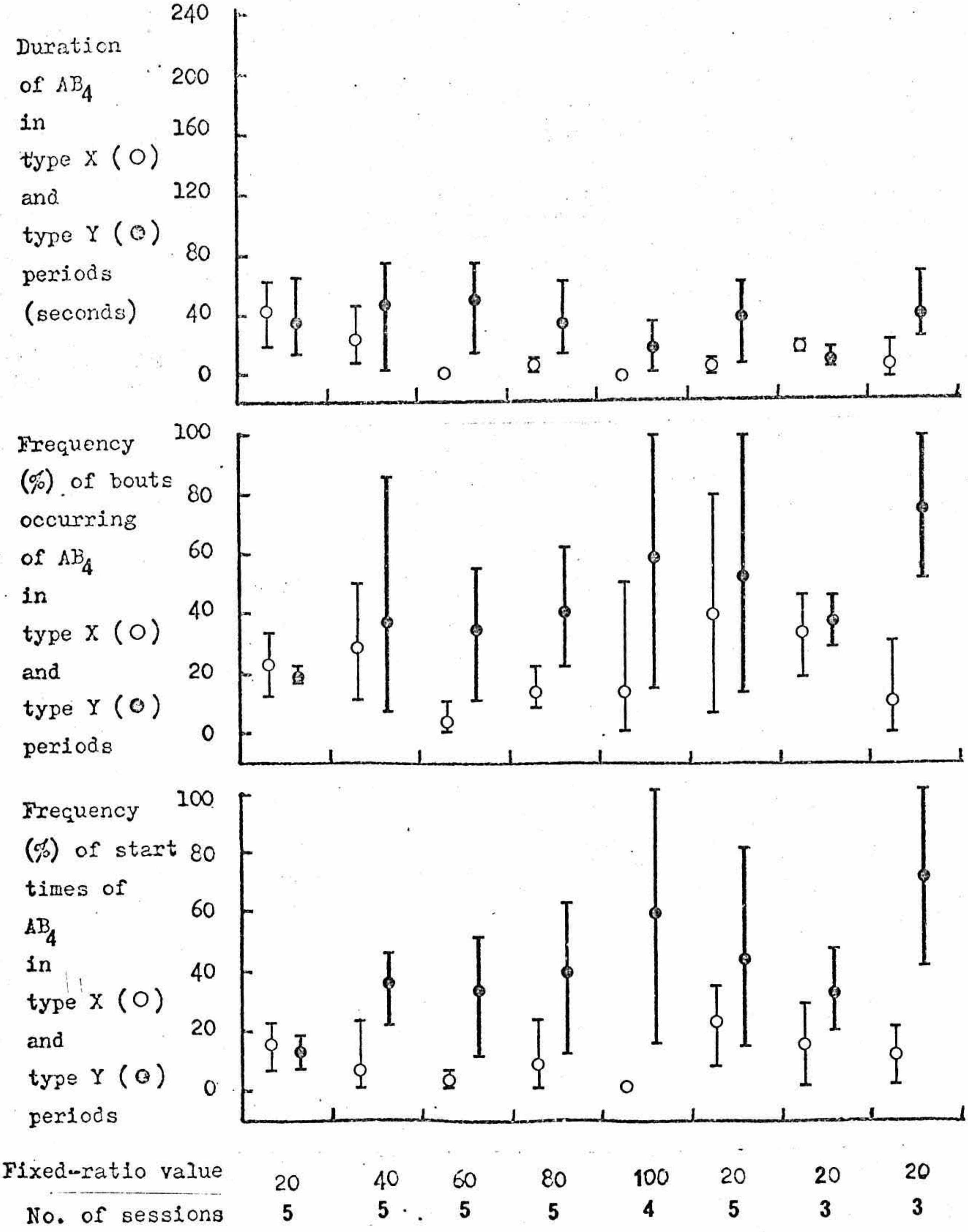


Figure 54 Means and ranges of durations and frequencies of bouts occurring and start times of AB_4 in type X and type Y periods for Subject 3

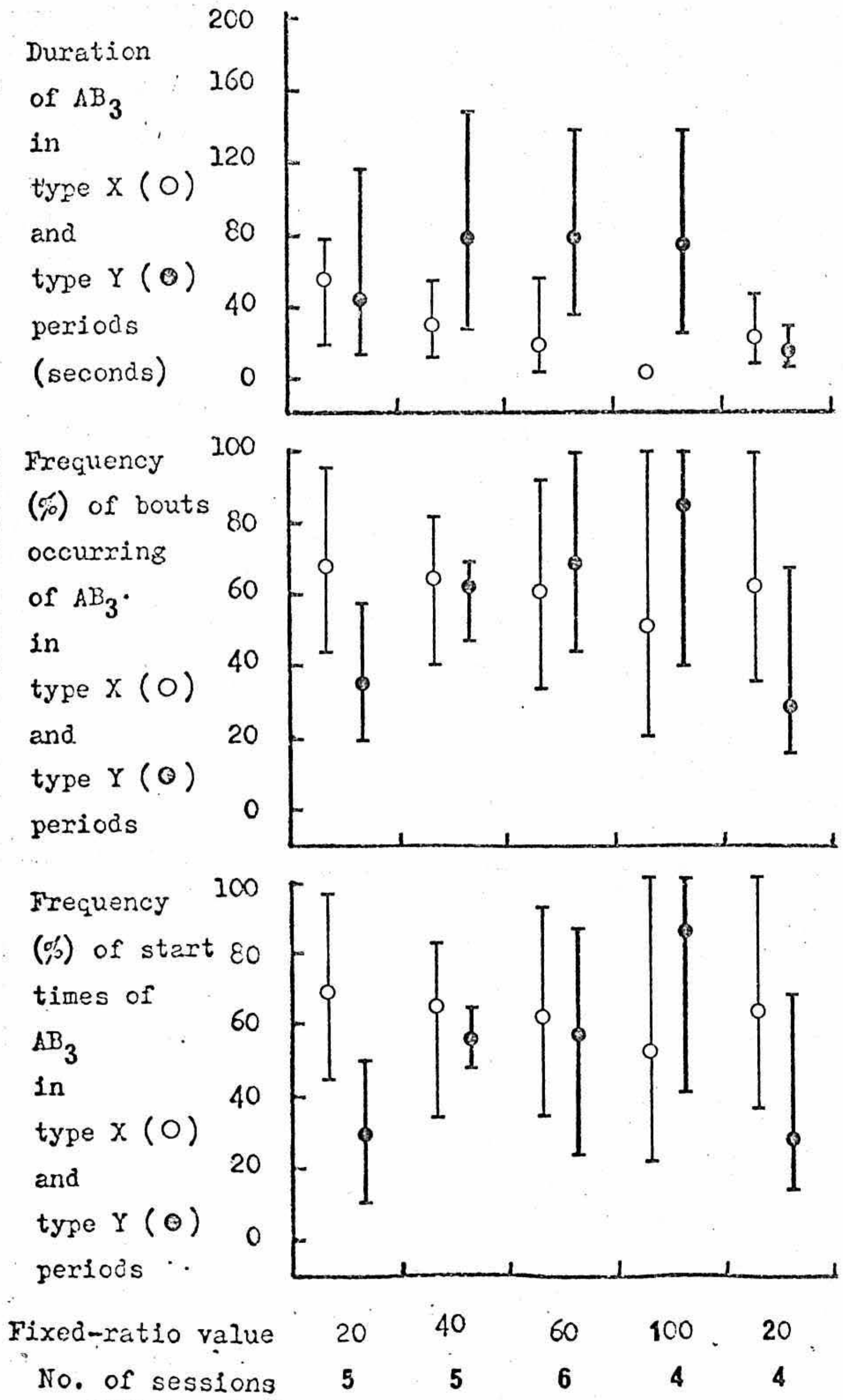


Figure 55   Means and ranges of durations and frequencies of bouts occurring and start times of AB_3 in type X and type Y periods for Subject 5

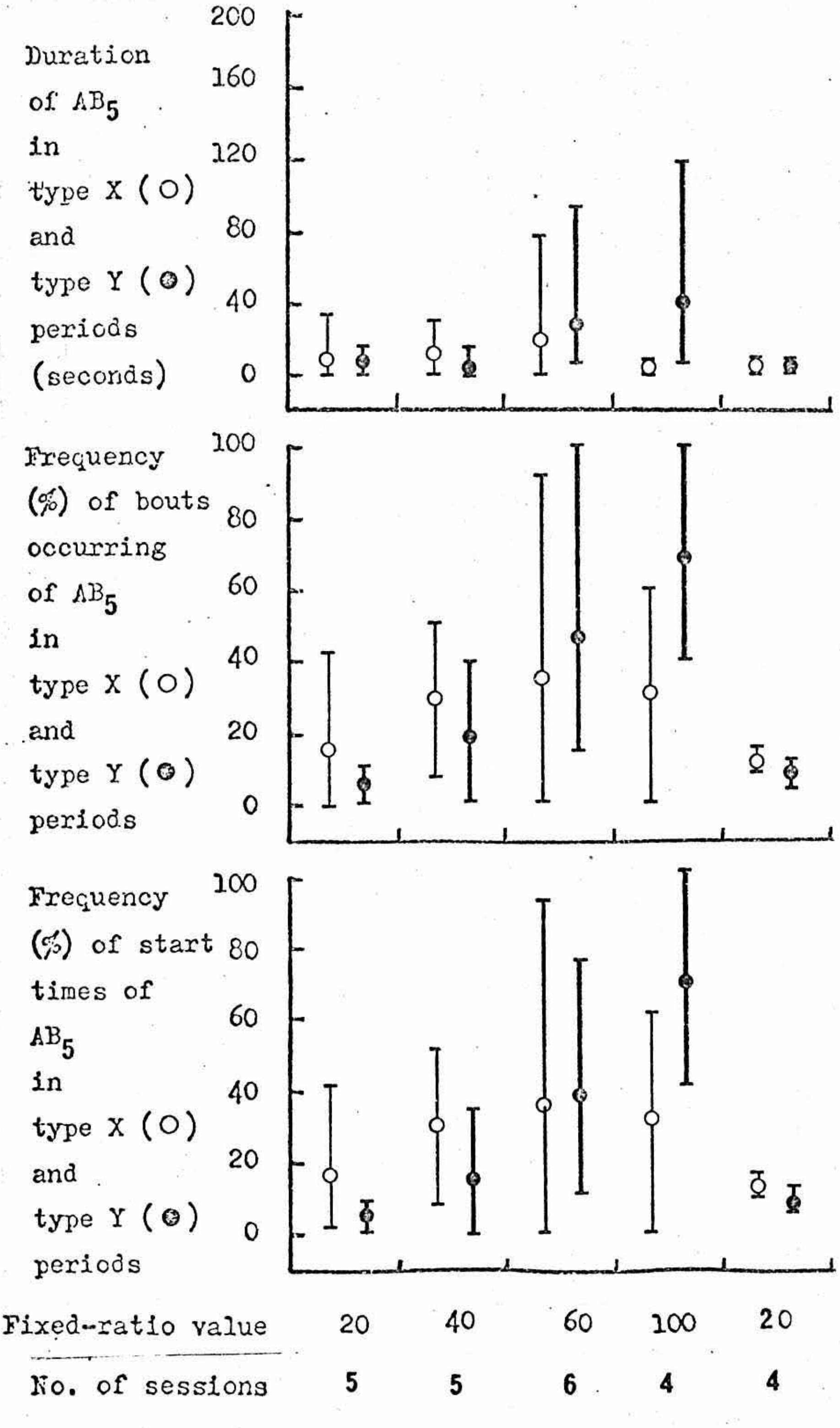


Figure 56 Means and ranges of durations and frequencies of bouts occurring and start times of AB_5 in type X and type Y periods for Subject 5

intervals also increased. The mean inter-stimulus intervals at each fixed-ratio value are shown in table 5. In all sessions there was never an inter-reinforcement interval of less than ten seconds and hance, there was always a type Y period in each inter-stimulus interval. However, as the fixed-ratio values increased then so the number of type X periods in fifteen-minute sessions decreased so that there was less type X time available for the alternative behaviours to be emitted.

Apart for the initial fixed-ratio 20 sessions, in which the frequencies of start times and bout occurring were higher in type X periods, all dimensions of AB_3 and AB_4 for Subject 3 were higher in type Y periods. For Subject 5, the durations and frequencies of both AB_3 and AB_4 varied more in type X periods within sessions of the same ratio value than between different ratio values. However, as the fixed-ratio increased all dimensions of both behaviours increased in type Y periods.

It appeared that for all the alternative behaviours recorded in this study, the frequencies of start times and bouts occurring in type Y periods correlated positively with the average inter-stimulus interval at each fixed-ratio value.

Mean bout length distributions for AB_4 with Subject 3 and AB_3 and AB_5 with Subject 5 are shown in figures 57, 58 and 59 respectively. The median and mode bout lengths of AB_3 and AB_5

TABLE 5 Average inter-stimulus intervals

Subject 3			Subject 5		
F R values	No. of sessions	Mean $IS^{R}I$	FR value	No. of sessions	Mean $IS^{R}I$
20	5	21.4 secs.	20	5	22.5 secs
40	5	39.1 secs	40	5	60.0 secs
60	5	42.9 secs	60	6	112.5 secs
80	5	81.8 secs	100	4	240.0 secs
100	4	225.0 secs	20	4	37.5 secs
20	5	118.4 secs			
20	3	69.6 secs			
20	3	84.4 secs			

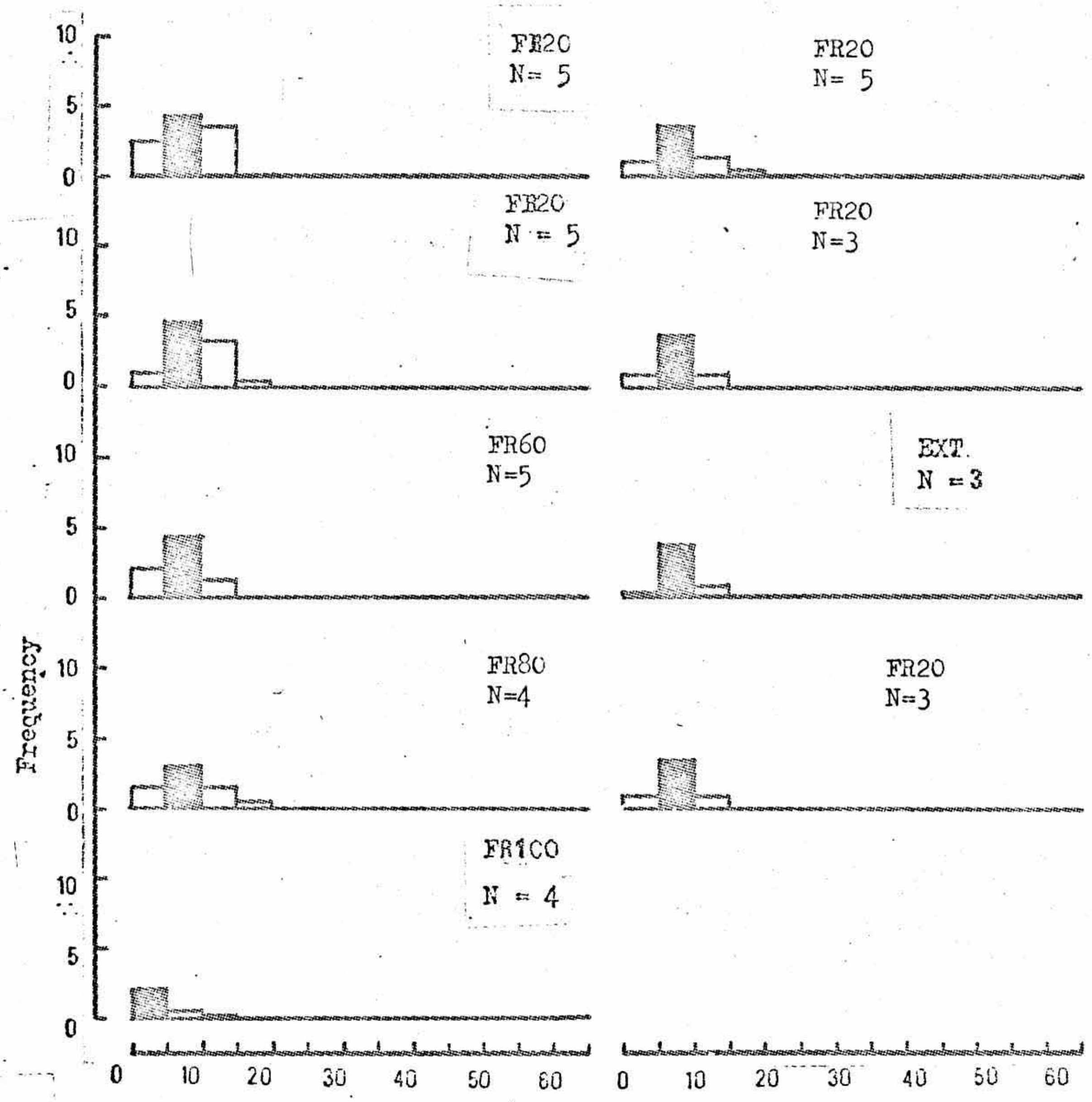


Figure 57 Mean frequency of bout lengths of AB_4 in five-second categories for Subject 3 The last category contains all bout lengths greater than sixty-seconds. The median bout length category is shaded.

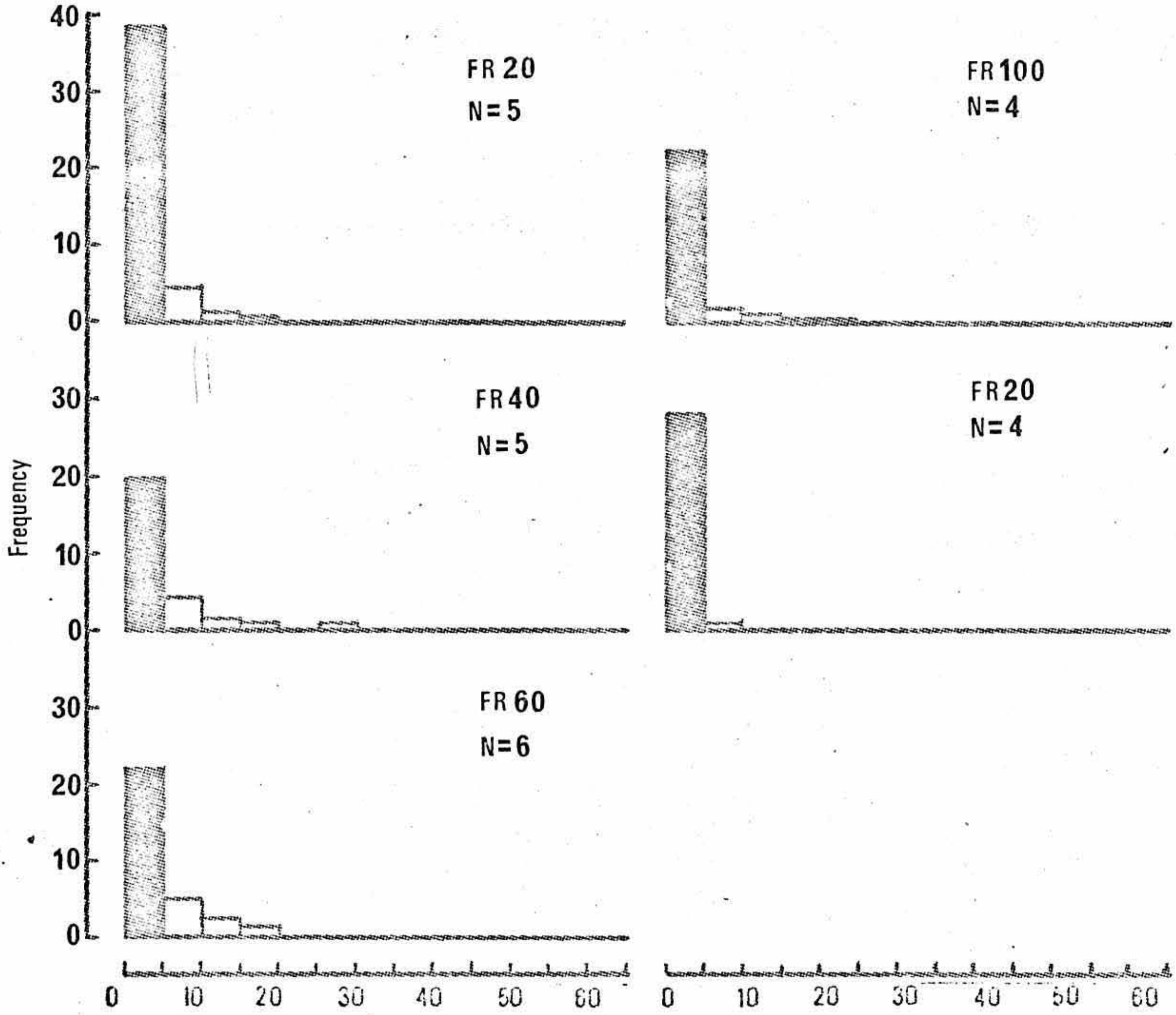


Figure 58 Mean bout lengths of A B_3 for Subject 5 in five-second categories. The last category contains all bout lengths of greater than sixty-seconds. The category in which the median bout length fell have been shaded in each condition.

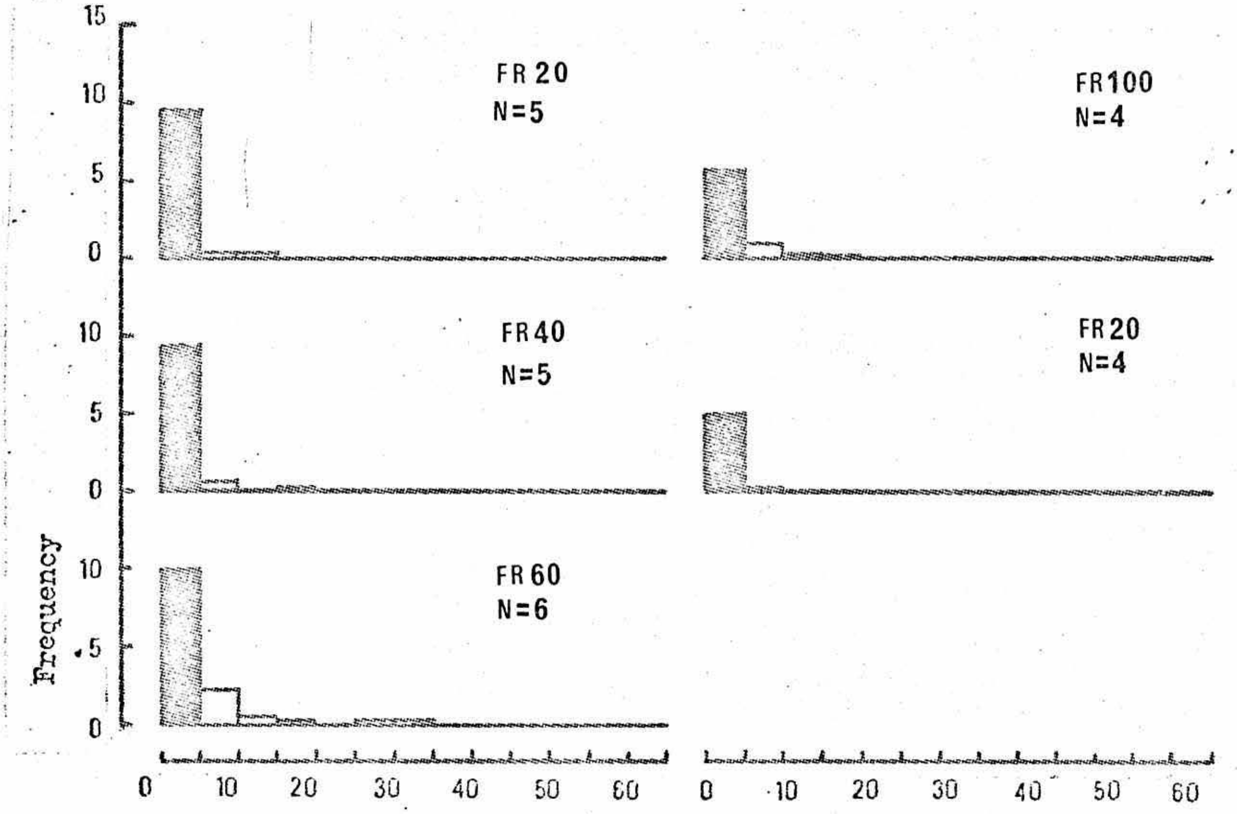


Figure 59   Mean frequency of bout lengths of AB_5 in five-second categories for Subject 5. The last category contains all bout lengths greater than sixty-seconds. The median bout length category is shaded.

for Subject 5 were in the first five second category at all fixed-ratio values. For Subject 12, the median and mode bout lengths of AB_4 were the five to ten second category at all fixed-ratio values except fixed-ratio 100 when both averages moved into the first five-seconds category.

Discussion.

Both subjects in this experiment showed an increase in the number of "inefficient" aspects of performance (higher frequency of split-runs, longer and more frequent pauses in responding) with increased in fixed-ratio value. In this respect the findings concurred with previous studies (Ellis et al, 1960; Wallace and mulder, 1973). However, the finding of an inverse relationship between respons rate and ratio value conflicted with that of two of Schroeder's (1972) subjects, but concurs with the finding for his third subject.

Three contrasting functional classes of alternative behaviours were seen in this experiment. Total AB_3 durations were unrelated to increases in fixed-ratio value for each subject AB_4 durations for Subject 3 decreased with increases in fixed-ratio value, and AB_5 for Subject 5 increased in duration with increases in fixed-ratio value. The average bout lengths of AB_4 for Subject 3 also decreased with increases in fixed-ratio value.

When fixed-ratio 20 was reintroduced, most aspects of performance returned to the same pattern as the initial fixed-ratio 20 sessions for Subject 5, but the initial fixed-ratio 20 performance was not recovered for Subject 3.

CHAPTER 12

CHANGES IN FIXED-INTERVAL VALUES

CHAPTER 12

CHANGES IN FIXED-INTERVAL VALUES

Introduction

Sidman (1962) noted that;-

> 'In general, the indications have been that the fixed-interval schedule is the least stable of all the reinforcement schedules in controlling human behaviour' (Sidman, 1962, p. 179).

Inter-subject differences have been reported with retardates on fixed-interval schedules of stimulation. Intermittent patterns of responding are usually transitory (Orlando, 1961) with performance eventually falling into one of two distinct categories. Individual performances are usually consistent but tend to polarise to either high "run way" rates of responding with littel pausing, or low rate "pacing" (Orlando and Bijou, 1960).

Some of the factors which determine at which pole of the comtinuum a subject's eventual performance will settle have been identified. Headrick (1963) has shown that with mildly retarded subjects the rate of responding obtained on fixed-interval schedules is a function of instructions and experience on previous schedules. Spradlin et al (1965) found that severely retarded subjects who were shifted from fixed-ratio to fixed-interval schedules of lever-pressing showed on initially high rate of responding after the shift which gradually diminished to a low rate.

Schroeder (1972) found that the rate of tool-usage on fixed-interval schedules with retardates decreased when the size of the interval was increased. Furthermore the frequency of contingent stimuli per opportunity remained constant with changes in fixed interval value.

The present study was carried out to investigate the changes in various aspects of lever-pressing and alternative behaviours when fixed-interval values were manipulated with two retardates.

Subjects

Subjects 12 and 20 served in this experiment. Both were experimentally naive at the start of the experiment apart from three training sessions.

Apparatus and Procedure

Five-second slide presentations were used as stimuli with both subjects and this was accompanied with pop-music for Subject 3. The standard experimental procedure was employed. The fixed-interval values were manipulated as indicated in figures 60 and 61. Alternative behaviours were not recorded at the first two fixed-interval values.

Results

Subject 12 refused to stay for the full fifteen minute duration in some sessions. The mean and range of session duration at each fixed-interval value are shown in table 6. Figures 60 and 61 show the mean overall response rates and the obtained frequency of stimulation at each fixed-interval value. Figure 61 also shows the frequencies of pauses greater than ten seconds for Subject 20. As session duration varied for Subject 12, this figure was not computed.

Each subject did not obtain the maximum number of stimulus deliveries possible. For both subjects there was considerable scatter in response rates and this variable did not seem to be related to the schedule of stimulation. Subject 20, however, produced considerably higher mean response rates than Subject 12 at all fixed-interval values.

Figure 62, shows the median and inter-quartile range of post-stimulus pauses at each fixed-interval value. For Subject 12, this variable was not related to the programmed schedule of stimulation, but for Subject 20, there was a tendency for post-stimulus pauses to increase with increases in fixed-interval value.

TABLE 6 - The mean and range of session durations for Subject 12.

Schedule	No. of sessions	Mean session duration with range in parenthesis
FI - 10 secs	11	15 mins
FI - 20 secs	5	15 mins
FI - 10 secs	7	14 mins (8.1 - 15.0 mins)
FI - 20 secs	6	14.7 mins (13.1 - 15.0 mins)
FI - 30 secs	6	13.0 mins (3.2 - 15.0 mins)
FI - 10 secs	8	10.6 mins (2.9 - 15.0 mins)

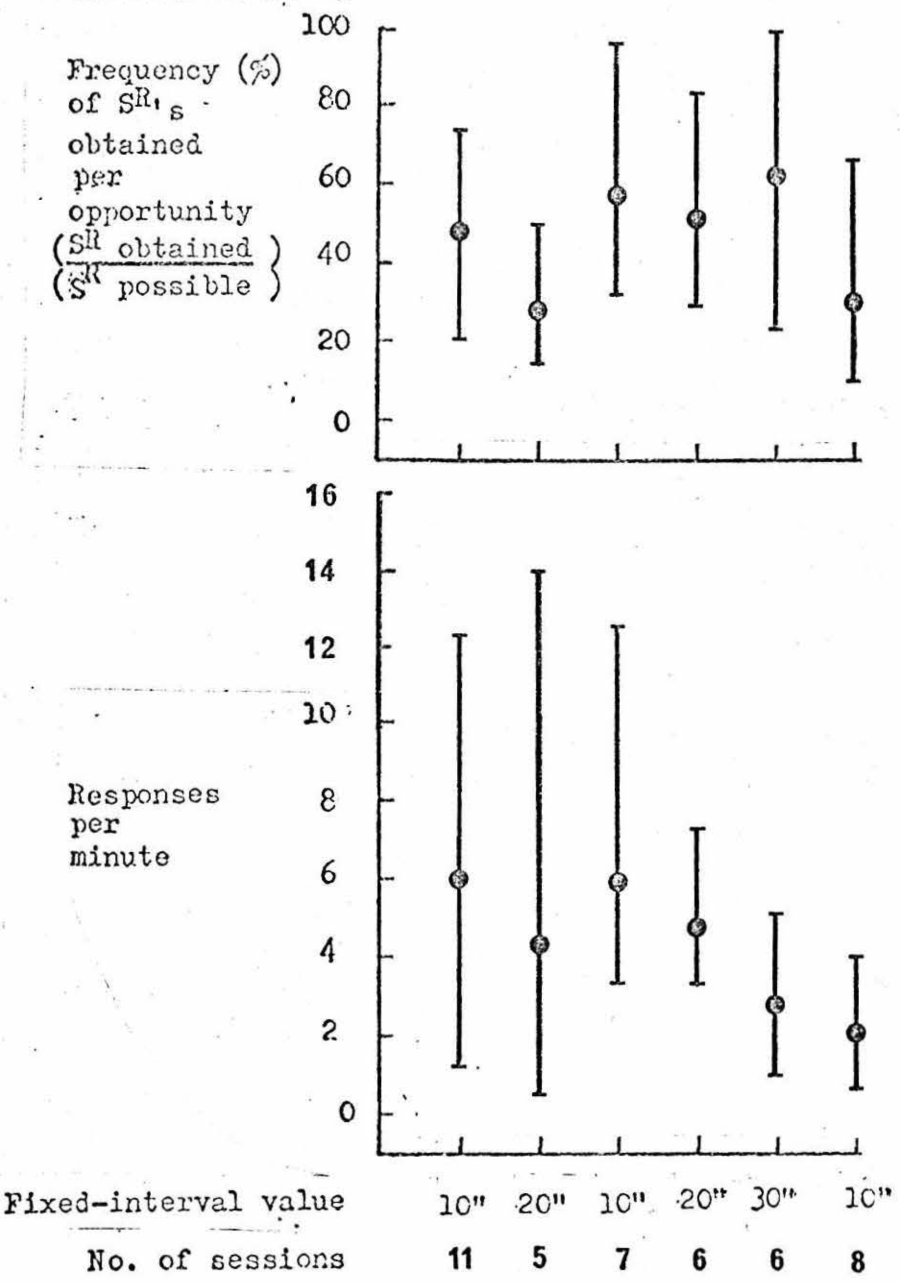


Figure 60. Means and ranges of frequency of stimuli obtained per opportunity and response rate for Subject 12.

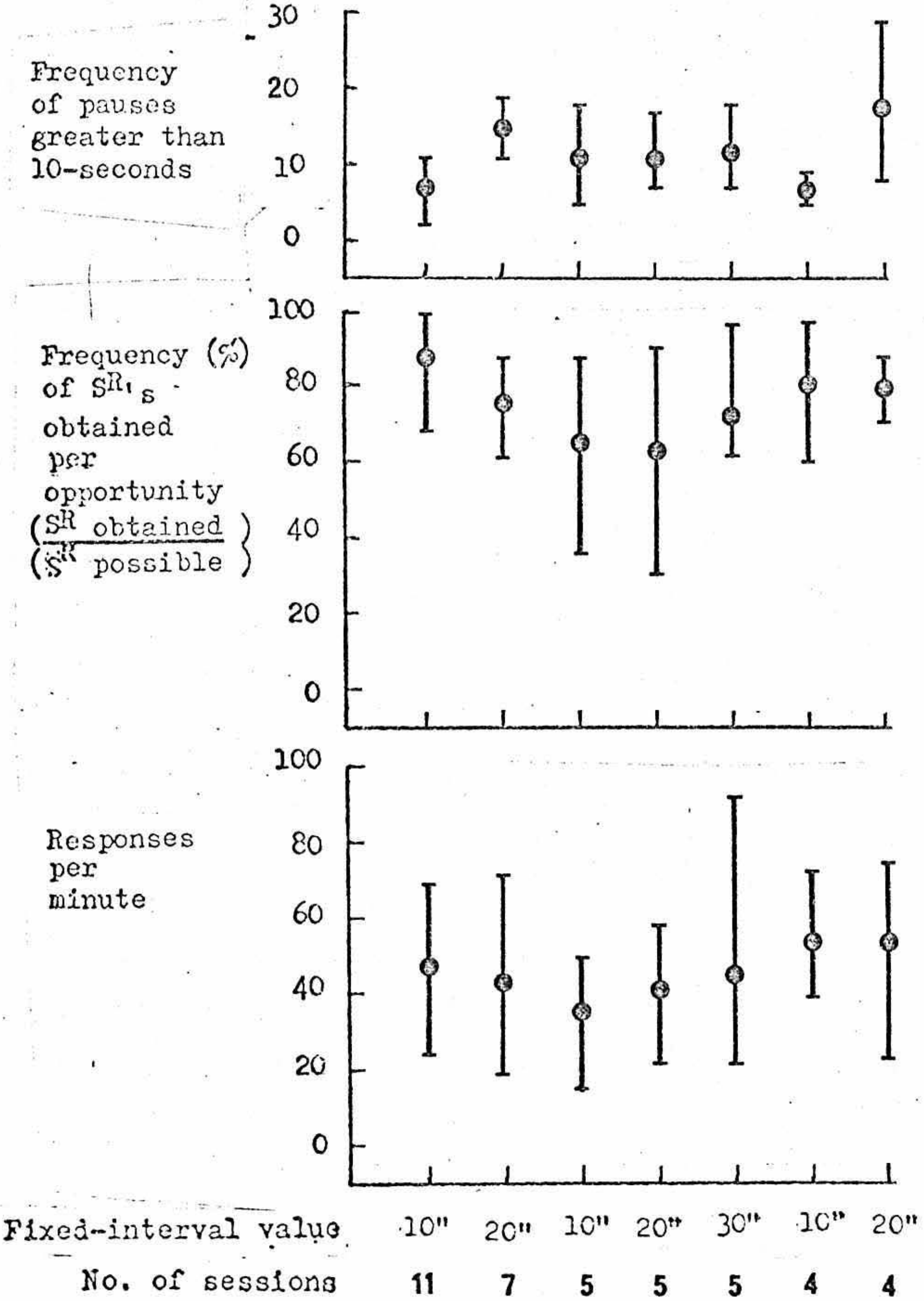


Figure 61 Means and ranges of frequency of pauses greater than 10-seconds, frequency of stimuli obtained per opportunity, and response rate for Subject 20.

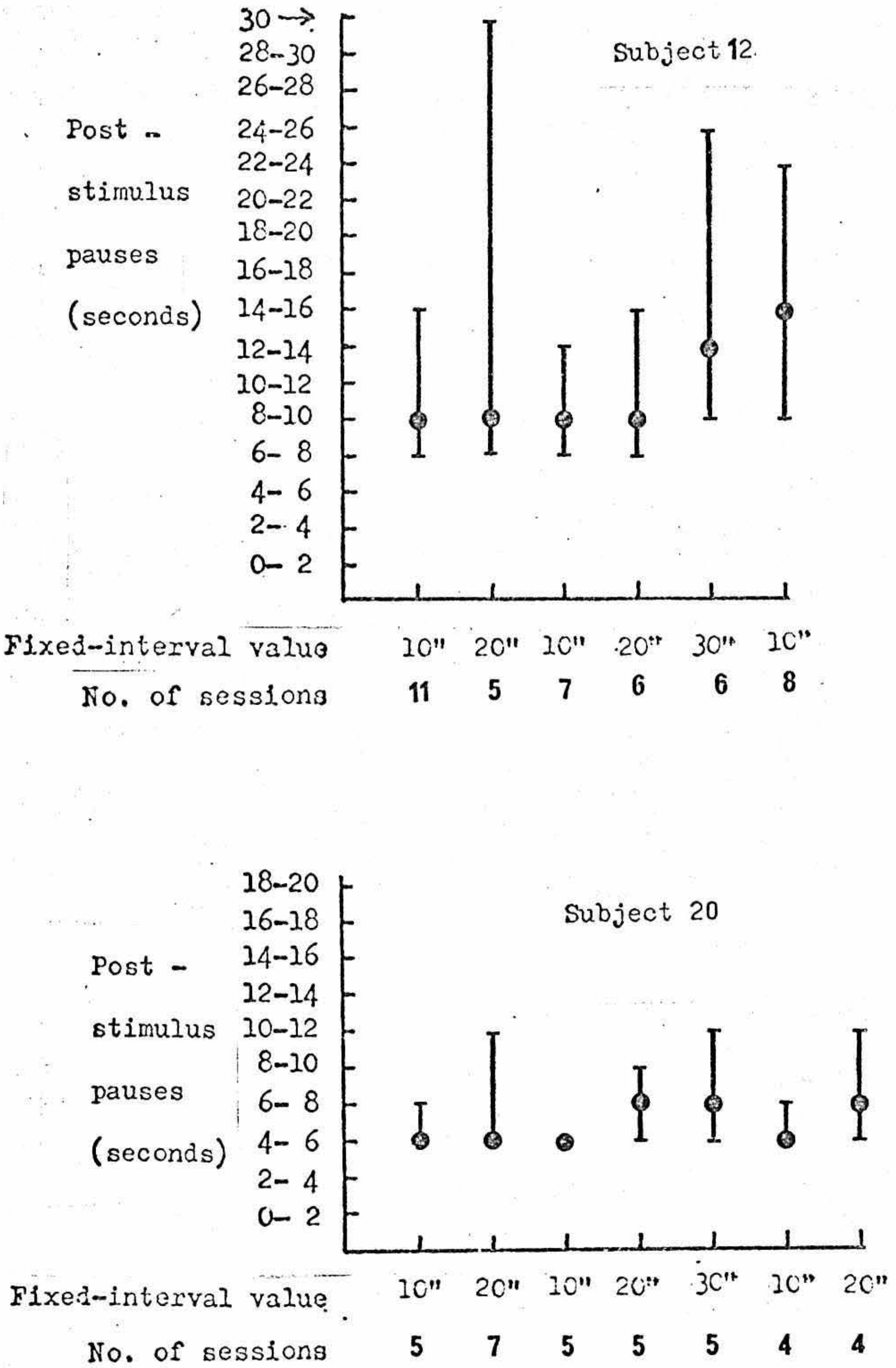
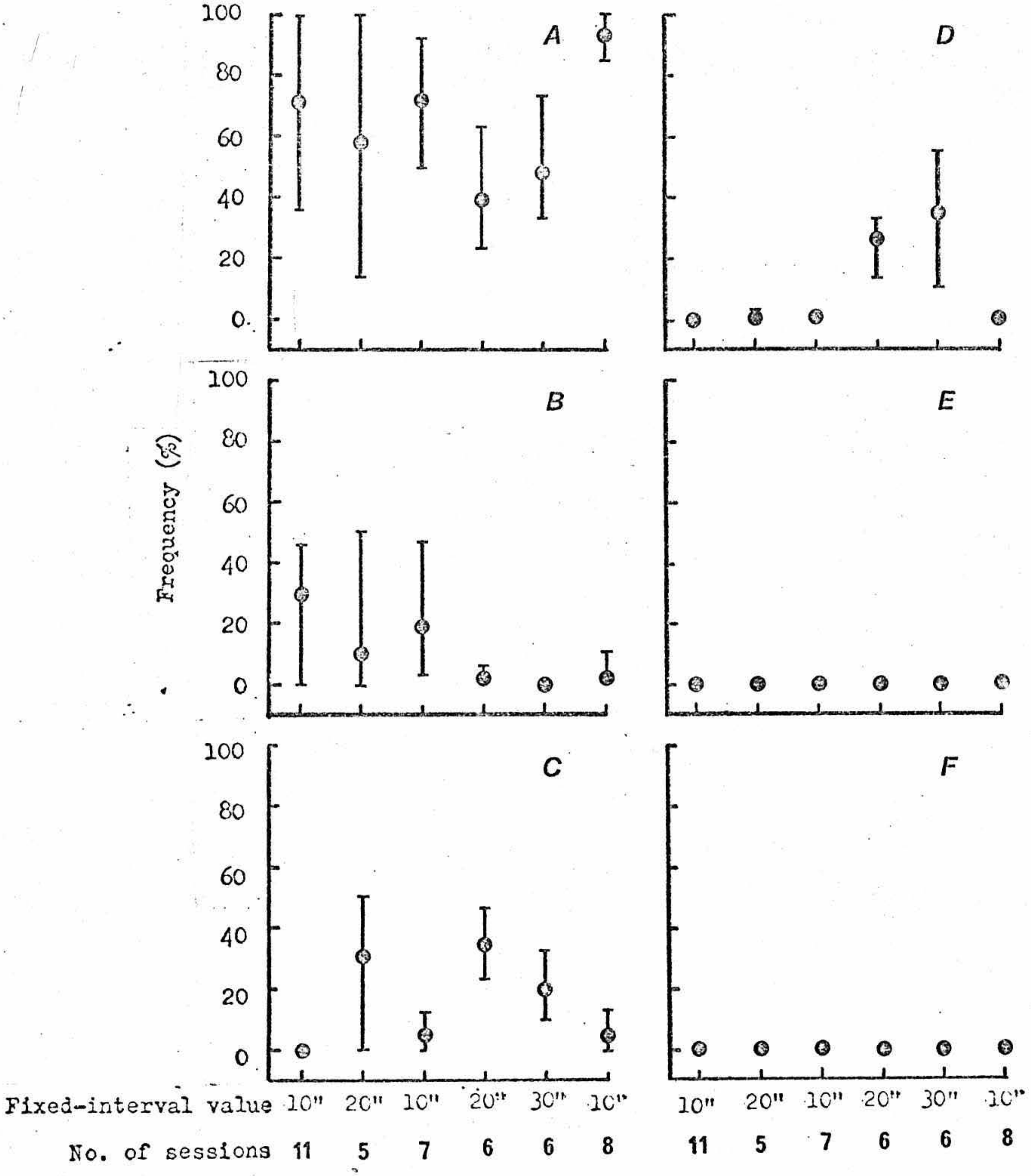


Figure 62 Medians and inter-quartile ranges of post-stimulus pauses in two-second categories. All post stimulus pauses of thirty-seconds or more were placed in the final category.

More detailed analyses of inter-stimulus patterns of responding are shown in figures 63 and 64. A comparison of pattern A (a single lever-press resulting in stimulation) shows considerable difference between the two subjects. Subject 20's responding tended to occur in runs, but Subject 12 emitted much slower rates of responding (compare their cumulative records in appendix III). However, for both subjects there was an increase in split runs (patterns C and D) with increases in fixed-interval value. Subject 12 never produced over-runs of responding (pattern E) and Subject 20's over-runs seemed to decrease with the number of sessions rather than with the fixed-interval value.

The durations and frequencies of alternative behaviours in inter-stimulus intervals are shown in figures 65, 66, 67 and 68. Because Subject 12's sessions varied in duration, the durations of alternative behaviours have been expressed as a percentage of the total session duration. AB_{11} for Subject 12 did not appear until the second session in the second fixed-interval 10-seconds block, and was only recorded from the fourth session in that block.

For Subject 12, the durations of AB_{10} showed considerable scatter amongst sessions at the same fixed-interval values, but the highest durations always occurred in the fixed-interval 10-seconds session. Similarly, AB_{11} had a higher mean duration in the fixed-interval 10 and 20-seconds sessions, relative to the fixed-interval 30-seconds sessions, but there was a good deal of scatter at each interval.



<u>Figure 63</u> Means and ranges of inter-stimulus patterns of responding for Subject 12.

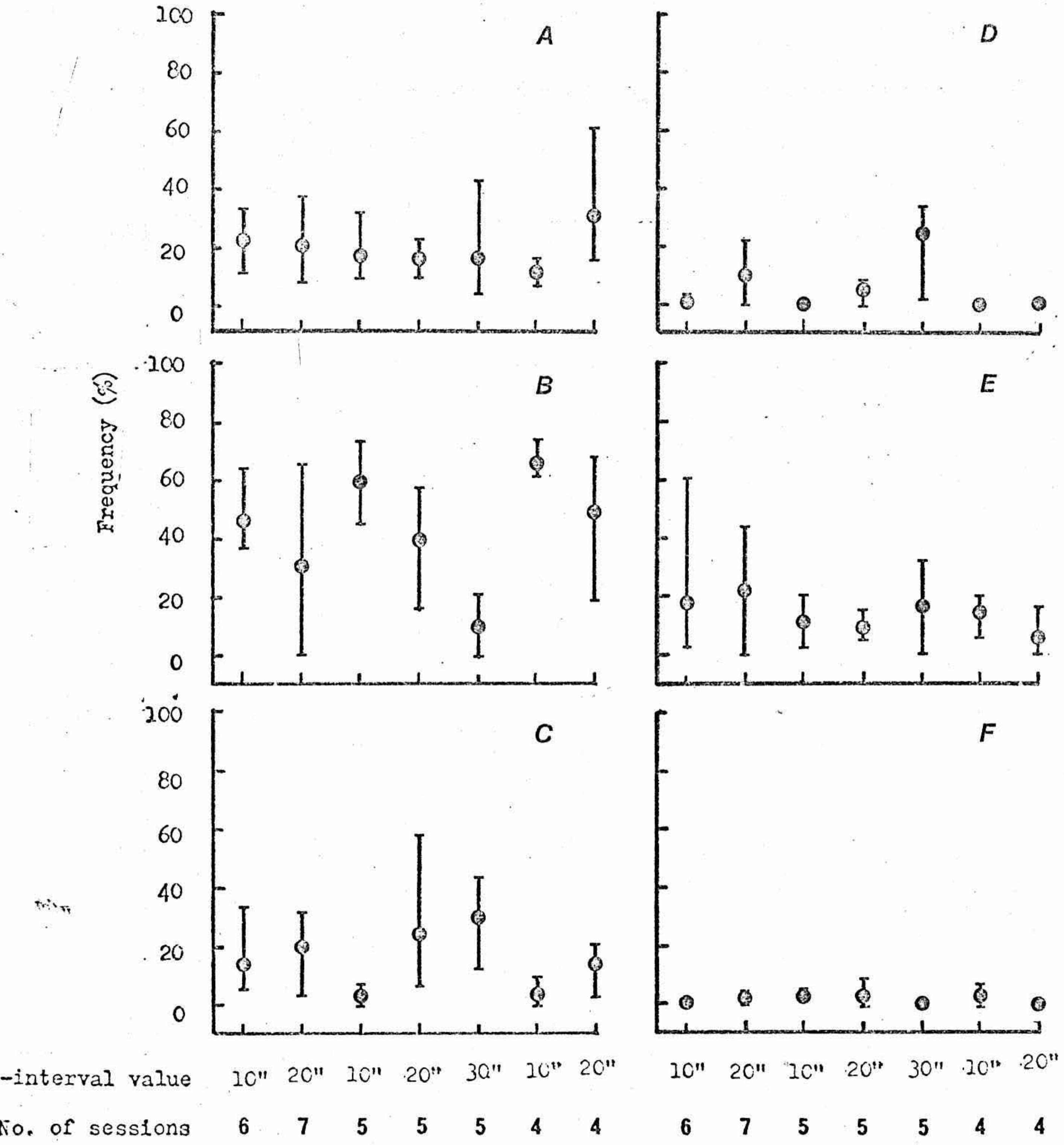


Figure 64 Means and ranges of inter-stimulus of responding for Subject 20.

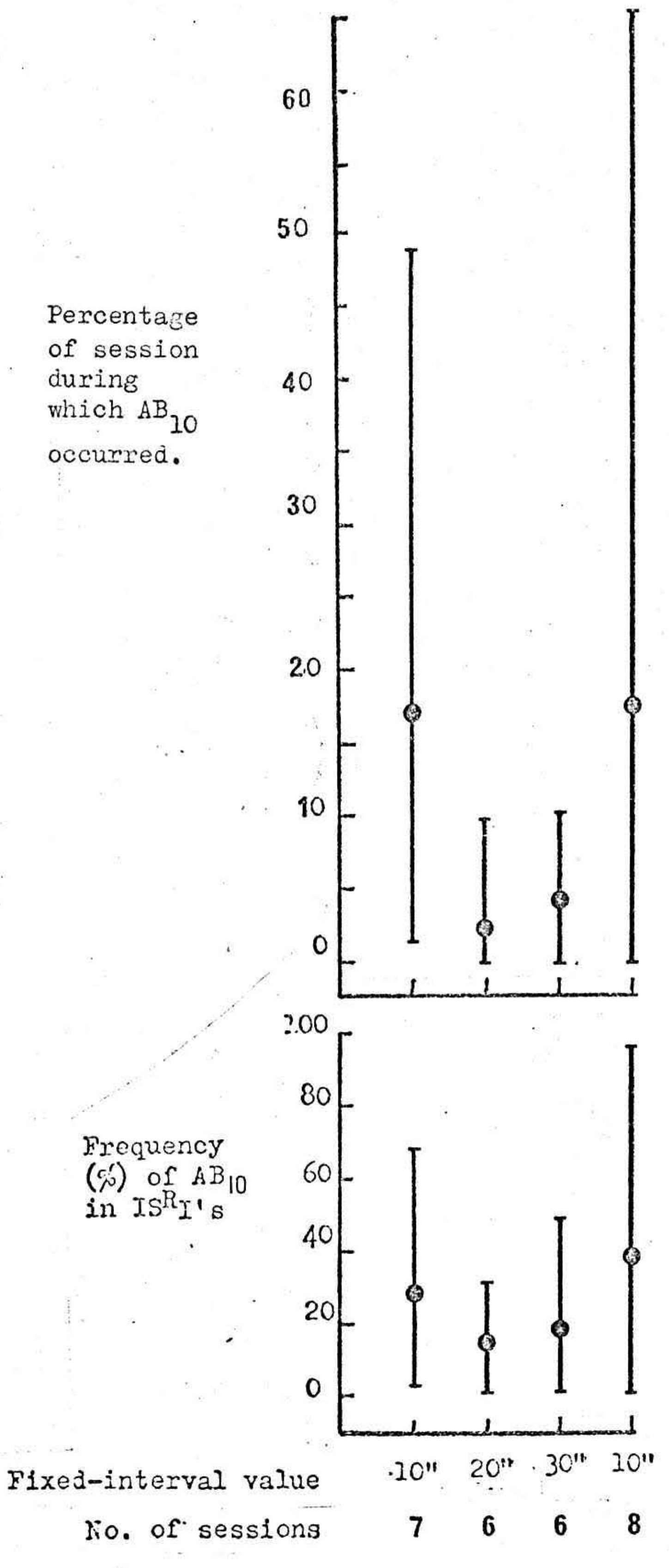


Figure 65 Means and ranges of percentage duration and frequency of AB_{10} in inter-stimulus intervals for Subject 12.

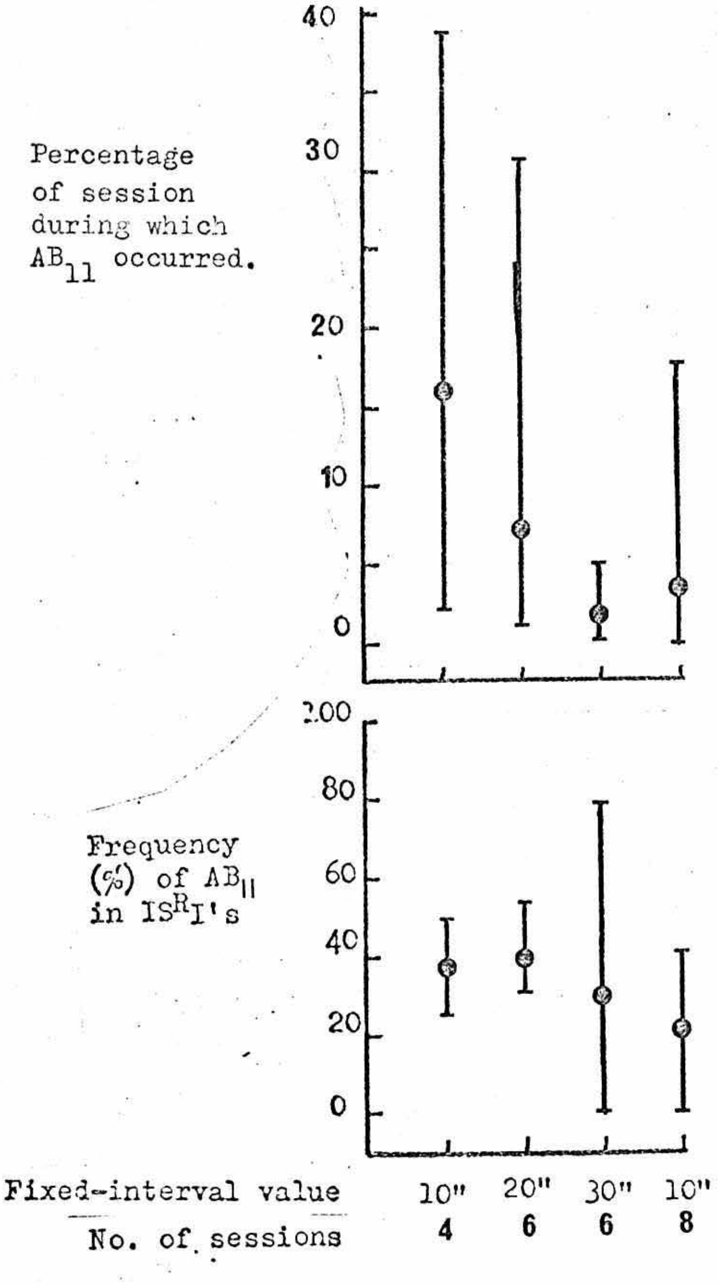


Figure 66 Means and ranges of percentage duration and frequency of AB_{11} in inter-stimulus intervals for Subject 12.

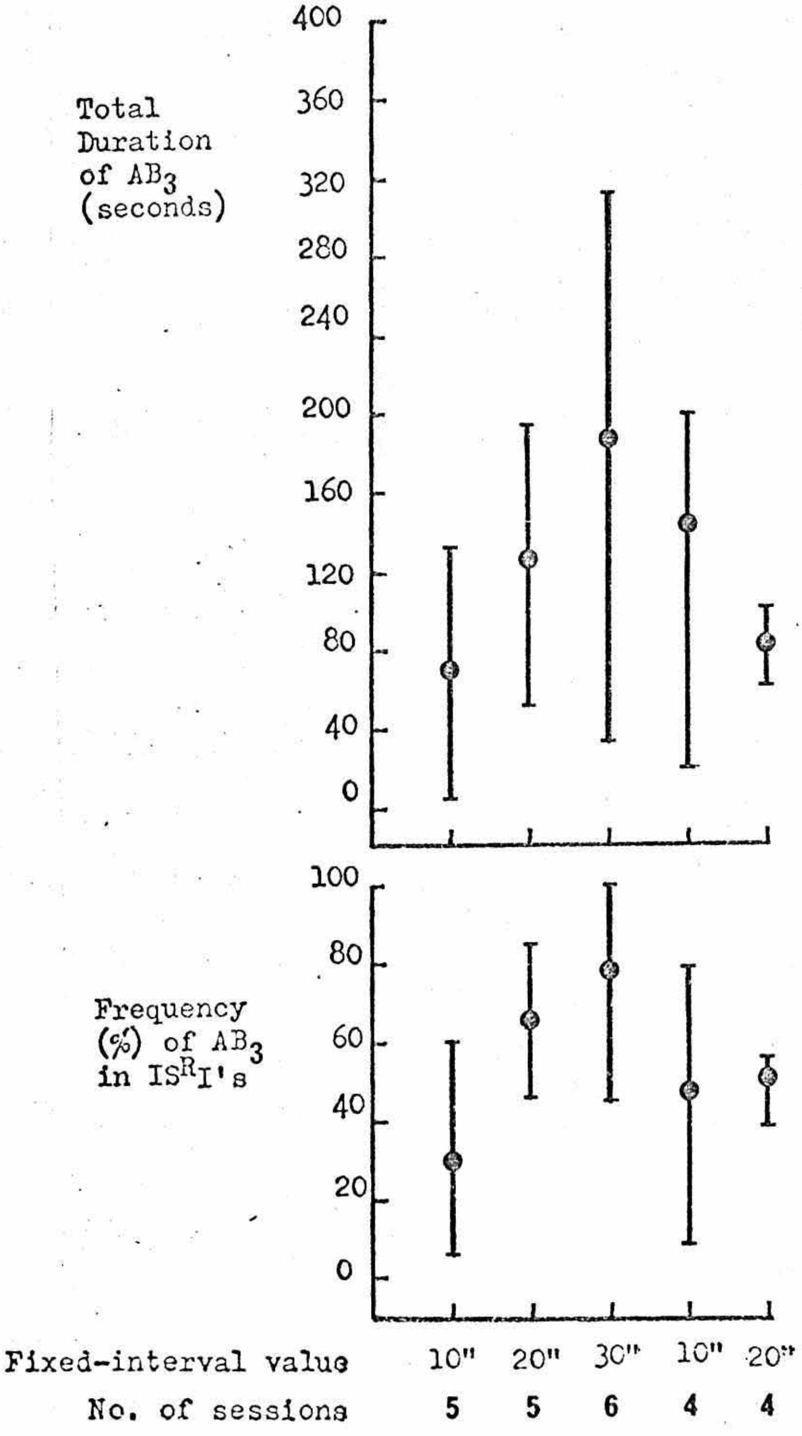


Figure 67 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 20

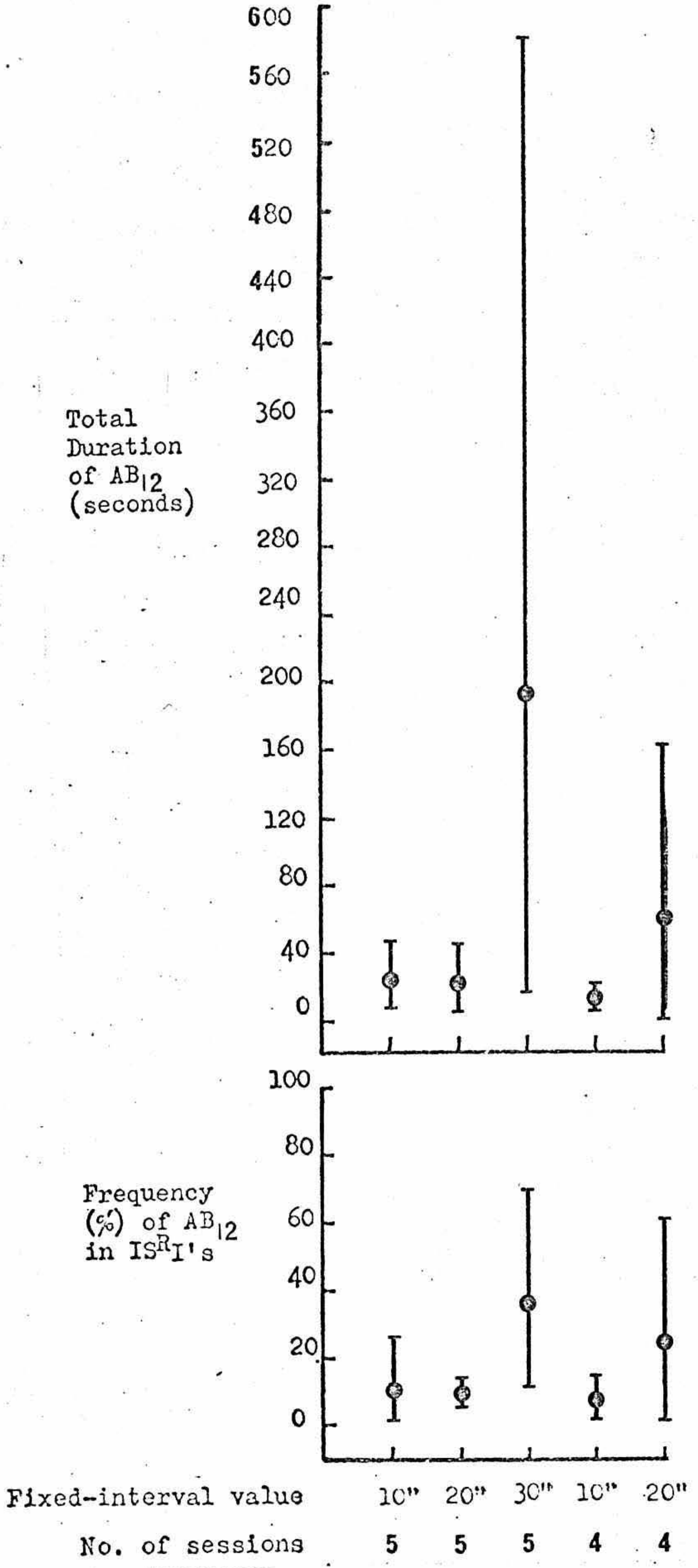


Figure 68 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_{12} for Subject 20

The highest durations of both AB_3 and AB_{12} for Subject 20 occurred in the fixed-interval 30-seconds sessions. Again there was considerable scatter, but the durations and frequencies of AB_3 showed a linear relationship with fixed-interval values.

Figures 69, 70, 71 and 72 show the durations and frequencies of alternative behaviours in type X and type Y periods. Because Subject 12's sessions varied in duration, the durations of alternative behaviours in type X and type Y periods have been expressed as a percentage of the total session time.

AB_{10} for Subject 12 and AB_{12} for Subject 20 showed similarities in their temporal loci relative to stimulus deliveries. Both showed generally higher durations and frequencies of start times and boutsoccurring in type Y periods at all fixed-intervals.

AB_{11} for Subject 12, however, was quite the reverse of this. Durations and frequencies were always higher in type X periods than in type Y periods at all fixed-interval values. Frequencies of start times and bouts occurring of AB_3 for Subject 20 varied between sessions at the same fixed-interval value but were generally higher in the type X periods. A comparison of the two fixed-interval 20-seconds blocks of sessions shows how the temporal loci of AB_3 seemed to change with further sessions. In the final fixed-interval 20-seconds condition all frequencies and durations were higher in type X periods.

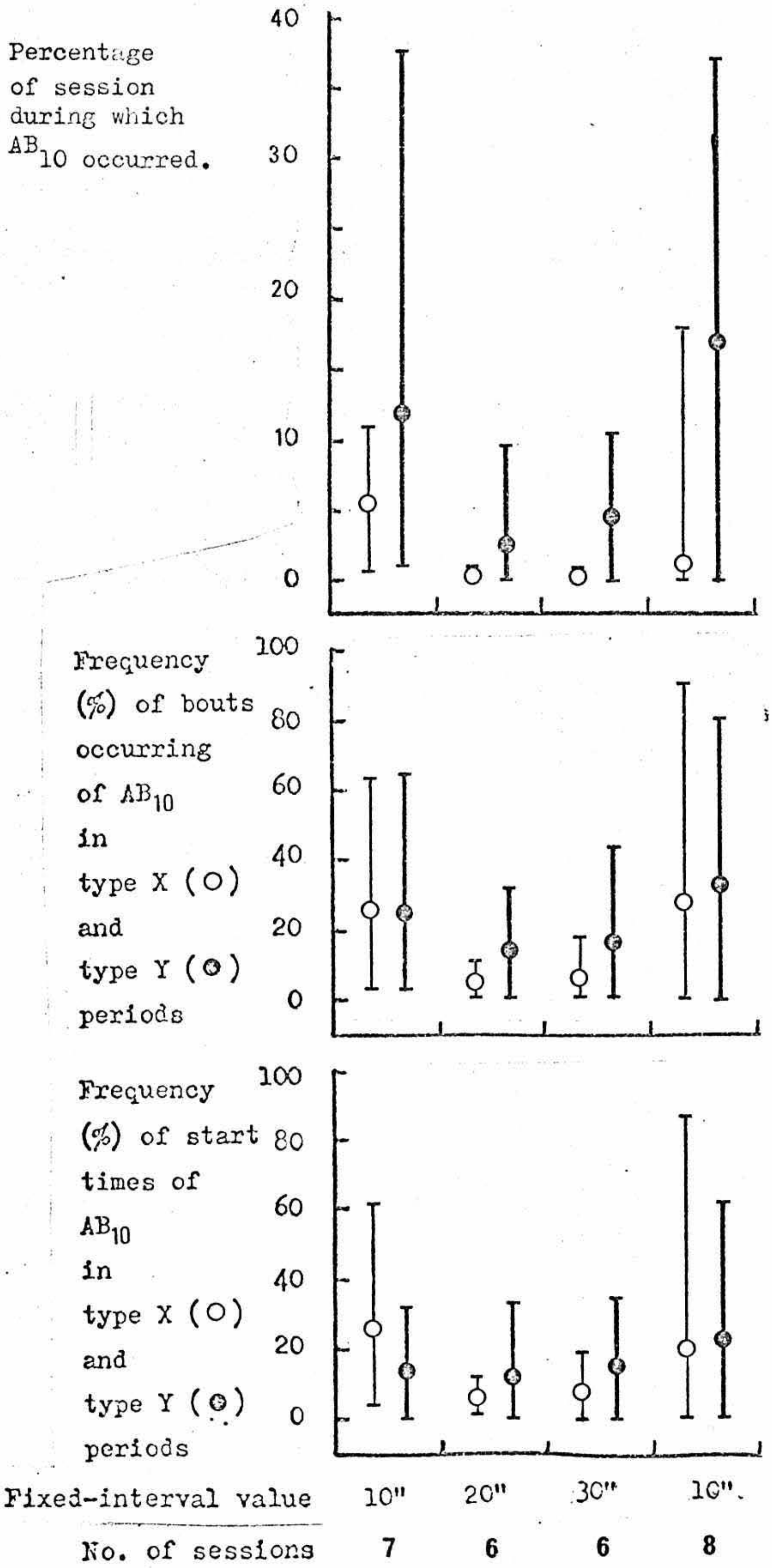


Figure 69 Means and ranges of percentage durations and frequencies of bouts occurring and start times of AB_{10} for Subject 12.

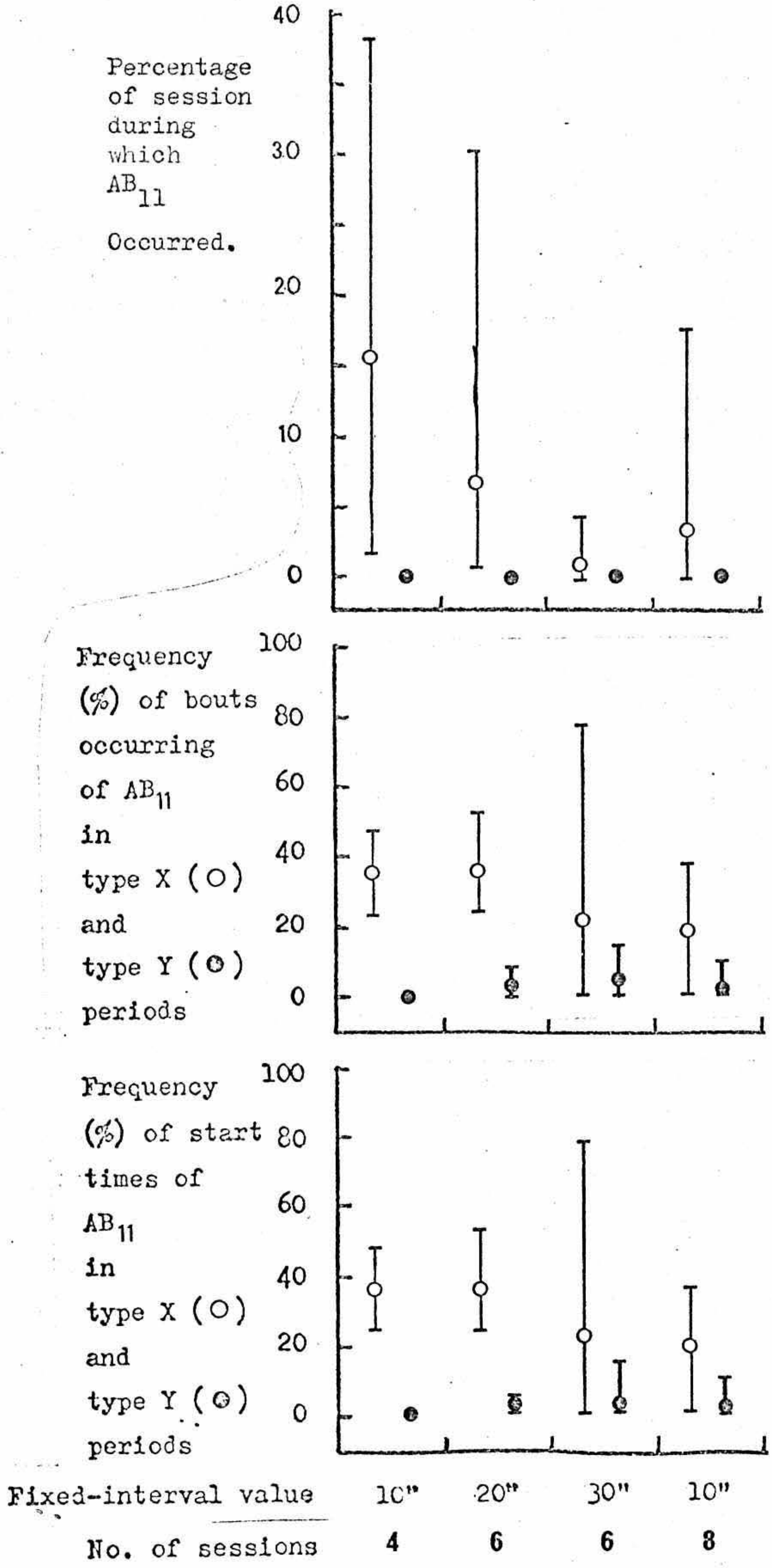


Figure 70 - Means and ranges of percentage duration and frequencies of bouts occurring and start times of AB_{11} for Subject 12.

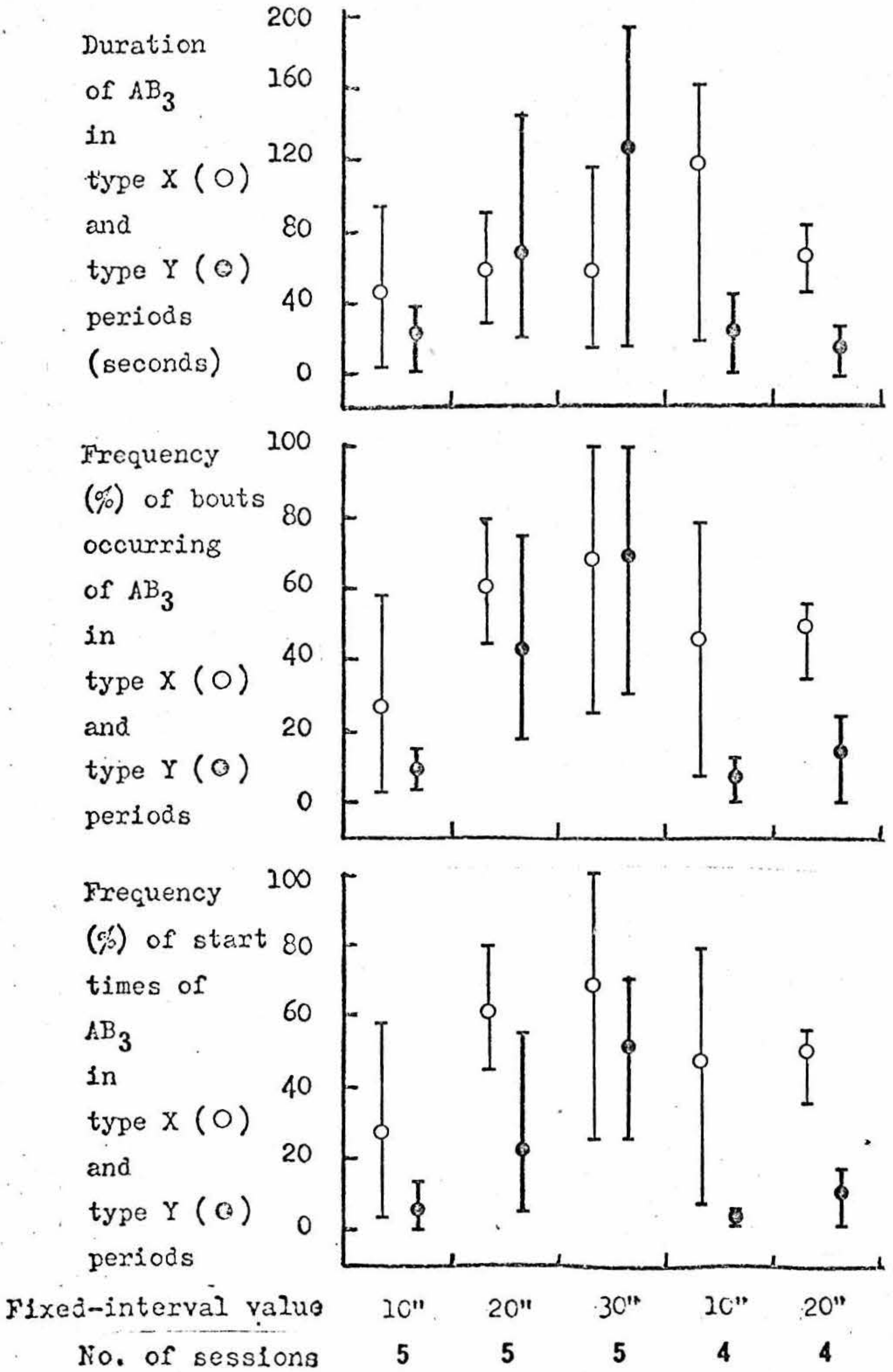


Figure 71 Means and ranges of durations and frequencies of bouts occurring and start times of AB_3 in type X and type Y periods for Subject 20

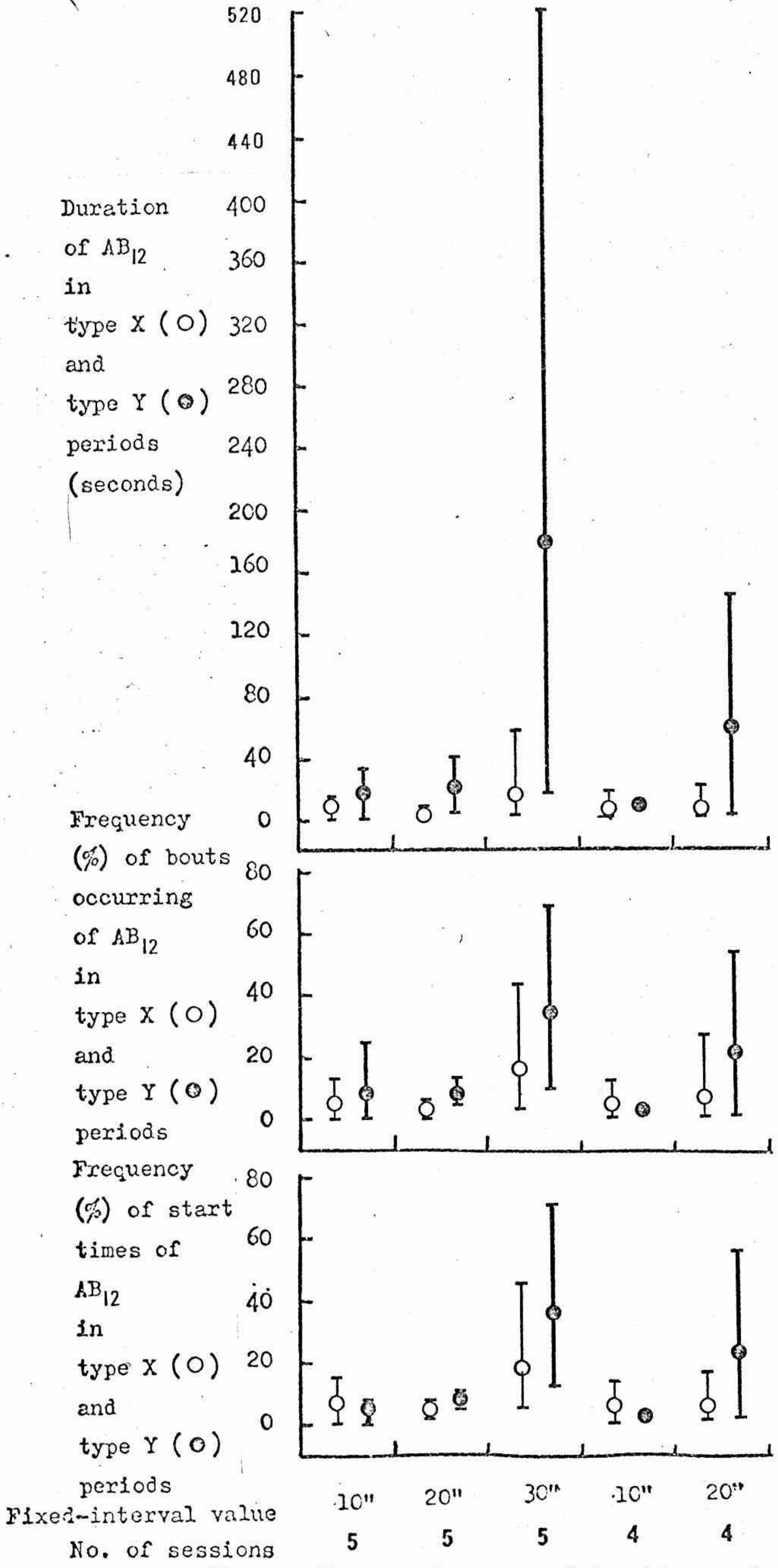


Figure 72

Means and ranges of durations and frequencies of bouts occurring and start times of AB_{12} in type X and type Y periods for Subject20

Discussion

Rates of lever-pressing did not show any significant relationships with fixed-interval values for either subject. In this respect the results fail to concur with those of Schroeder (1972). However, a different "operant" and different stimuli were used in that study compared with the present one, and a different range of fixed-interval values were examined. Although response rates were unrelated to fixed-interest, post-stimulus pauses for Subject 20 were related to interval value.

All the alternative behaviours that were examined revealed functional relationships with fixed-interval value. Each subject, however, showed completely different relationships. Both alternative behaviours examined with Subject 12 were higher in duration at lower fixed-interval values and both alternative behaviours examined with Subject 20 were higher in duration at higher fixed-interval values.

An interesting finding was that each subject has one alternative behaviour which occurred predominantly in type X periods and one alternative behaviour which occurred predominantly in type Y periods. The alternative behaviours which occurred predominantly in the type X periods also showed interesting development. AB_{11} for Subject 12 did not occur at all until the second block of fixed-interval 10-seconds sessions and very rarely occurred in type Y periods. AB_3 for Subject 20 came to occur less and less in type Y periods as further sessions were run. In this respect these two behaviours share features in common with the development of adjunctive behaviours reported in the animal literature (c.f. Falk, 1971).

CHAPTER 13

CHANGES IN TYPE OF STIMULATION

CHAPTER 13

CHANGES IN TYPE OF STIMULATION

It has been well documented that the type of stimulus used in schedules of stimulation can be an important factor in determining the pattern of responding with retardates under various schedules of stimulation (c.f. Spradlin et al, 1965; Woods, 1973). Furthermore, Schroeder (1972) showed an inverse relationship between amount of tokens delivered and work rate with retardates under variable-interval, variable-ratio, fixed-interval, and fixed-ratio schedules.

The experiment reported in this chapter examined various aspects of lever-pressing and alternative behaviours when the schedule of stimulation was held constant, but the type of stimulus was varied.

Subjects

Subjects 10, 11 and 17 served in this experiment. Subjects 10 and 11 had previously participated in similar experiments (Woods, 1973) Subject 17 was experimentally naive apart from three training sessions.

Apparatus and Procedure

A different schedule of stimulation was used for each subject in this experiment (escept for extinction conditions) but schedule parameters were kept constant throughout. Fixed-ratio 40 was used with Subject 10, fixed-ratio 20 with Subject 11 and fixed-interval 10-seconds with Subject 17.

The different types of stimuli used with each subject, the sequence of conditions and the number of sessions in each condition are shown in figures 73, 74 and 75. For Subject 17, the experiment reported in chapter 15 intervened between the two blocks of sessions in which "neck tickling" was used as the stimulus.

Slides and pop-music, when employed as stimuli, were presnted for five-seconds. In some sessions the red neon light on the consol was illuminated for five-seconds as the scheduled stimulus. The experimenter stood silently behind the subject in the first and second block of sessions in which the red light was used as a stimulus, but observed from the observation/recording room for the third block of sessions.

FIGURES 73 - 90

Key to abbreviations used for the types of stimuli:-

E - Extinction
M - Music
N.T. - Neck tickling
RL - Red light (without experimenter present)
RL - Red light (with experimenter present)
SI - Slides
SW - Sweets
VA - Verbal approval
SI+ VA - Every fifth stimulus delivery

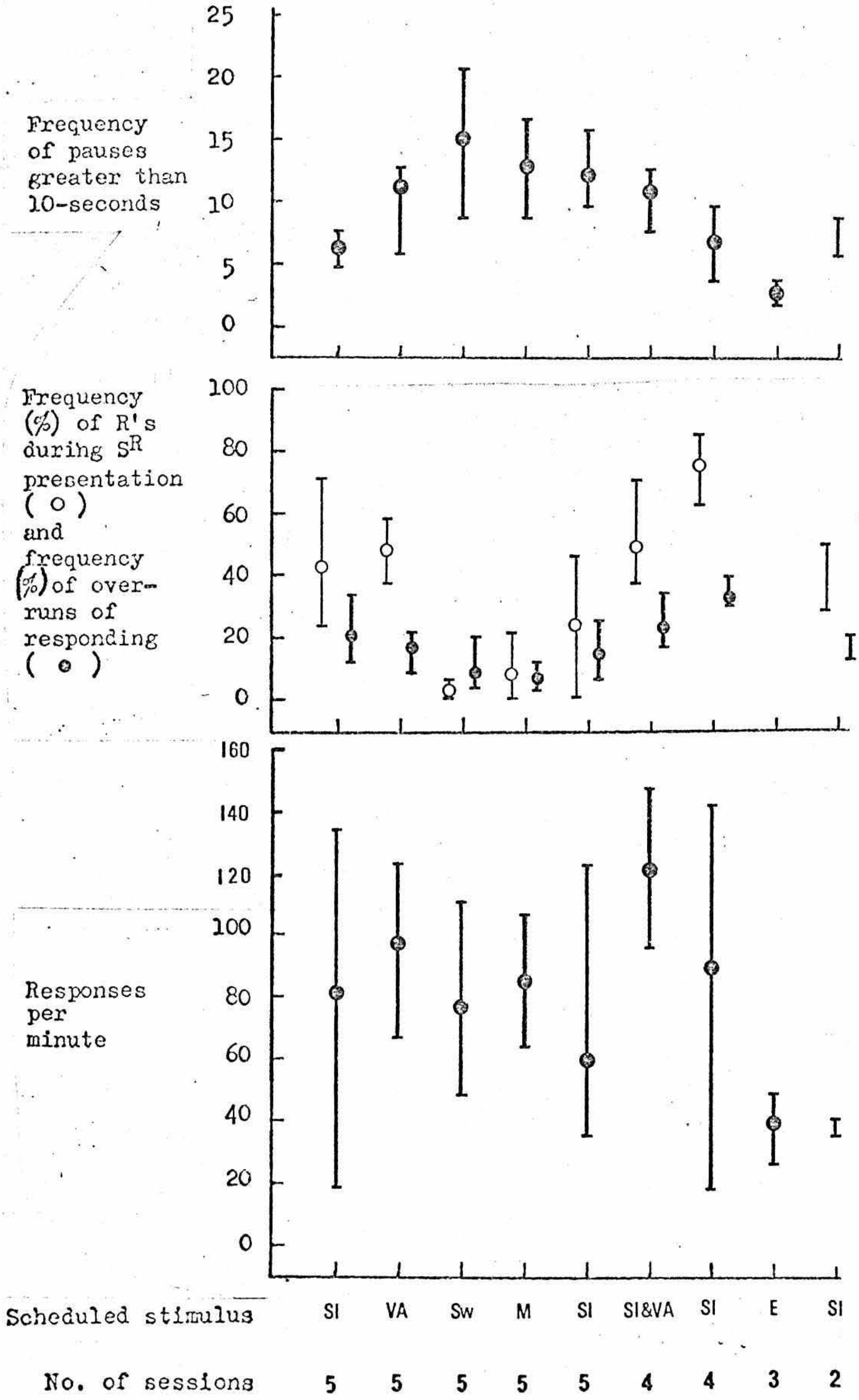


Figure 73 Means and ranges of frequency of pauses greater than 10-seconds, frequencies of responses during stimulus presentations and over-runs, and response rate for Subject 10.

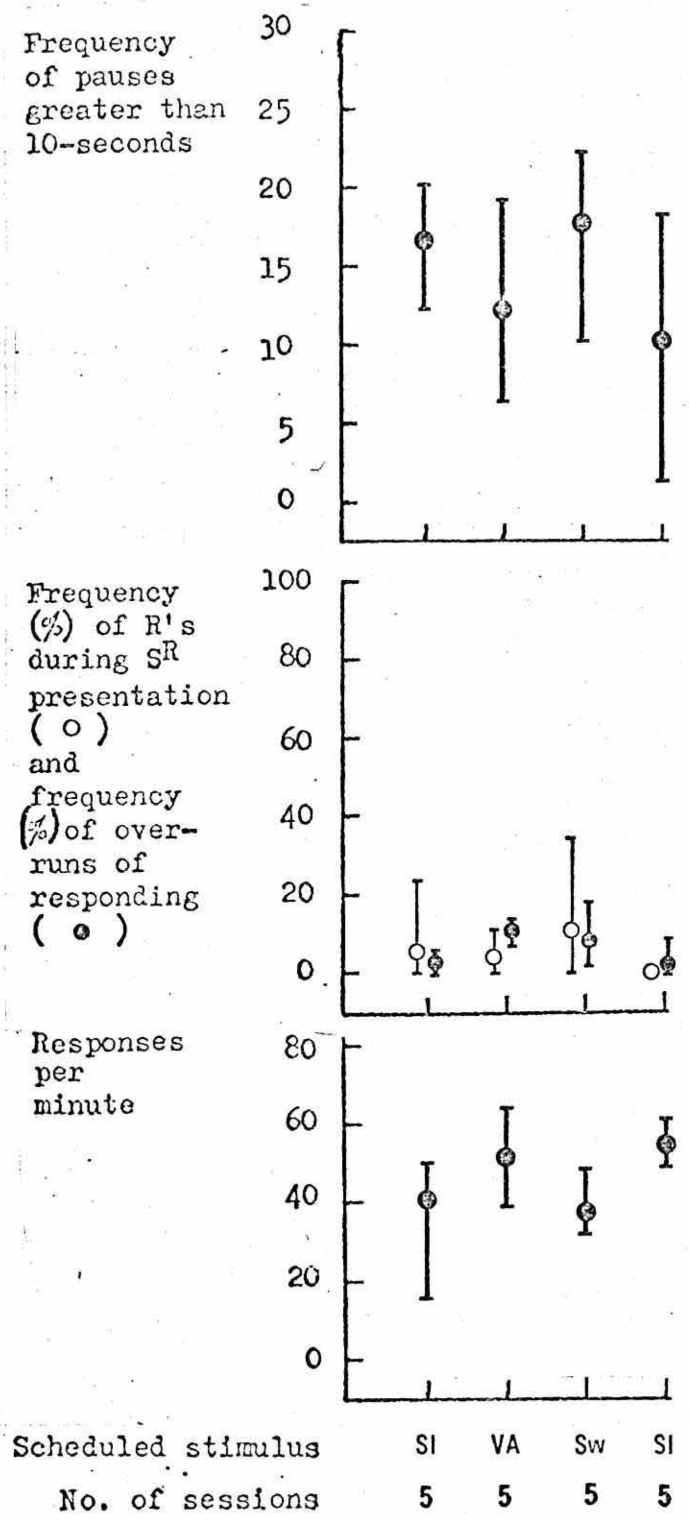


Figure 74 Means and ranges of frequencies of pauses greater than 10-seconds, responses during stimulus presentation and over-runs and response rate for Subject 11.

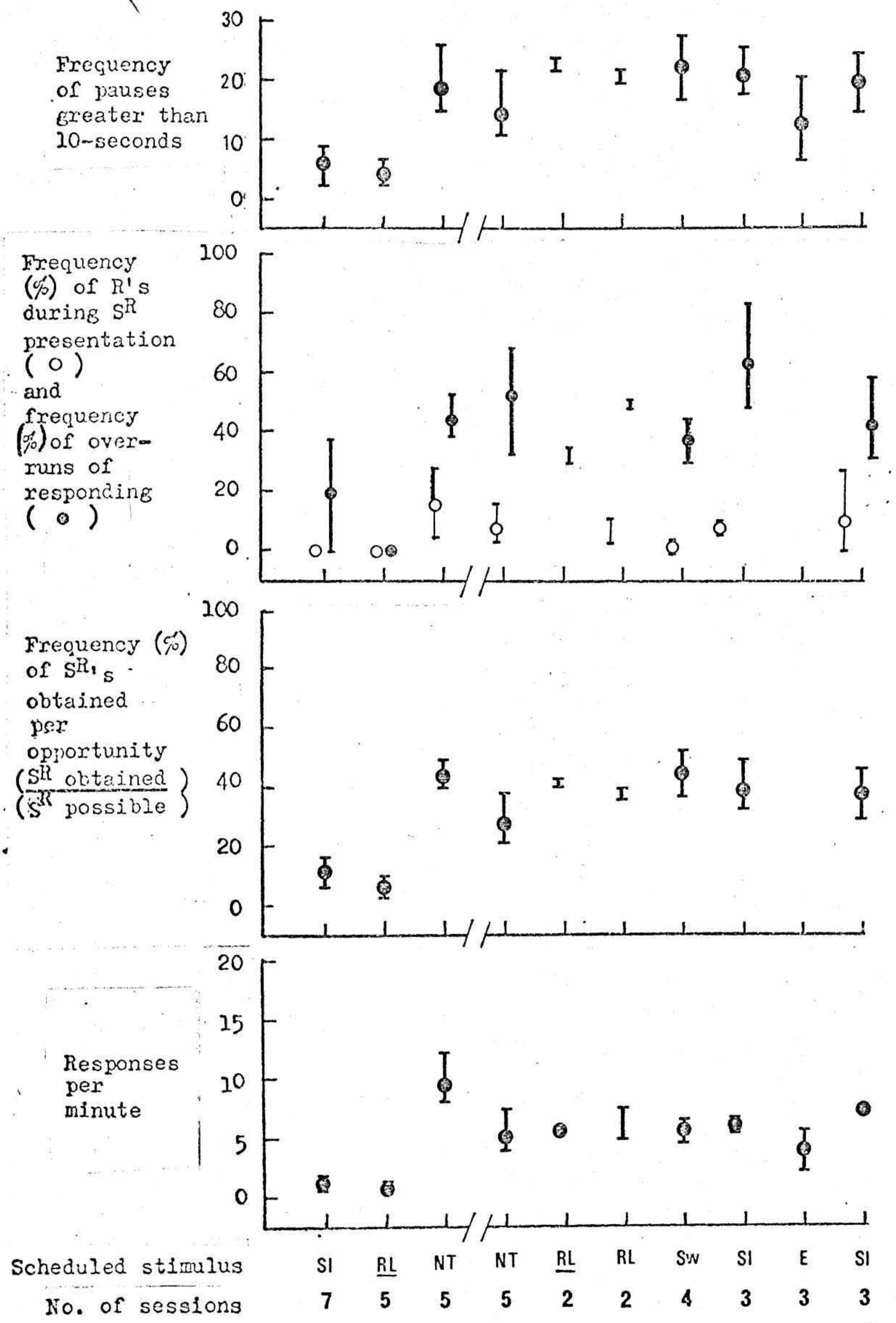


Figure 75 Details of lever-pressing and frequency of stimuli delivered per opportunity for Subject 17.

In sessions in which neck tickling was used as a stimulus the red light was illuminated for five-seconds and during this period the experimenter tickled the back of Subject 17's neck. The red light signalled the experimenter when to tickle Subject 17's neck. Hence whenever neck-tickling was used, the red-light was presented simultaneously.

Verbal approval was used with Subjects 10 and 11, and consisted of the experimenter saying "Good lad" into the microphone which was connected, via an amplifier, to the speaker above the console. Whenever verbal approval or sweets were used as stimuli, the counter which recorded the number of responses emitted during stimulus presentation recorded the number of responses made in the five seconds immediately following the delivery of a sweet or verbal approval. This enabled comparisons between stimuli which were presented for five seconds and stimuli which were discrete presentations.

With Subject 10, one block of sessions used both slides and verbal approval as stimuli, but they were not presented simultaneously. Verbal approval was presented on every fifth stimulus delivery and slides were used for all the others. After the experiment, an analysis of the occurrence of alternative behaviours in successive inter-stimulus intervals was carried out by inspection of event records. This compared the slides and approval sessions with the slides only sessions.

Alternative behaviours were recorded in all sessions for Subjects 10 and 11. For Subject 17, however, alternative behaviours were recorded from the neck tickling sessions onwards. The durations of AB_6 were also recorded for Subject 17 in the first red light condition.

Results

Data relating to lever-pressing are shown in figures 73, 74 and 75. Figure 75 also shows the obtained frequency of stimulation for Subject 17. For all subjects, the frequency of pauses greater than ten-seconds was not significantly related to changes in stimulus type.

Response rates for Subject 10 varied considerably between sessions using the same stimulus with some sessions producing extremely high rates. This variable was consistently high, however, in the slide-and-verbal approval sessions, and was consistently lower in the extinction sessions. Frequencies of over-runs of responding showed a good deal of scatter but were generally higher when slides or verbal approval were used as stimuli compared to sweets or pop-music. The median and inter-quartile ranges of post-stimulus pauses for each subject are shown in figure 76. For Subject 10, longer post-stimulus pauses were produced with sweets and music as the contingent stimuli than with slides or verbal approval.

All dimentions of lever-pressing did not appear to be related to stimulus type for Subject 11. Although they were well

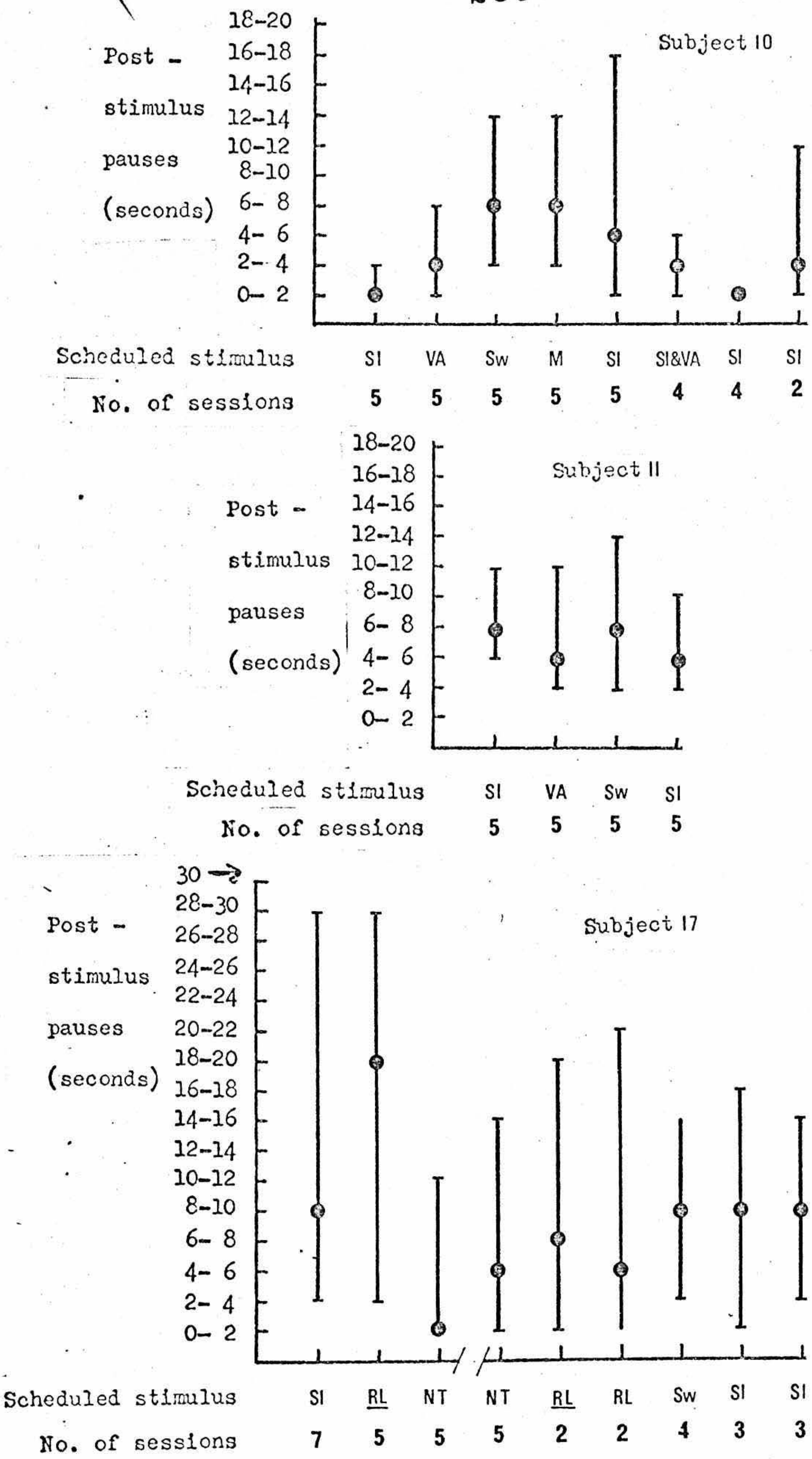


Figure 76 Medians and inter-quartile ranges of post-stimulus pauses in two-second categories. All post stimulus pauses of thirty-seconds or more were placed in the final category.

scattered, Subject 11's response rates did not reach the extremely high rates sometimes produced by Subject 10.

Subject 17 never obtained every available stimulus delivery. Low rates of responding were produced with all stimuli, but extremely low response rates were obtained in the initial slide and red-light conditions. A relatively large increase in response rate was produced when neck-tickling was used as the stimulus which dropped slightly by the second block of neck-tickling sessions. The rate then remained at roughly the same value for all stimulus changes, dropping slightly in the extinction sessions. An increase in the frequency of responding during stimulus presentation (or in the five-seconds immediately after sweet delivery) accompanied the relatively higher response rates.

Post-stimulus pauses for Subject 17 were considerably scattered and varied little between stimulus types. However, the median post-stimulus pause with the red-light alone as stimulus were much shorter after the re-light had been paired with neck-tickling than in the first block ofred-light sessions.

The total durations and frequencies of occurrence of alternative behaviours in inter-stimulus intervals are shown in figures 77, 78, 80, 81 and 82. Figure 79 shows the actual frequency of bouts of AB_7 for Subject 10. For this subject, the durations and frequencies of all three alternative behaviours were relatively low compared with alternative behaviours for other

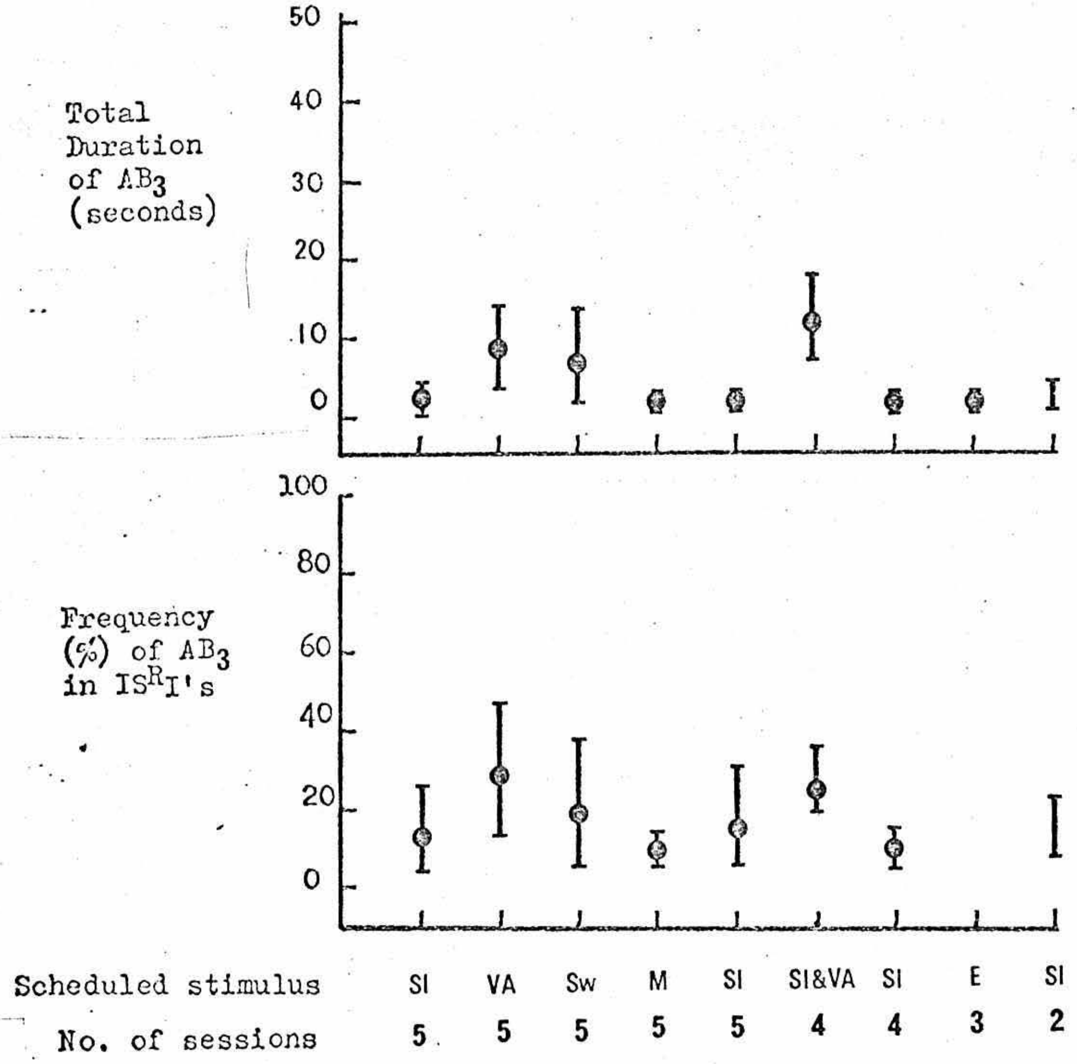


Figure 77 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 10

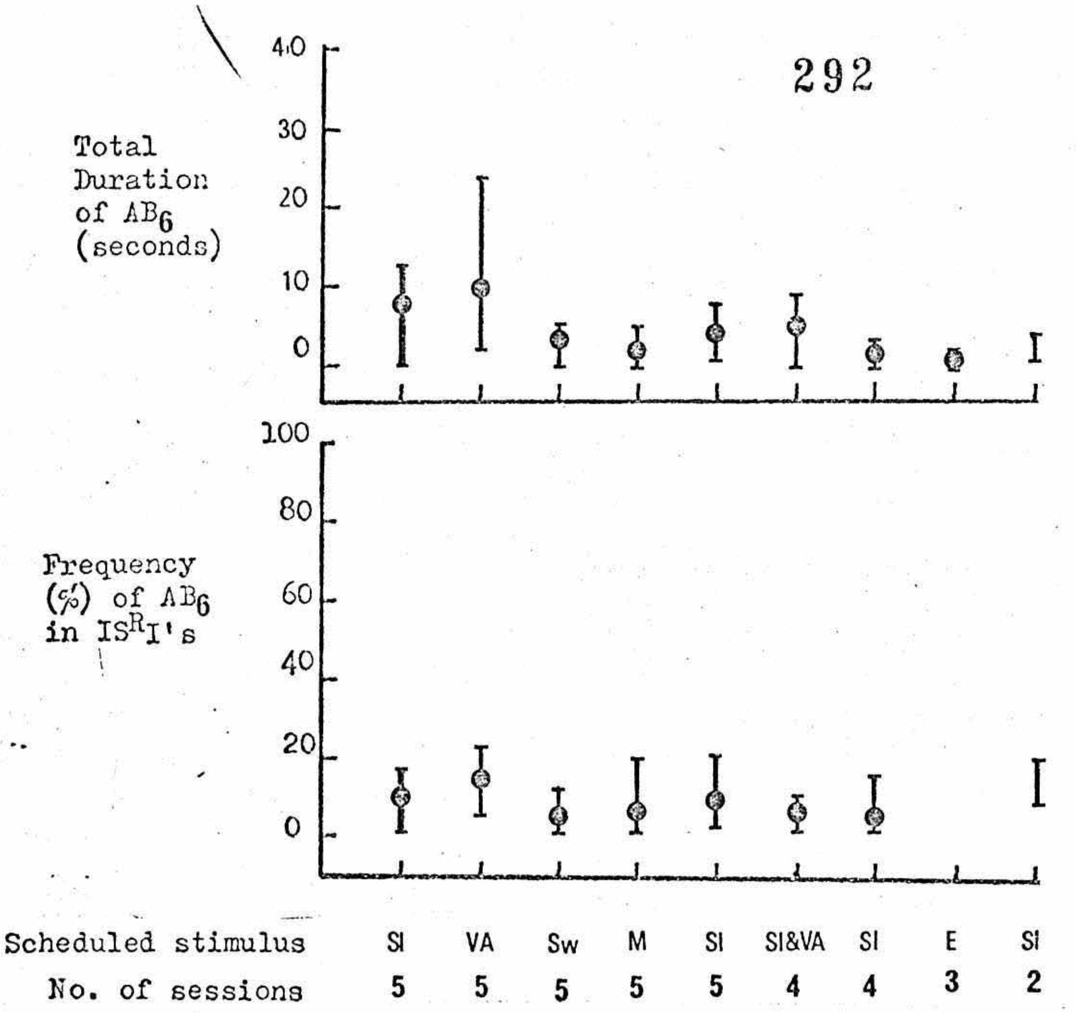


Figure 78 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_6 for Subject 10

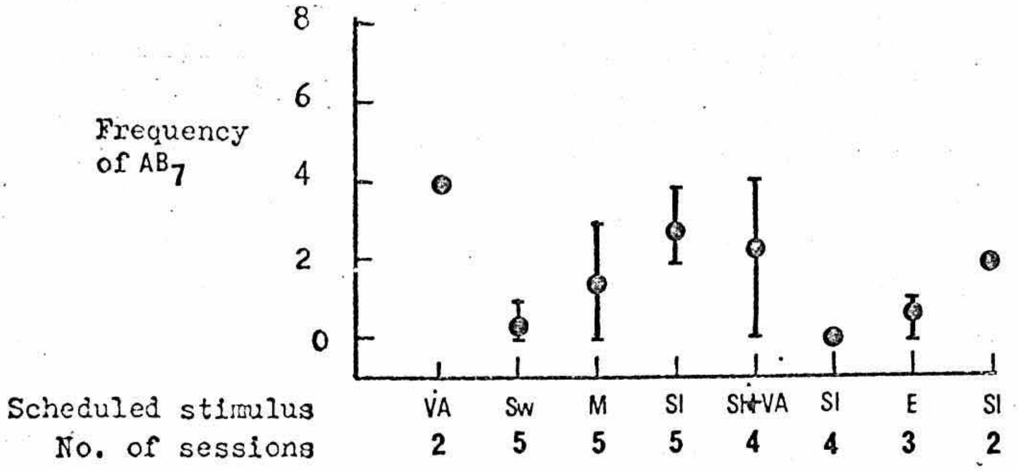


Figure 79 Means and ranges of frequencies of AB_7 for Subject 10

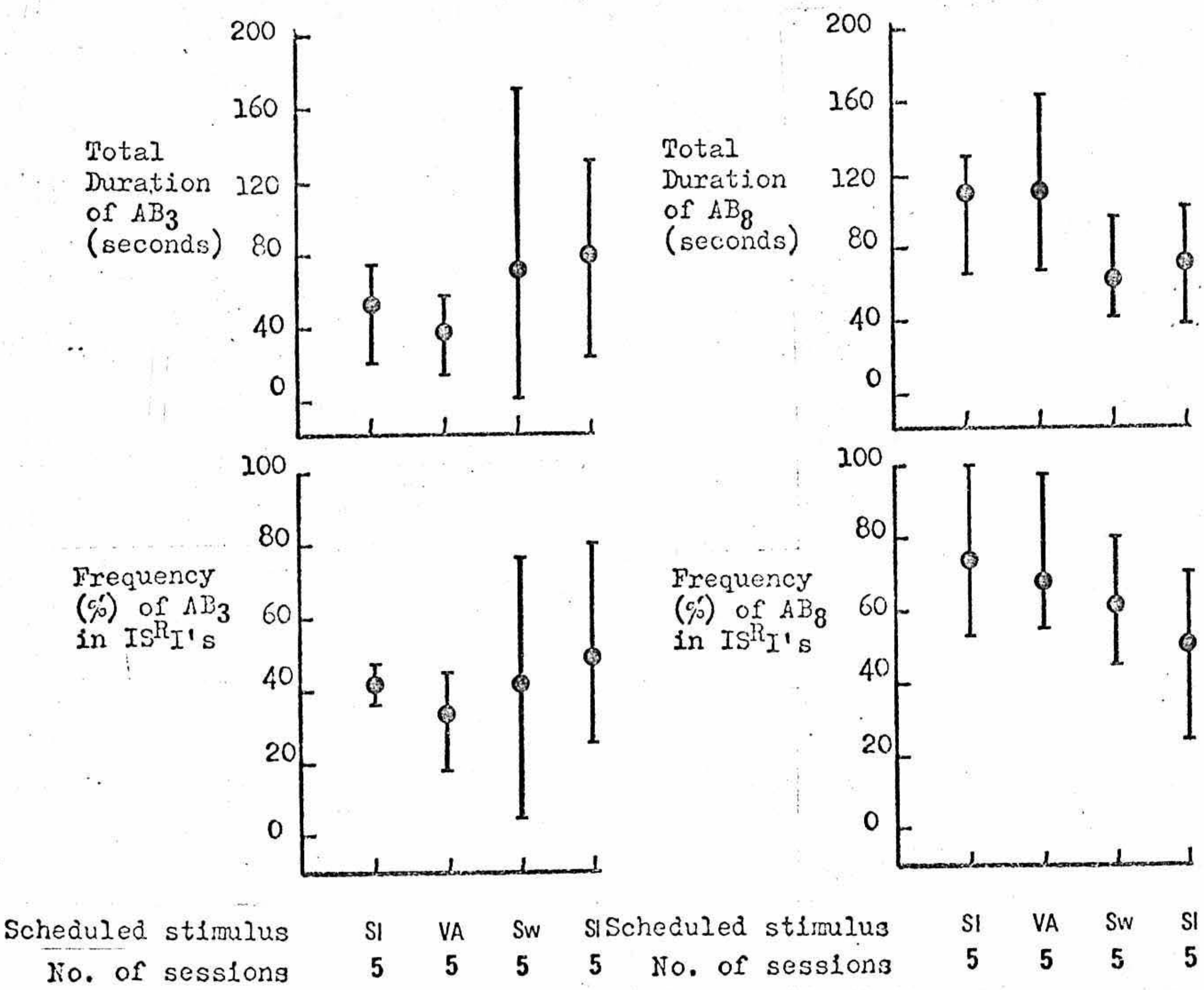


Figure 80 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 (left)

and

Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_8 for Subject II (right)

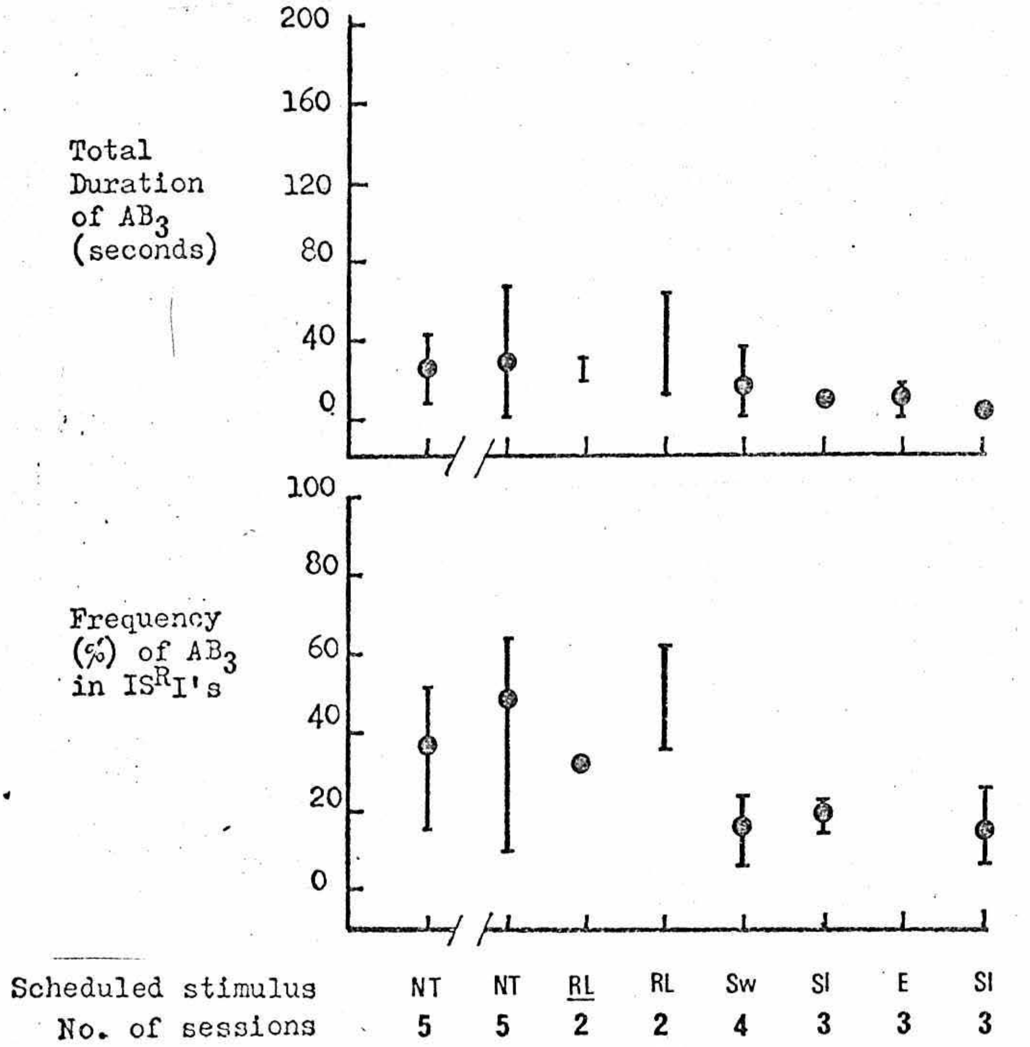


Figure 81 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 17

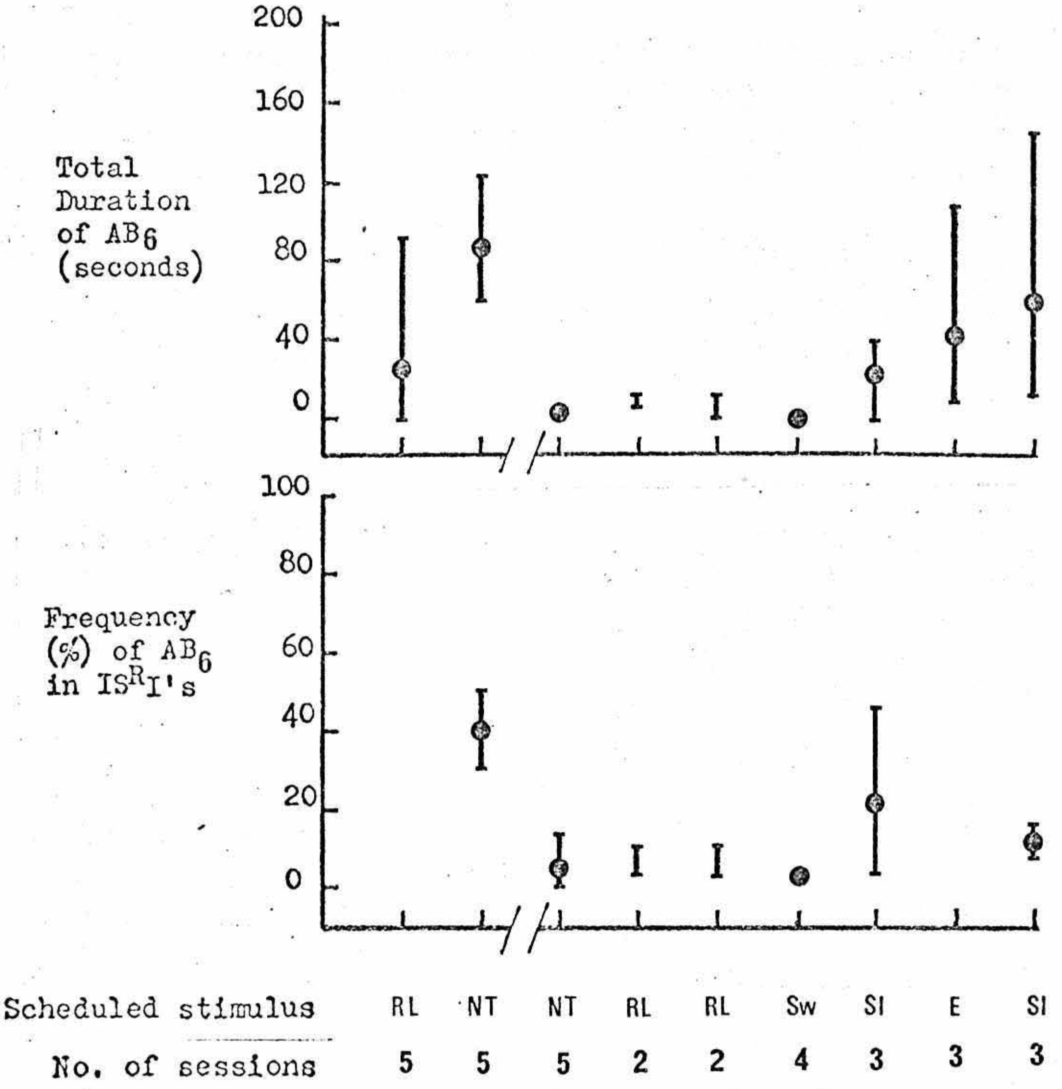


Figure 82 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_6 for Subject 17

subjects, and seemed unrelated in duration and frequency to changes in stimulus type. The only exception was AB_3 which occurred with a slightly higher duration in the slide-and-verbal approval condition. Both durations and frequencies of alternative behaviours for Subject 11 were scattered and there were no relationships with stimulus type.

Subject 17 produced slightly higher frequencies of AB_3 in the neck-tickling and red light sessions relative to other stimuli. AB_6 for subject 17 was unusual. Durations and frequencies were higher in the slide and extinction conditions than when sweets were used. However, the durations of AB_6 showed considerable discrepancies between the first blocks of red-light and neck-tickling sessions and the later blocks of such sessions.

Figures 83, 84, 85, 86, 87, and 88 show the durations and frequencies of bouts occurring and start times of alternative behaviours in type X and type Y periods for the different scheduled stimuli conditions. For Subject 10, both AB_3 and AB_6 were generally higher in frequency and duration in the type X periods and for Subject 11, both AB_3 and AB_8 were generally higher in frequency and duration in type Y periods.

The temporal loci of these alternative behaviours relative to stimulus presentations was not related to changes in stimulus

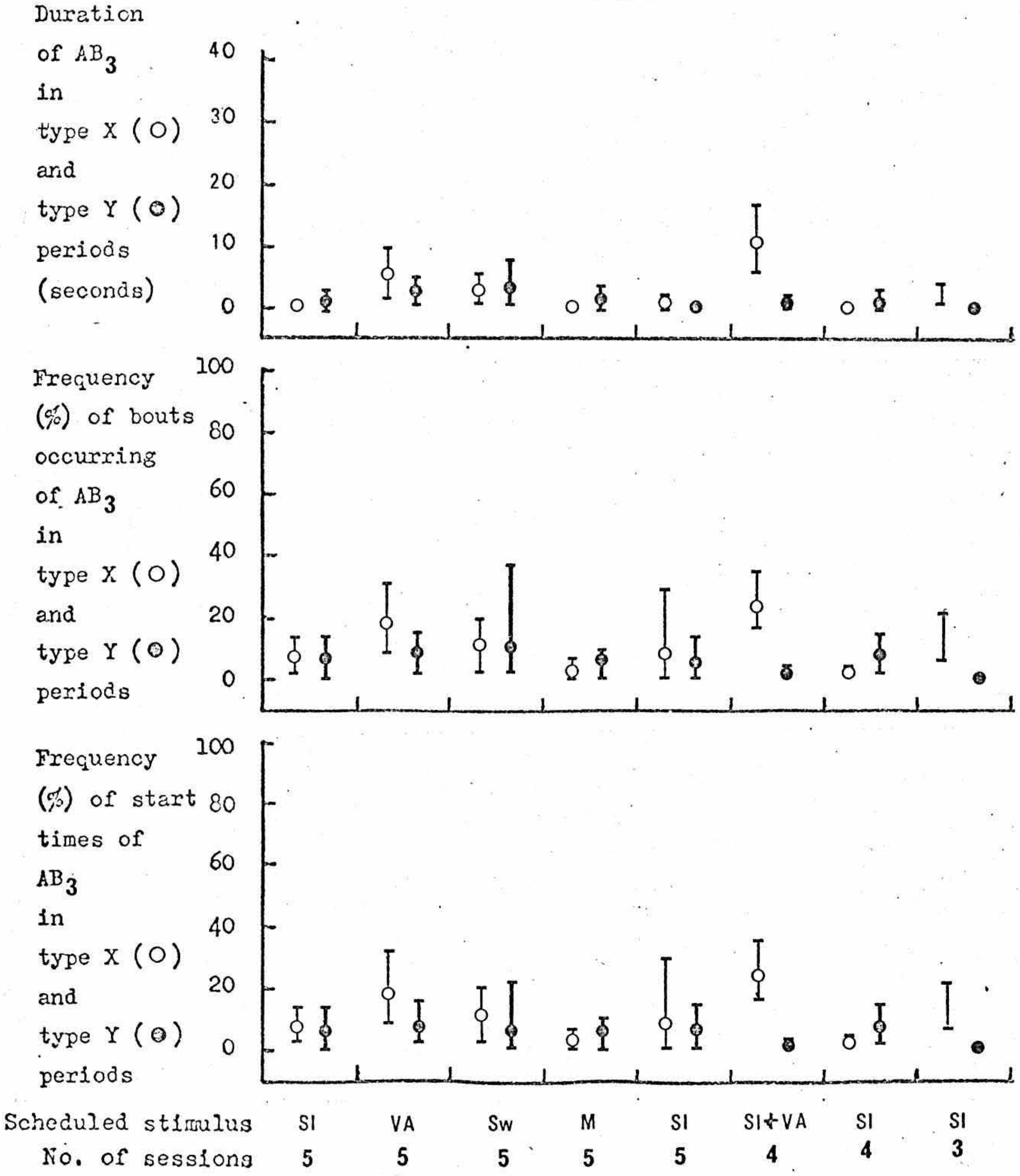


Figure 83 Means and ranges of durations and frequencies of bouts occurring and start times of AB_3 in type X and type Y periods for Subject 10

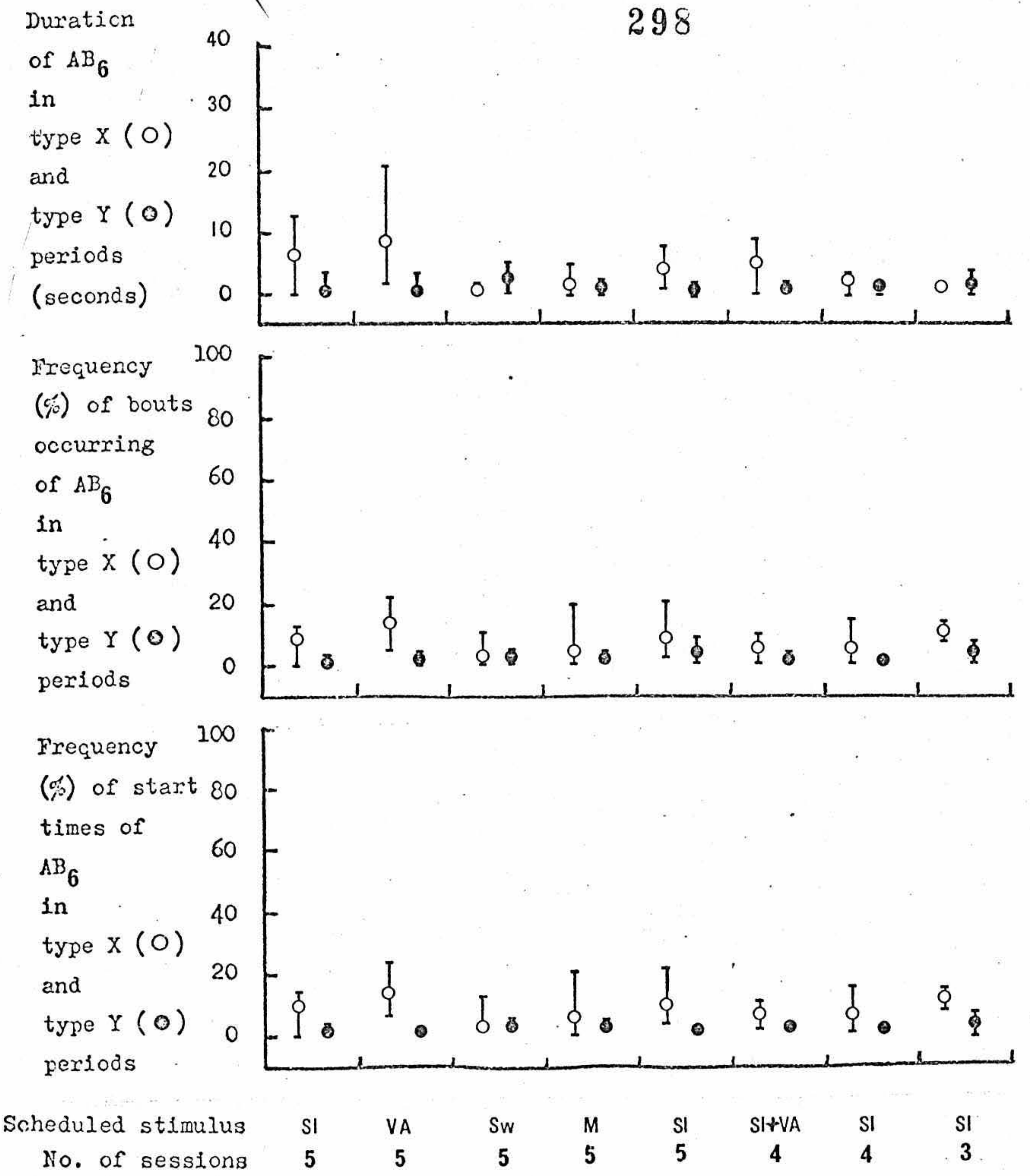


Figure 84 Means and ranges of durations and frequencies of bouts occurring and start times of AB_6 in type X and type Y periods for Subject 10

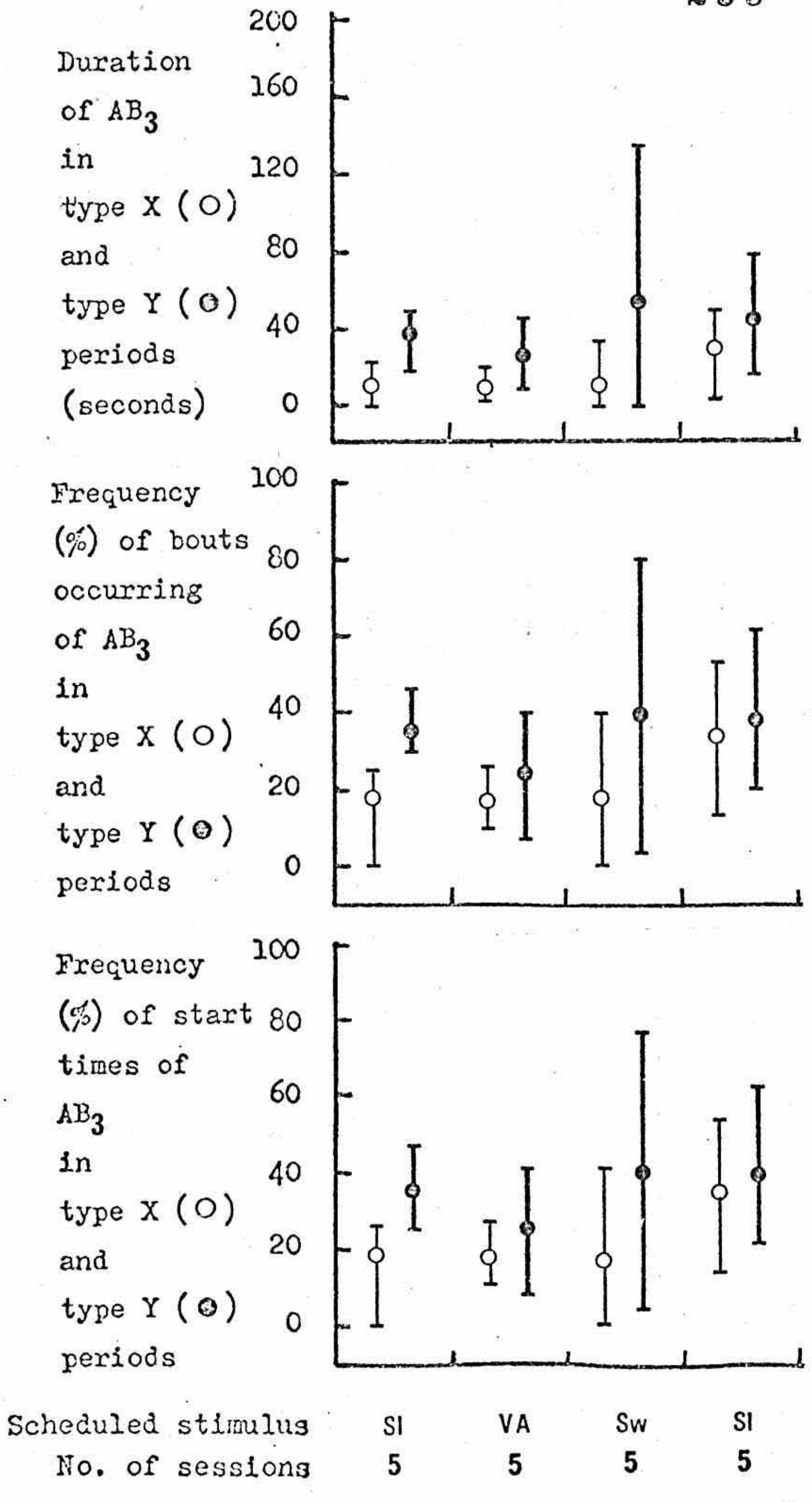


Figure 85 Means and ranges of durations and frequencies of bouts occurring and start times of AB_3 in type X and type Y periods for Subject II

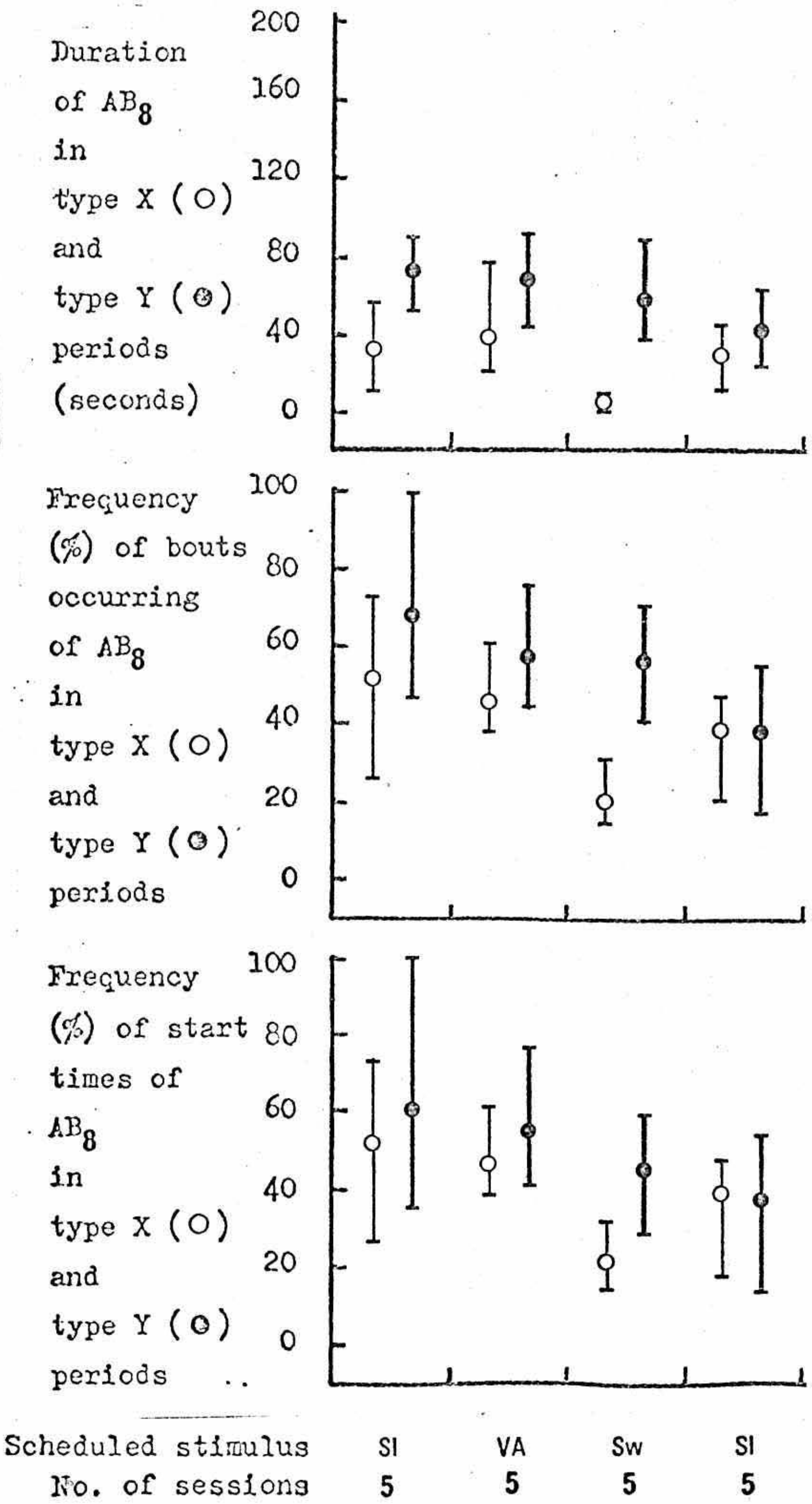


Figure 86 Means and ranges of durations and frequencies of bouts occurring and start times of AB_8 in type X and type Y periods for Subject II

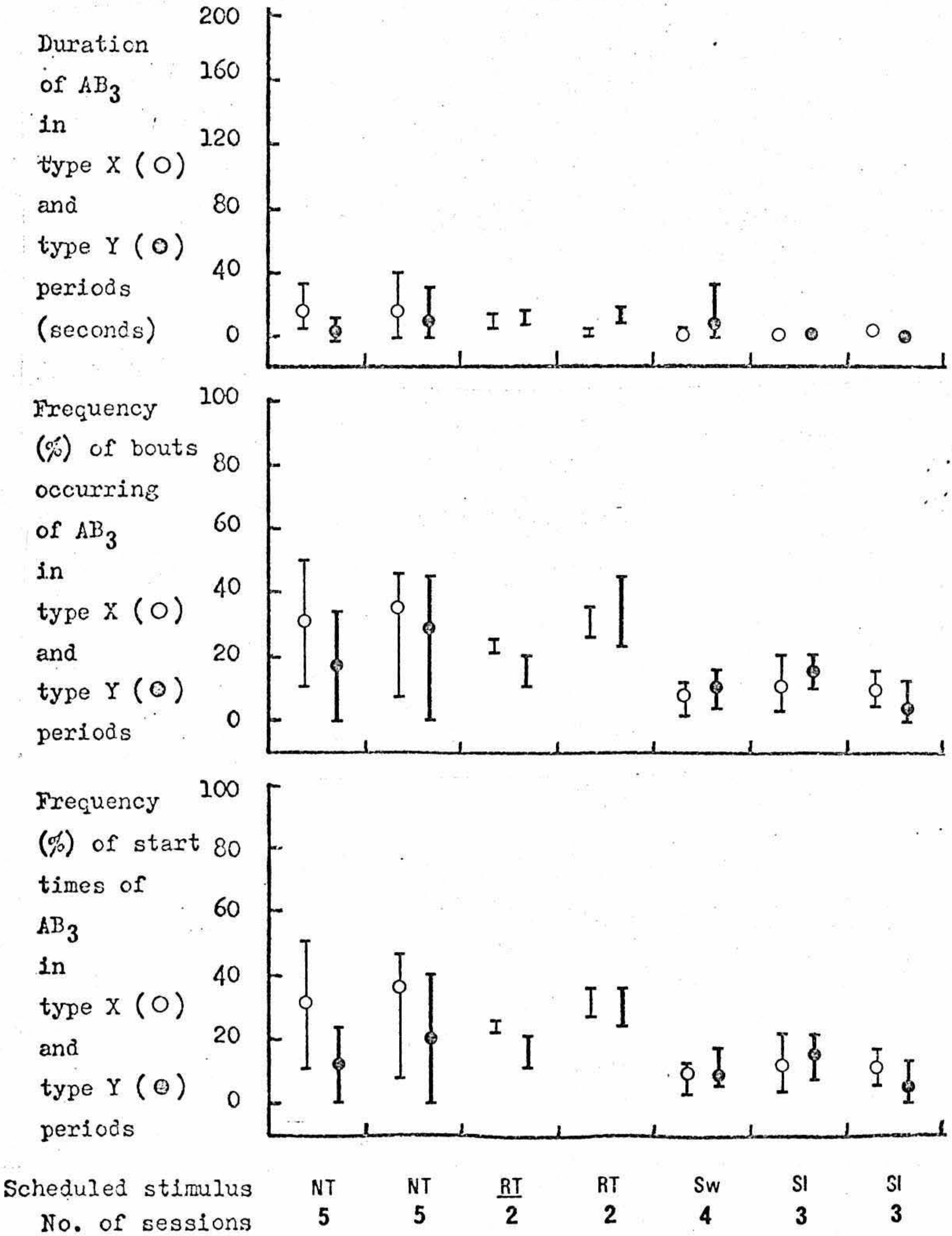


Figure 87 Means and ranges of durations and frequencies of bouts occurring and start times of AB_3 in type X and type Y periods for Subject 17

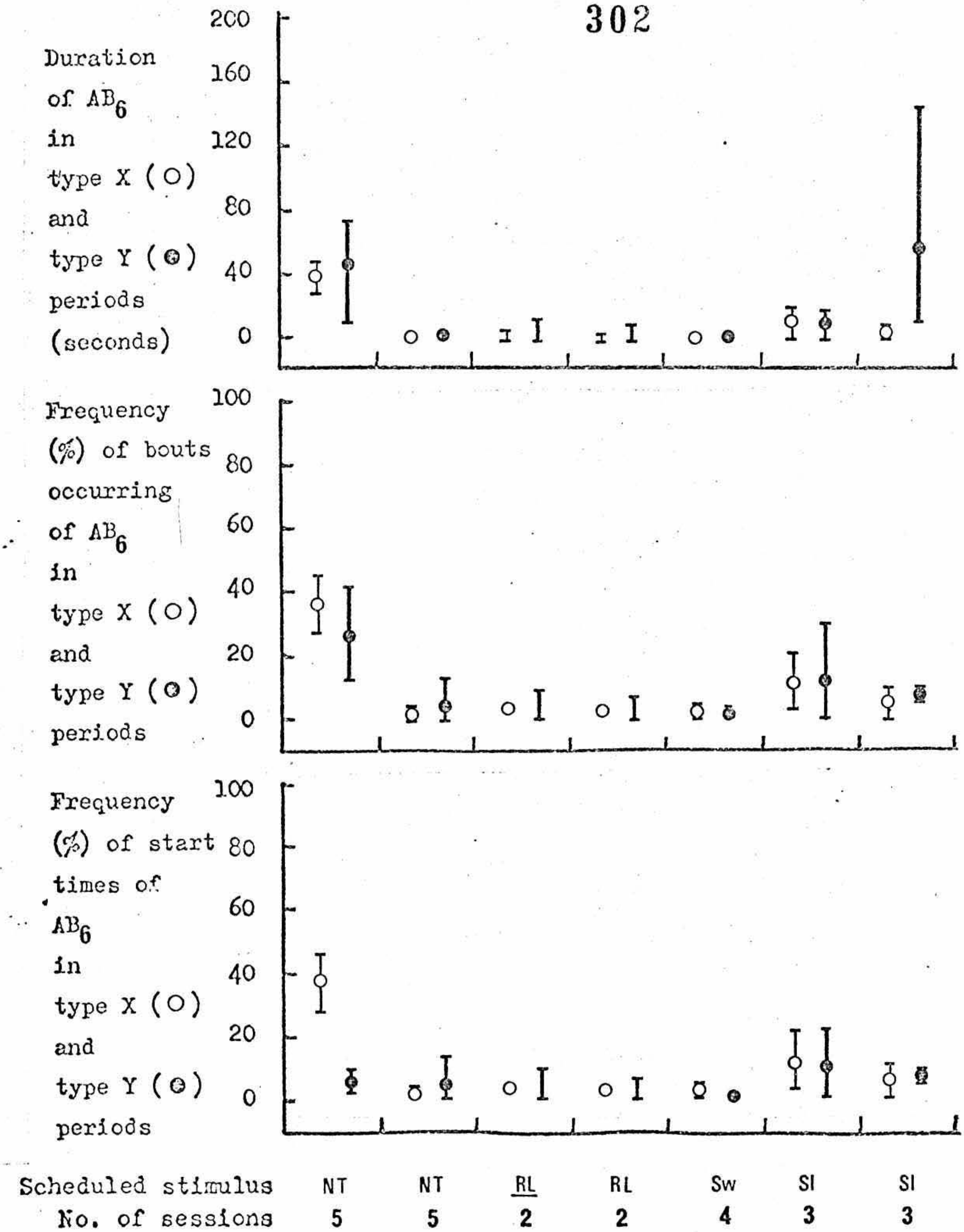


Figure 88 Means and ranges of durations and frequencies of bouts occurring and start times of AB_6 in type X and type Y periods for Subject 17

type. The frequencies and durations of both alternative behaviours for Subject 17 varied between sessions using the same stimulus, but were roughly equivalent in both type X and type Y periods.

The distributions of mean bout lengths of AB_8 for Subject 11 are shown in figure 89. Both the mode and median (shaded category on the histogram) bout length of AB_8 fell in the first five seconds category with all types of stimulation.

Figure 90 shows the frequency of occurrence of AB_3 and AB_6 in successive inter-stimulus intervals for Subject 10 through the four sessions in which both slides and verbal approval were used as stimuli (every fifth stimulus was verbal approval) and through the four sessions immediately before, and four sessions immediately after, in which slides alone were used as stimuli. As four sessions were used in each block, the maximum frequency of occurrence in each inter-stimulus interval was four. Occurrences of AB_6 did not alter significantly when verbal approval replaced a slide exposure on every fifth stimulus delivery. However, AB_3 was related to the change of stimulus, there being a higher frequency of occurrences of AB 3 in the inter-stimulus intervals which followed verbal approval.

Discussion

An interesting comparison of response rates and frequency of stimulation is made between the slide and red-light sessions

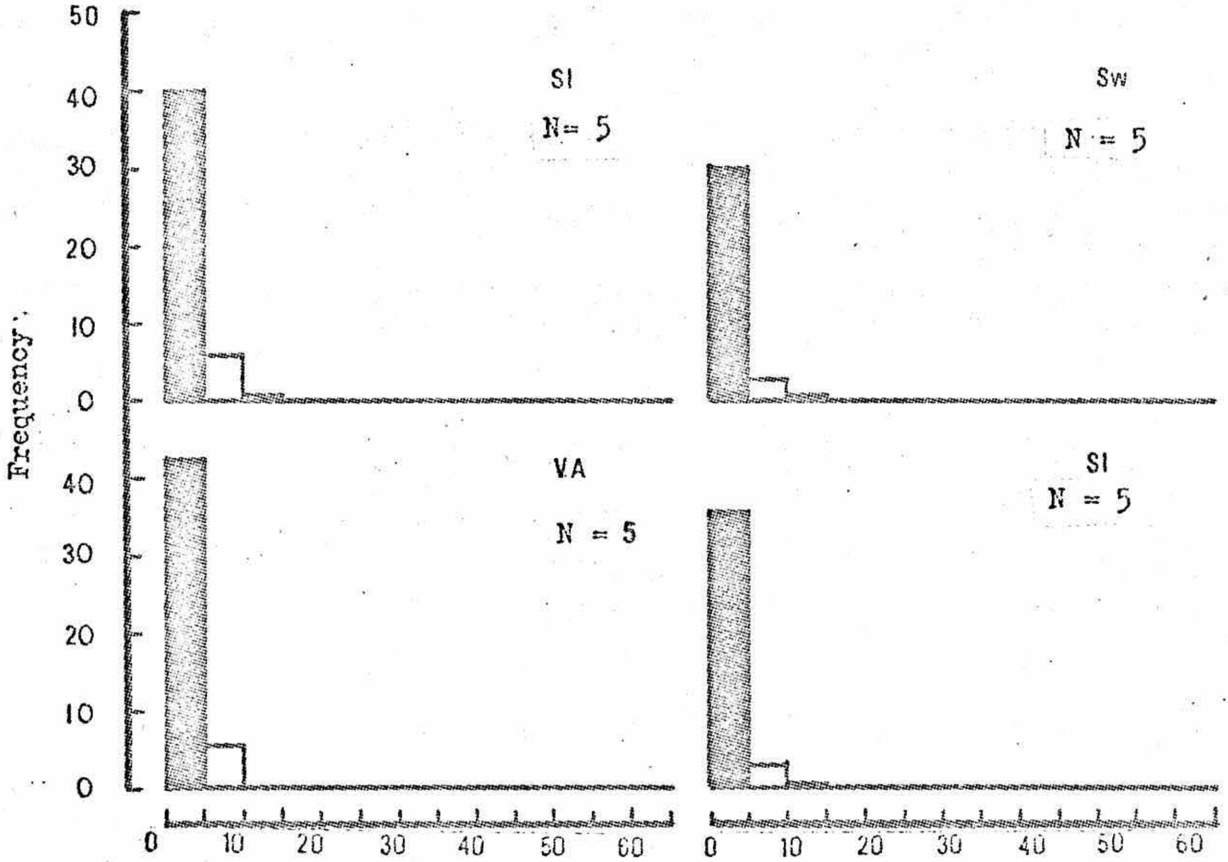


Figure 89 Mean frequency of bout lengths of AB_8 in five-second categories for Subject 11 The last category contains all bout lengths greater than sixty-seconds. The median bout length category is shaded.

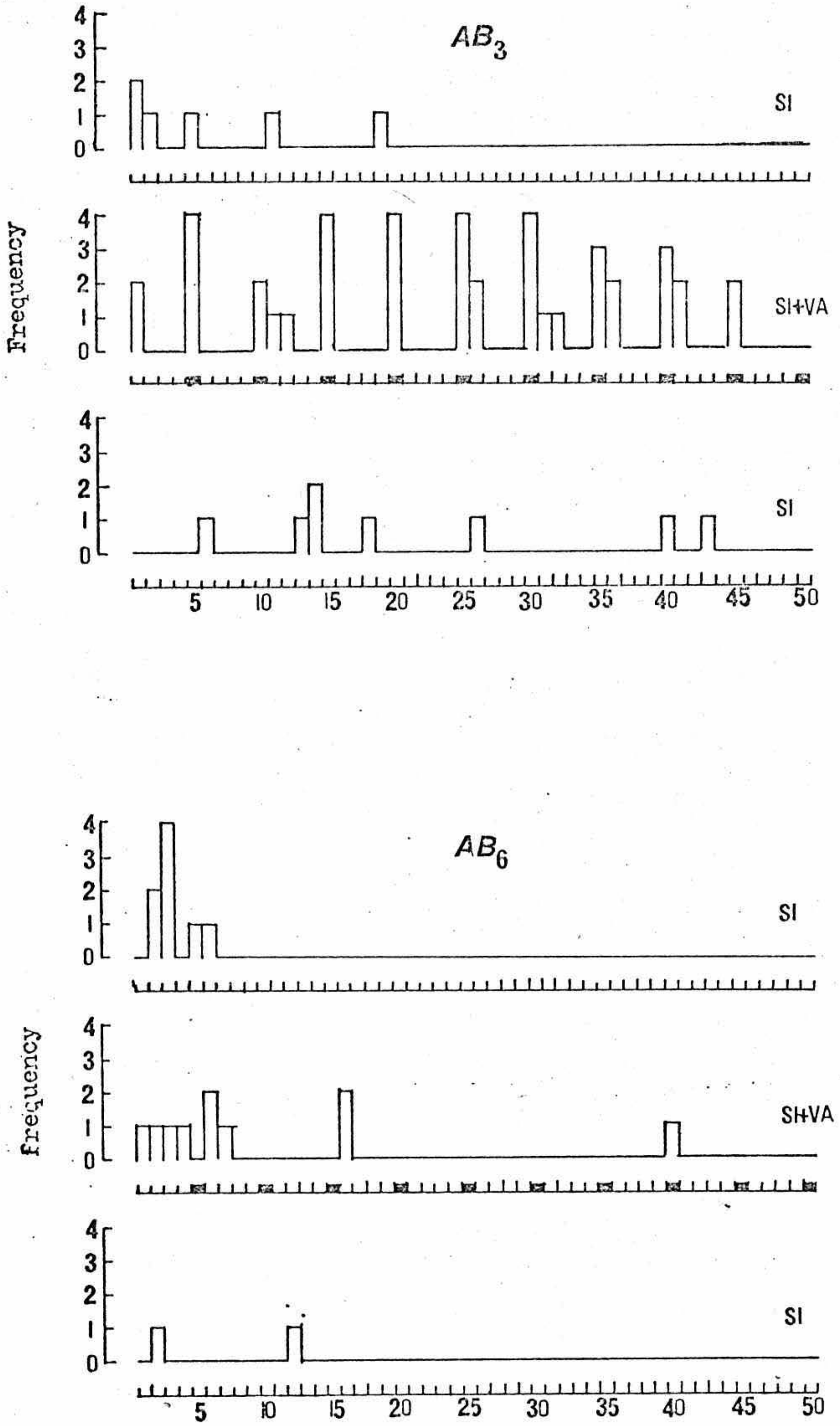


Figure 90 Frequency of occurrence of AB_3 (above) and AB_6 (below) in consecutive inter-stimulus intervals for Subject 10. There were four sessions in each condition and hence the maximum frequency was four.

before and after neck-tickling had been used as the scheduled stimulus. In the case of the red-light it could be argued that the pairing with neck-tickling could have been related to the increased "reinforcing efficacy", but not for slide presentations which were never paired with neck-tickling. Skinner (1957) has suggested that;-

> 'A step in the direction of destroying the relationship with a particular state of deprivation is taken by reinforcing a single form of response in ways appropriate to many different states. If we have reinforced a selected response with food when the organism is hungry, we may also reinforce it with water when the organism is thirsty. We may then increase the strength of the response by depriving the organism of either food or water. This process could be continued until we had exhausted all reinforcers associated with forms or modes of deprivation or with release from all sorts of aversive conditions. The response would then exist in some strength except when the organism was completely satiated and free of aversive stimulation ' (Skinner, 1957, p. 53).

In the present experiment, the rate of lever-pressing for slides and red-light increased after other stimuli had been made contingent on fixed-ratio lever pressing for Subject 17, and even the rate of lever-pressing in extinction conditions was higher than in the initial slide and re-light sessions.Such a finding would be expected from Skinner's (1957) suggestion.

On the whole neither lever-pressing nor alternative behaviours were related to stimulus changes for Subject 10 and 11. Furthermore, the temporal loci of alternative behaviours were unaltered by stimulus changes but differed completely between the two subjects. Perhaps the only exception was AB_3 for Subject 10 which slightly more frequently in the verbal approval and slides plus verbal approval sessions.

Of particular interest was the relationship of occurrences of AB_3 for Subject 10 with the type of stimulus when both slides and verbal approval were used. This condition maintained high mean response rates relative to other conditions and controlled the points of occurrence of AB_3. Clearly the type of stimulus delivered had at least two functional relationships with behaviours in the behaviour stream.

CHAPTER 14

CHANGES IN AMOUNT OF EFFORT REQUIRED ON THE MANIPULANDUM

CHAPTER 14

CHANGES IN AMOUNT OF EFFORT REQUIRED ON THE MANIPULANDUM

Introduction

Notterman and Mintz (1965) reported that, with rats, there was a positive relation between effort expended for lever-presses and ratio length when the required response effort criterion was low, but not when is was high.

Schroeder (1972) examined the rate of tool usages, and units of work produced per minute, with a retarded adult when tokens were delivered for unscrewing nuts from studs. Tokens were delivered according to various fixed-ratio values, and the nuts were tightened prior to the experiment such that a preset degree of torque was required to unscrew them. It was found that for a response with a low force criterion, an increase in fixed-ratio requirement was correlated with an increase in response rate. With a high force criterion, however, an increase in the ratio requirement produced a decrease in response rate. Response rates were generally lower at a higher force criterion.

The present experiment examined the effects of manipulating the amount of effort required on the manipulandum, on both lever-pressing and alternative behaviours, for two retarded children on fixed-interval schedules of stimulation.

Subjects

Subjects 25 and 26 served in this experiment. Both were experimentally naive apart from two training sessions, at the start of the experiment.

Apparatus and Procedure

Subject 25 sat at the console and was presented with five-second slide exposures on a fixed-interval 10-seconds schedule for lever-pressing. Two response-effort criteria on the lever were examined, 1.25 N and 2.5N according to an ABA experimental design

For Subject 26, the alternative manipulandum and procedure dexcribed in Chapter 9 were employed. Three seconds of eye-contact from the experimenter was used as the stimulus on a fixed-interval 20-seconds schedule. Initially, the maniuplandum was uncovered, and required a force of 0.5N to operate it. However, after six sessions at this value, the subject broke the lever at the start of a seventh session, which was immediately terminated. The manipulandum was repaired and covered with hesian to prevent Subject 26 from breaking it again, and the force requirement was increased to 1.25N.

Results

The frequency of stimuli obtained and various aspects of lever-pressing are shown in figure 91 for Subject 25. Response rates varied considerably at both force criteria, but the mean response rate was slightly higher, and the range greater, at the lower force requirement. The frequency of stimuli obtained also varied considerably at both force criteria but had a higher mean at the higher force criteria. That is, it was often the case that more responding occurred with the lower force criterion, but less stimuli were obtained than in the higher force criterion sessions. The graphs for over-runs of responding and frequency of responding during stimulus presentations show that a higher frequency of each generally occurred at the lower force criterion. The frequencies of pauses greater than ten-seconds was not related to force criteria.

Durations and frequencies of AB_3 in inter-stimulus intervals for Subject 25 are shown in figure 92, both of which, although considerably scattered,increased with the number of sessions

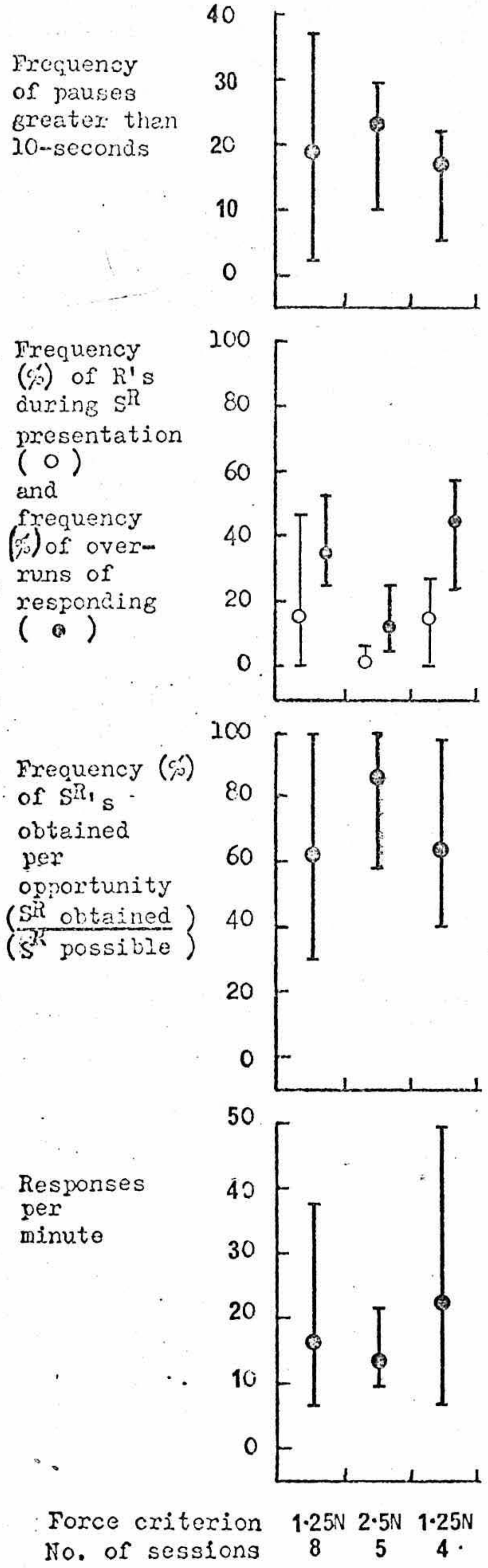


Figure 91 Details of lever-pressing and frequency of stimuli obtained per opportunity for Subject 25.

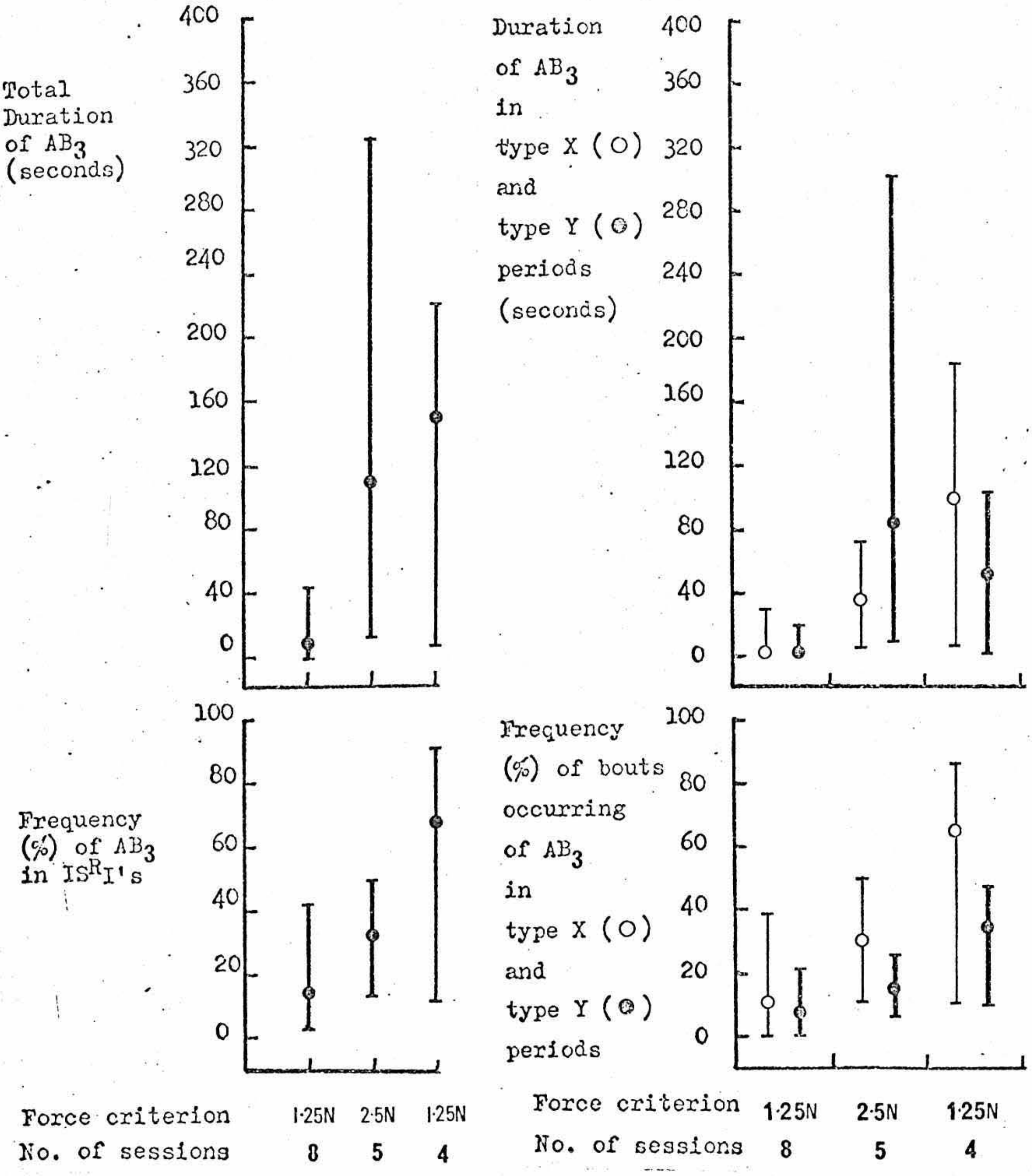


Figure 92 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 25

and

Means and ranges of durations and frequencies of bouts occurring of AB_3 in type X and type Y periods for Subject 25 rather than show a relationship with the force criteria. Also shown in figure 92 are the durations and frequencies of bouts occurring of AB_3 in type X and type Y periods. Considerable scatter in all dimensions of AB_3 in type X and type Y periods was shown, but the mean duration was slightly higher in type Y periods at the higher force criterion, and slightly higher in type X periods at the lower force criterion. The mean frequency of bouts occurring of AB_3 was always slightly higher in type X periods and the difference of mean frequencies in type X and type Y periods increased with the number of sessions.

Comparisions of all aspects of behaviour for Subject 26 at the two force criteria are shown in figures 93 and 94. Response rates, frequencies of stimuli obtained, and frequencies of over-runs of responding and responses during stimulus presentations were all higher at the lower force criterion. However, the duration and frequency of AB_3 in inter-stimulus intervals were generall y higher at the higher force criterion. The distribution of AB_3 duration through the sessions produced a flat histogram at both response criteria, and the mode and median bout length of AB_3 fell in the first five second category at both response criteria.

Discussion

A comparison of lever-pressing and alternative behaviour (AB_3) for Subject 25 suggests that certain aspects of lever-pressing were related to the changes in force criteria, but AB_3 changed with the number of sessions rather than with the

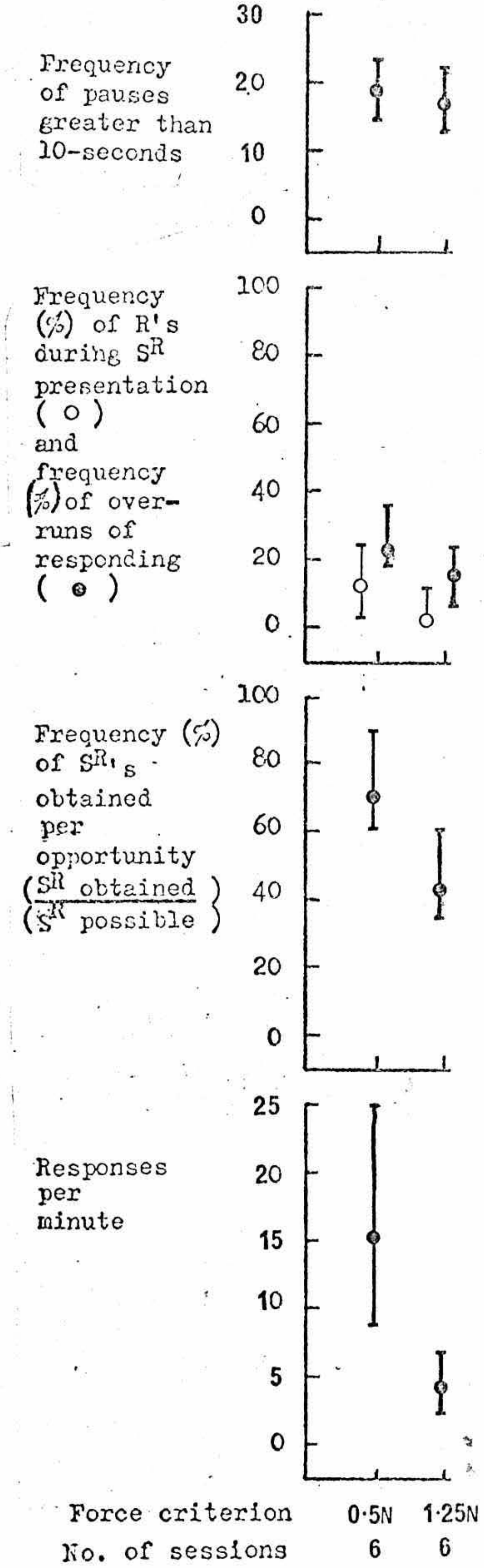


Figure 93 Details of leverpressing and frequency of stimuli obtained for Subject 26.

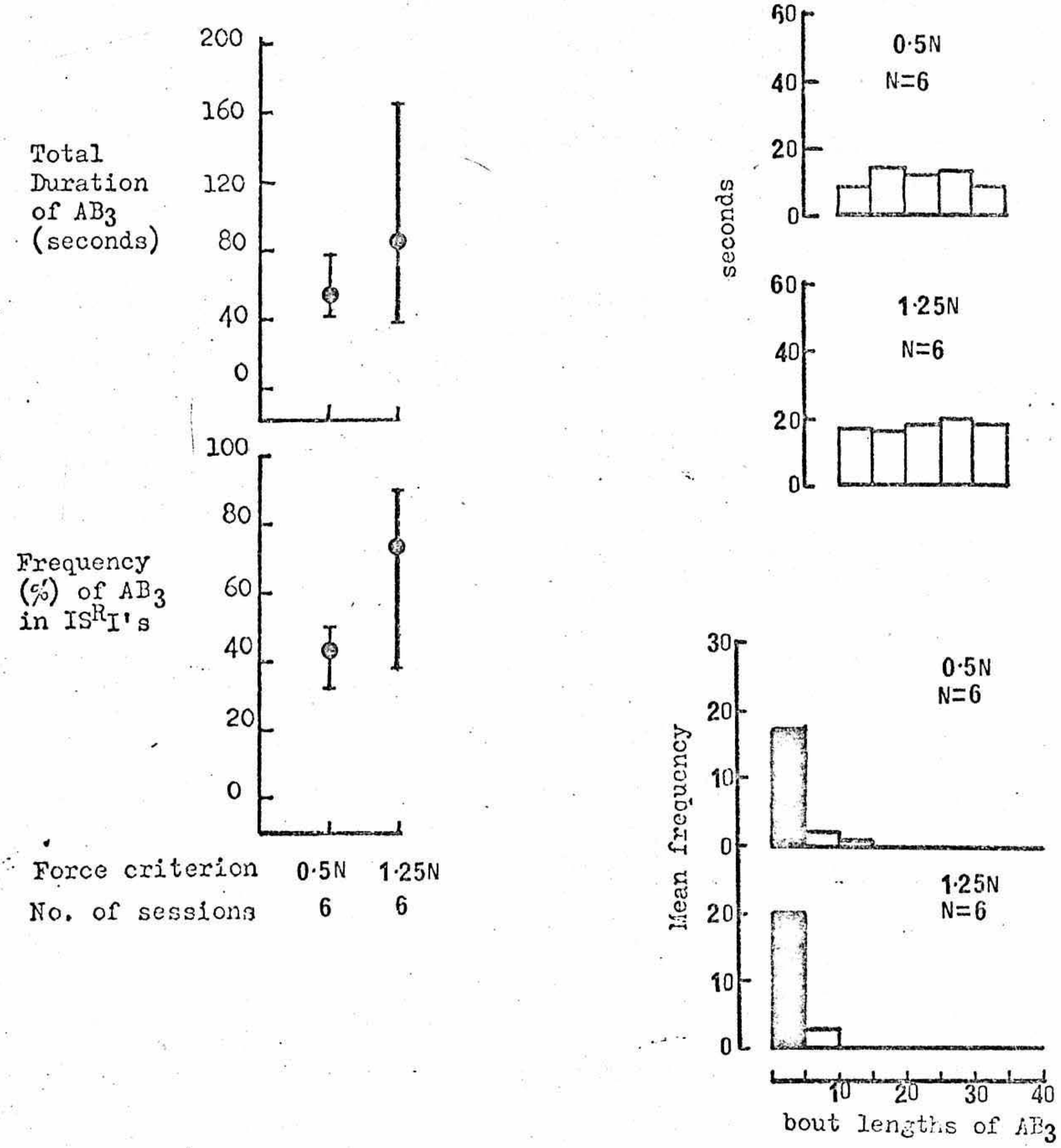


Figure 94 Details of AB_3 for Subject 26. The top right graphs show the mean durations of AB_3 in consecutive three-minute periods

manipulated variable. That is, the two behaviours were a function of different variables.

For Subject 26, however, both lever-pressing and AB_3 changed with the manipulated force criteria, but as a reversal design was impossible a post hoc ergo propter hoc conclusion cannot be claimed. Nevertheless, the changes in both behaviours were quite marked, particularly when compared with the relative insensitivy of lever-pressing to changes in schedule of stimulation found in Chapter 9.

The higher response rates at lower response force criteria shown by both subjects concurs with previous studies with both retardates and animals.

CHAPTER 15

CHANGES IN STIMULUS DURATION

CHAPTER 15

CHANGES IN STIMULUS DURATION

Introduction

Staddon (1970) examined the key-pecking of pigeons on a fixed-interval schedule when the duration of food presentation was varied. Post-stimulus pauses were found to be directly related to the duration of food presentation. "Running" rates (the response rate between the termination of a post-stimulus pause and the next stimulus presentation) were indirectly related to the duration of food presentation initiating each fixed-interval.

Jensen and Fallon (1973) examined the lever-pressing of rats on multiple fixed-interval fixed-interval schedules of water presentation. The duration of licking time was held constant in one fixed-interval component but maniuplated in the other component. They found that the response rate in the maniuplated component was a monotonic function of stimulus duration in that component.

The present experiment examined the effects of manipulating the duration of stimulation with a retardate on a fixed-interval schedule.

Subject

Subject 17 served in this experiment which intervened in the experiment reported in Chapter 13.

Apparatus and Procedure

The type of stimulus, neck-tickling, and the schedule of stimulation, fixed-interval 10-seconds, were kept constant throughout this experiment. The variable that was manipulated was the duration of neck-tickling. Three durations were used; one-, five-, and ten-seconds. Figure 95 indicates the sequence of durations employed. The general procedure for using neck-tickling as a stimulus, described in Chapter 13, was used.

Results

Various aspects of lever-pressing are shown in figure 95. Mean response rate decreased with number of sessions, and was not related to stimulus duration. Similarly, the frequency of stimuli obtained decreased from the first to the second block of sessions at five-seconds duration. Pauses greater than ten

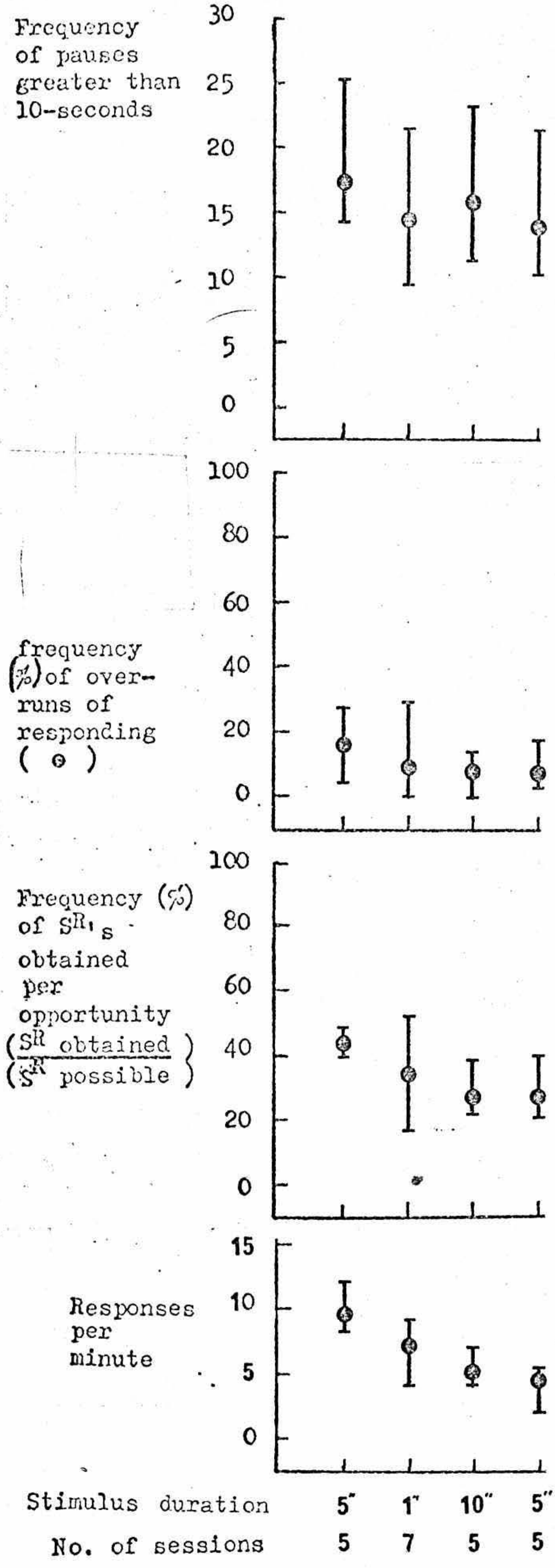


Figure 95 Details of lever-pressing and frequency of stimuli per opportunity for Subject 17. (Means and ranges).

seconds and over-runs of responding were not related to stimulus duration nor did they change with the number of sessions. Post-stimulus pauses (see figure 96) increased with the number of sessions.

Total durations and frequencies of occurrence of alternative behaviours in inter-stimulus intervals are shown in figure 98. The durations and frequencies of bouts occurring and start times in type X and type Y periods for AB_3 and AB_6 are shown in figures 99 and 100, respectively. Total durations and frequencies of occurrence of AB_3 in inter-stimulus intervals ranged considerably and were not related to stimulus duration. The durations and frequencies shown in figure 99 were scattered but the means were slightly higher in type X periods at one- and five-seconds stimulus durations. At ten-seconds duration, however, the mean duration and frequencies of AB_3 were higher in the type Y periods, particularly the frequency of start times.

AB_6 showed unusual results. Comparison of the first and second blocks of five-second duration sessions shows that all durations and frequencies were higher in the first block. Durations and frequencies were higher at ten-seconds stimulus duration than at one-second. Hence, it appeared that both stimulus duration and the number of previous sessions were involved in determining the AB_6 outcome.

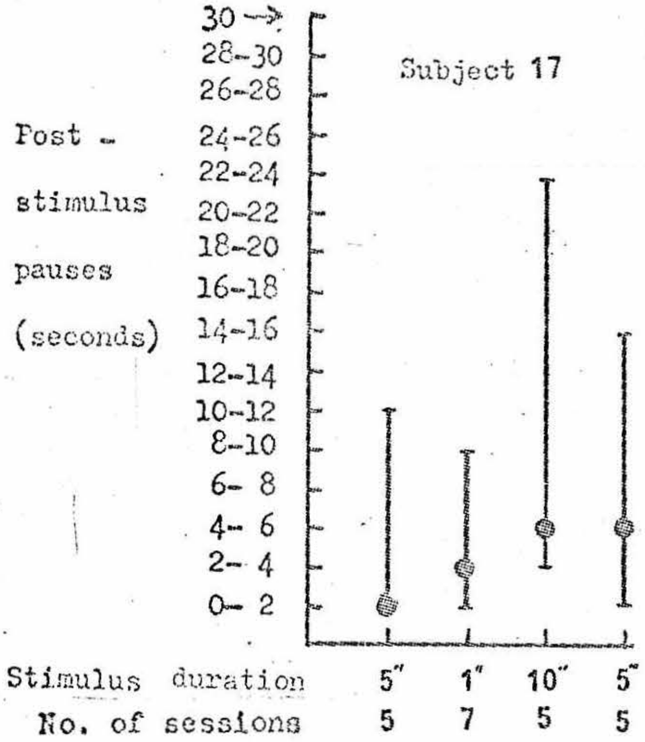


Figure 96 Medians and inter-quartile ranges of post-stimulus pauses in two-second categories. All post stimulus pauses of thirty-seconds or more were placed in the final category.

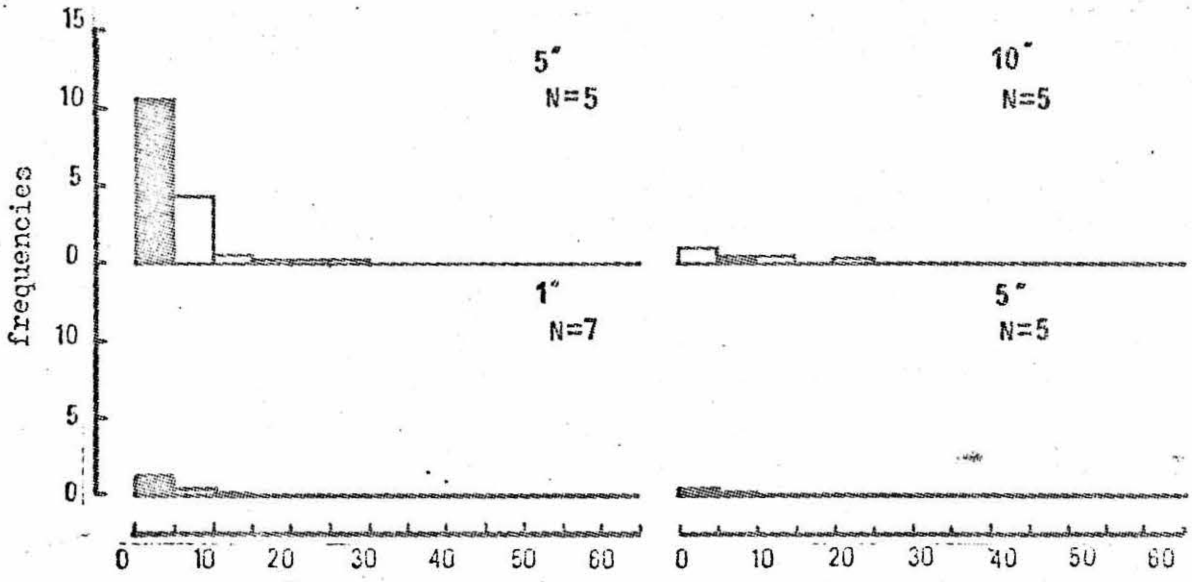


Figure 97 Mean frequency of bout lengths of AB_6 in five-second categories for Subject17 The last category contains all bout lengths greater than sixty-seconds. The median bout length category is shaded.

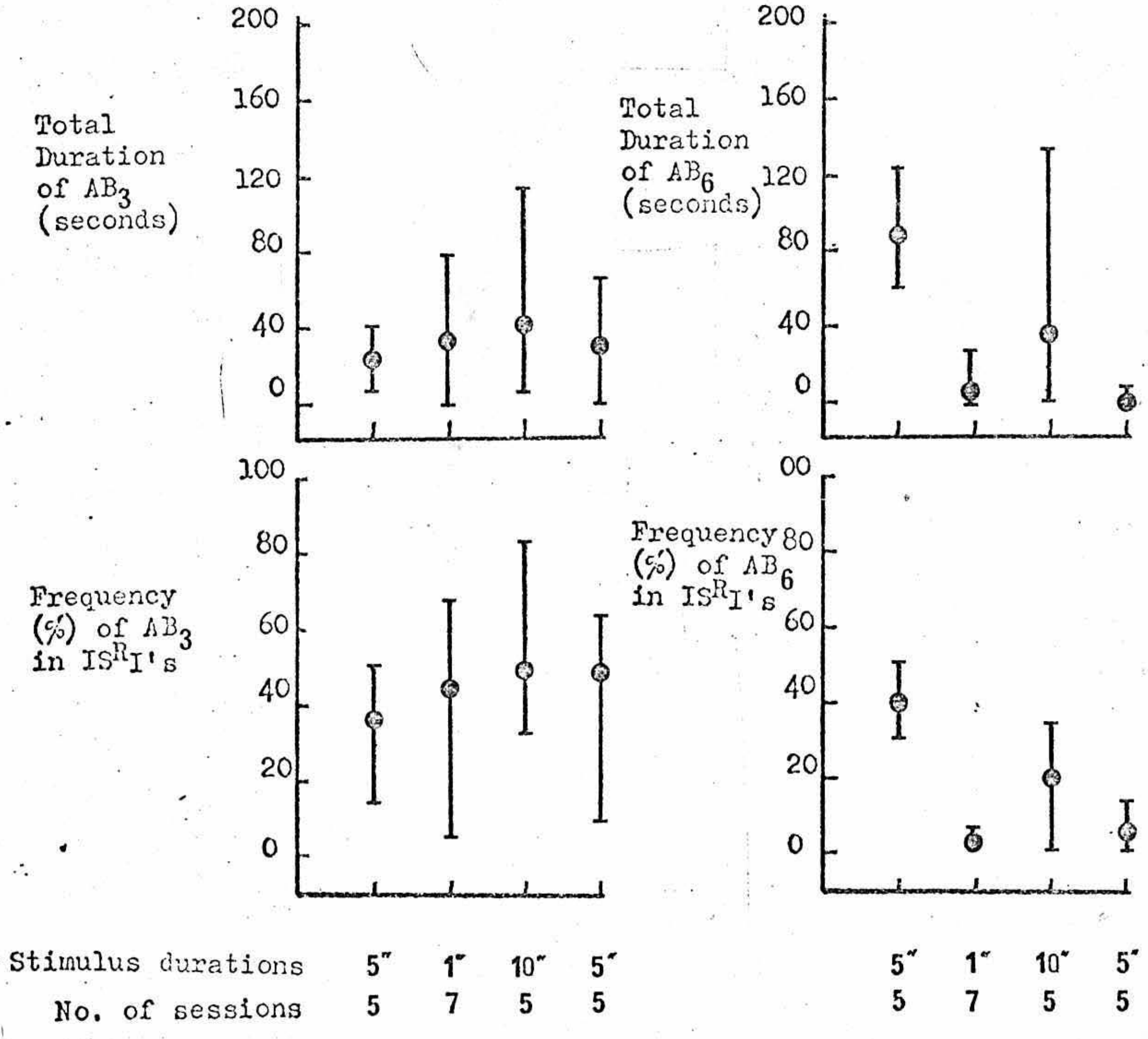


Figure 98 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 and AB_6 for Subject 17

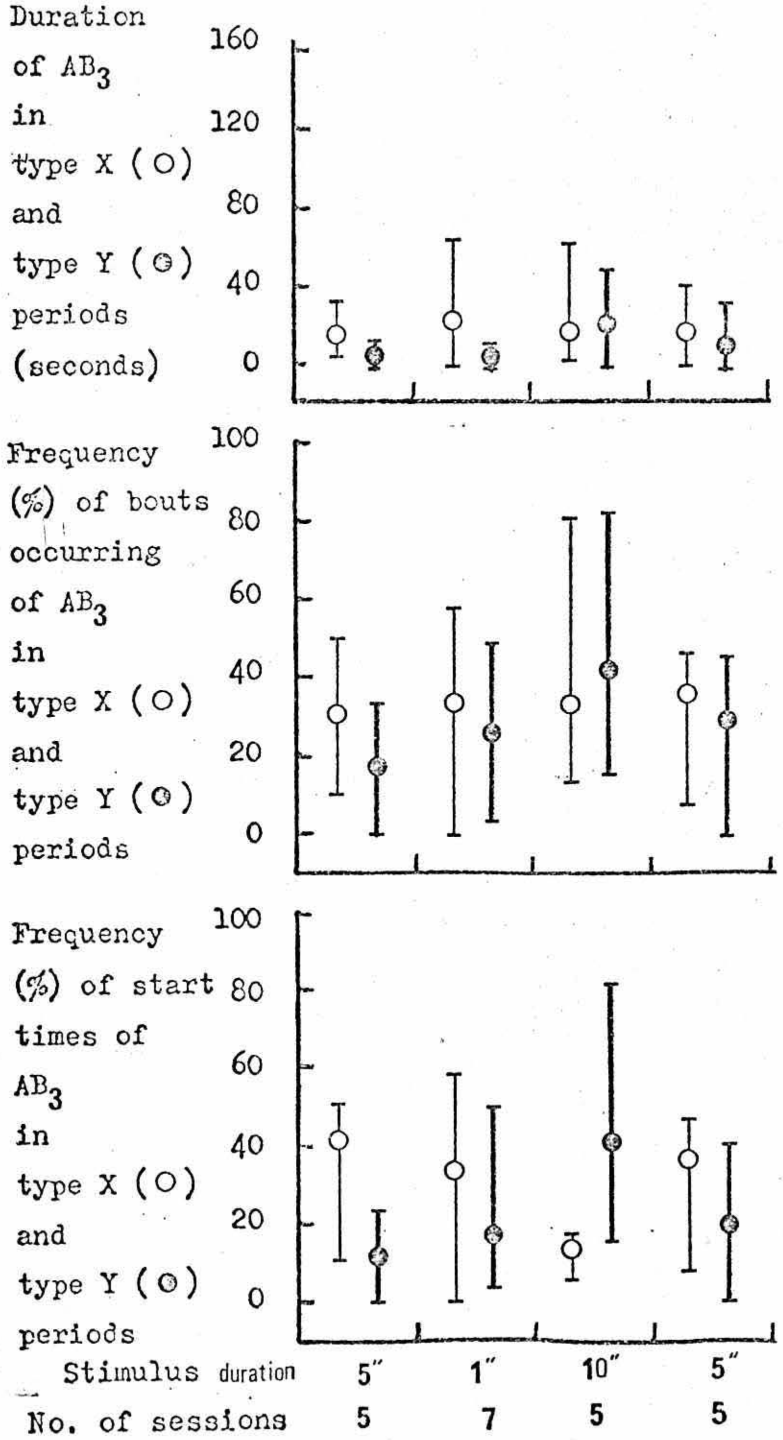


Figure 99 Means and ranges of durations and frequencies of bouts occurring and start times of AB_3 in type X and type Y periods for Subject 17

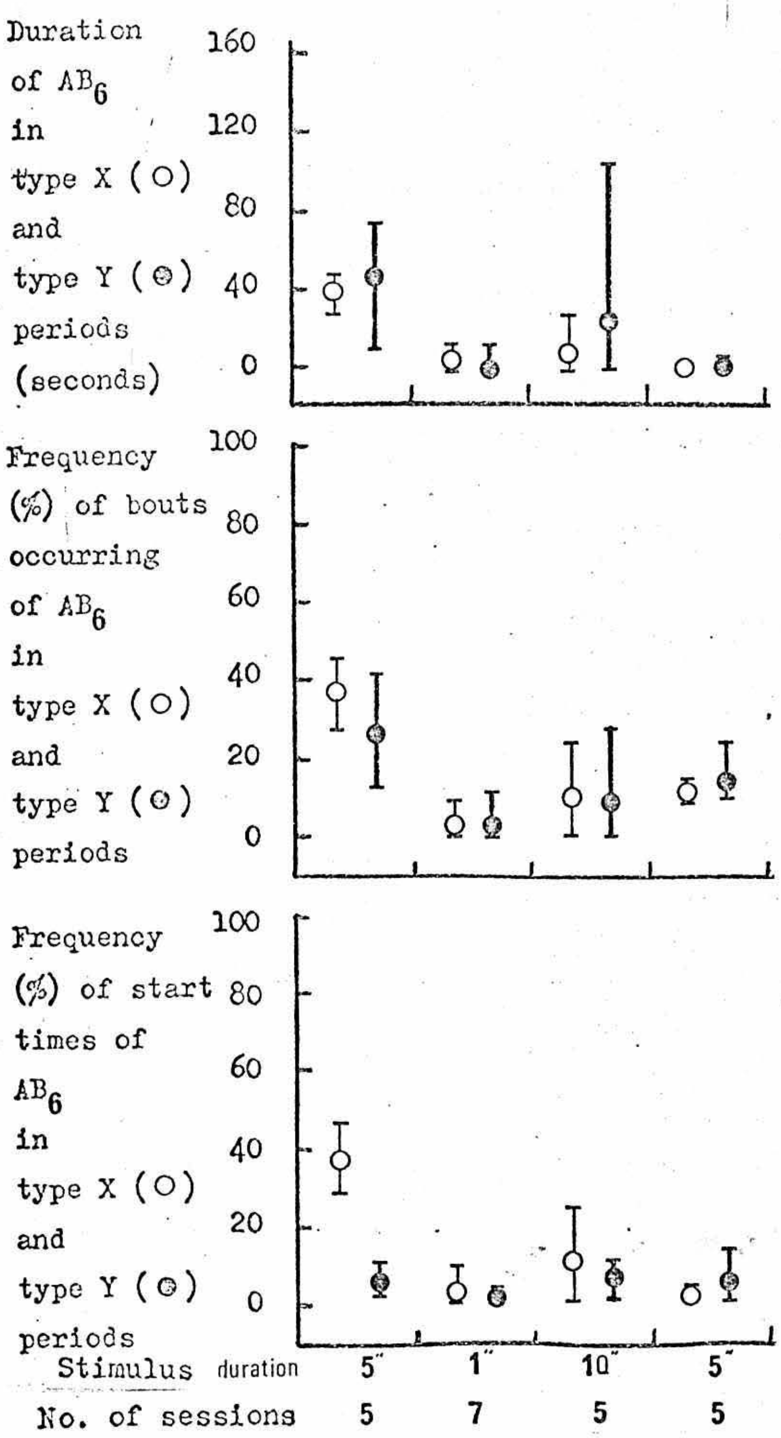


Figure 100 Means and ranges of durations and frequencies of bouts occurring and start times of AB_6 in type X and type Y periods for Subject 17

Mean bout lengths of AB_6 are shown in figure 97. The mode bout length was in the first five-seconds category at all stimulus durations. The median bout length was in the first five seconds at one-and five-seconds stimulus duration, but shifted to the five- to ten-seconds category when the stimulus duration was extended to ten-seconds.

Discussion

The three well defined behaviours examined in this experiment lever-pressing, AB_3 and AB_6 showed different functional relationships with the experimental variable. Lever-pressing was unrelated to stimulus duration but decreased with the number of sessions, the temporal loci of AB_3 was related to stimulus duration, and the durations and frequencies of AB_6 were related to both the number of sessions and the stimulus duration. Bout lengths of AB_6 were related to stimulus duration.

The absence of a functional relationship between response rate and duration of stimulation in this experiment may have been due to the fact that a relatively short fixed-interval (ten-seconds) was used. Schroeder (1972) examined another parameter of stimulus magnitude, amount, in an experiment in which the number of tokens delivered to a retarded subject for soldering wires to lugs on a fixed-interval schedule was manipulated. An inverse relationship between amount of tokens and work rate was found. However, the fixed-interval value used was fixed-interval 10-minutes. Considerable differences in schedule parameter, stimulus and response exist between the two studies.

CHAPTER 16

A DIFFERENTIAL REINFORCEMENT OF LOW RATES STUDY

CHAPTER 16

A DIFFERENTIAL REINFORCEMENT OF LOW RATES STUDY

Introduction

Differential reinforcement of low rate studies with both normal children (Stoddard, 1962) and normal adults (e.g. Holland, 1958; Lane, 1960) have revealed bimodal interresponse time distributions resembling those of animals (Anger, 1956). Stoddard (1962) reported that older children were "more precise in timing their responses" producing much less variable interresponse-time distributions than younger children and animals.

Most reports of human subjects' performance on differential reinforcement of low rate schedules include some reference to "collateral" behaviour. For example, Kane (cited in Spradlin and Girardeau, 1966) studied the behaviour of two moderately retarded girls on differential reinforcement of low rate schedules of token deliveries for manipulandum pulling, and reported that the subjects walked to the opposite side of the room, tapped on the wall and then walked back to the manipulandum. However, such reports do not provide objective reoords of the alternative behaviours under other schedules of stimulation for comparison.

The present study examined the development of performance of a retarded subject on a differential reinforcement of low rate schedule. Both lever-pressing and alternative behaviours were investigated. Performance under the differential reinforcement of low rate condition was compared with fixed-interval and extinction conditions.

Subject

Subject 24 served in this experiment. She was experimentally naive at the start of the experiment and was not given any training sessions.

Apparatus and Procedure

Five-seconds of slides and pop-music delivered simultaneously were used as the stimulus. A differential reinforcement of low rate

10-seconds schedule was in effect from the start of the experiment. No instructions or physical prompts were given, the subject was placed in front of the consol and left. All sessions were of twenty-minutes duration.

Thirty differential reinforcement of low rate 10-seconds sessions were followed by five fixed-interval 10-seconds sessions, followed by five more differential reinforcement of low rate 10-seconds sessions. This was followed by four extinction sessions, and then finally five differential reinforcement of low rate 10-seconds sessions. Alternative behaviours were not recorded for the first twenty sessions.

Results

Response rates, post-stimulus pauses and the number of stimuli delivered in each condition are shown in figure 101. The initial thirty differential reinforcement of low rate 10-seconds sessions have been grouped into six blocks of five-sessions to enable an examination of performance development. There was a slight decrease in response rate, and slight increases in post-stimulus pauses and number of stimuli obtained across the first four blocks of differential reinforcement of low rate sessions. Comparisions of the three conditions reveals that response rates were about equal in the fixed-interval 10-seconds and differential reinforcement of low rate 10-seconds conditions, but relatively lower in extinction. Considerably more stimuli were obtained in the fixed-interval sessions that in the differential reinforcement of low rate sessions.

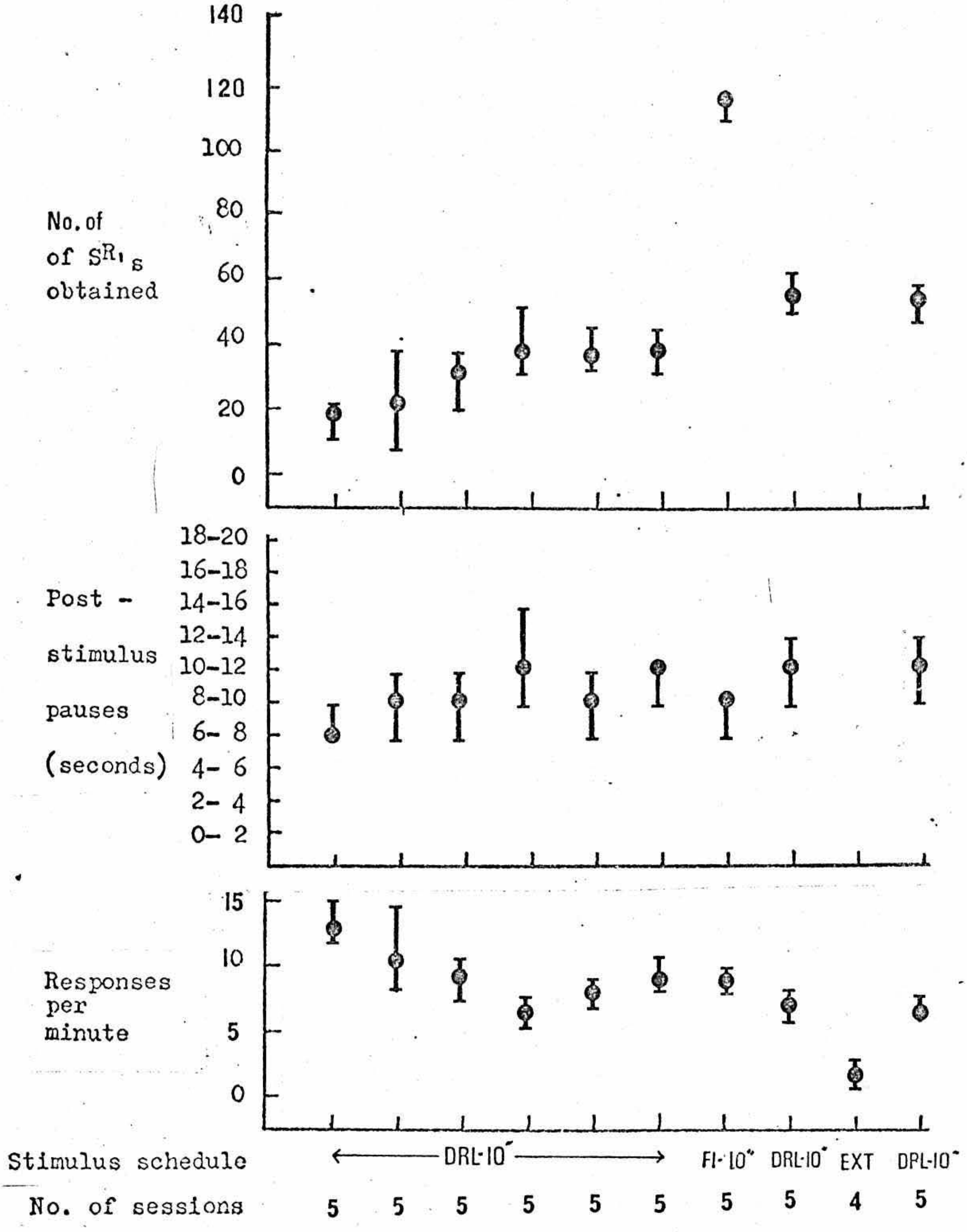


Figure 101. Means and ranges of response rates and number of stimuli obtained, and medians and inter-quartile ranges of post-stimulus pauses for Subject 24.

Figures 102 and 103 compare the relative frequencies and conditional probabilities of interresponse-times in each block of sessions. Figures 104, 105, 106, and 107 show the dwelling times in each interresponse-time category in each condition. Each of these distributions shows how the temporal discrimination was gradually acquired over the initial thirty differential reinforcement of low rate 10-seconds sessions. By the sixth block of differential reinforcement of low rate sessions the modal dwelling time fell in the ten-to twelve-seconds interresponse-time category

Although mean response rates in the fixed-interval block of sessions were roughly equivalent to the block of differential reinforcement of low rate sessions which immediately preceded figure 105 and 106 show that the modal dwelling-time shifted to a lower interresponse-time category in fixed-interval. In extinction there were no definite modes in all three distributions. The final block of differential reinforcement of low rate 10-seconds sessions produced a mode in the ten-to twelve-seconds interresponse-time category in all three distributions.

Total durations and frequencies of occurrence in inter-stimulus intervals of AB_6 and AB_{13} are shown in figures 108 and 109, respectively. The highest durations of both alternative behaviours occurred in the extinction sessions. The frequency of occurrence of AB_6 in inter-stimulus intervals was low in the

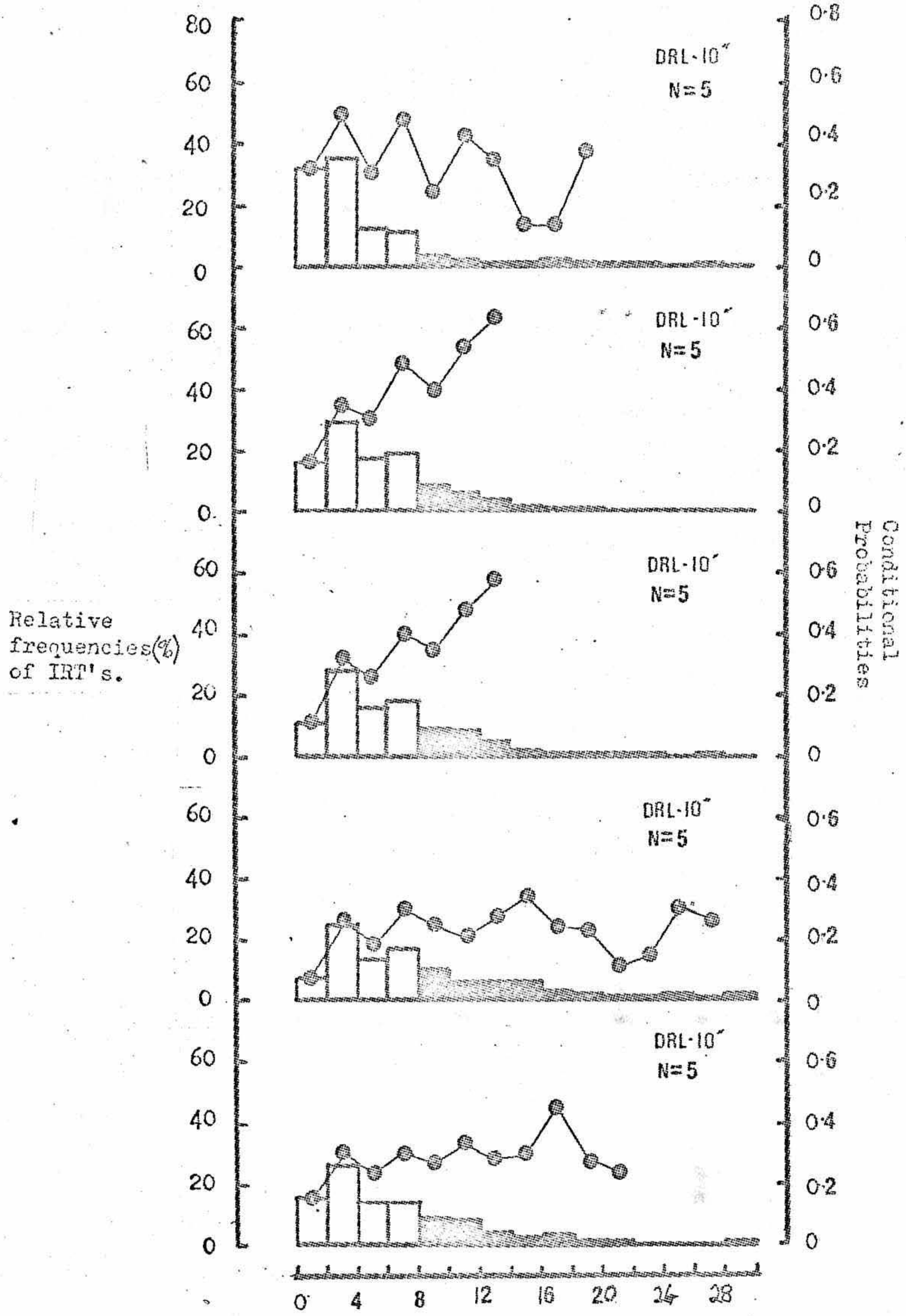


Figure 102 Relative frequencies and conditional probabilities of interresponse times in two-second categories for Subject 24. The last category contains all interresponse times greater than thirty-seconds.

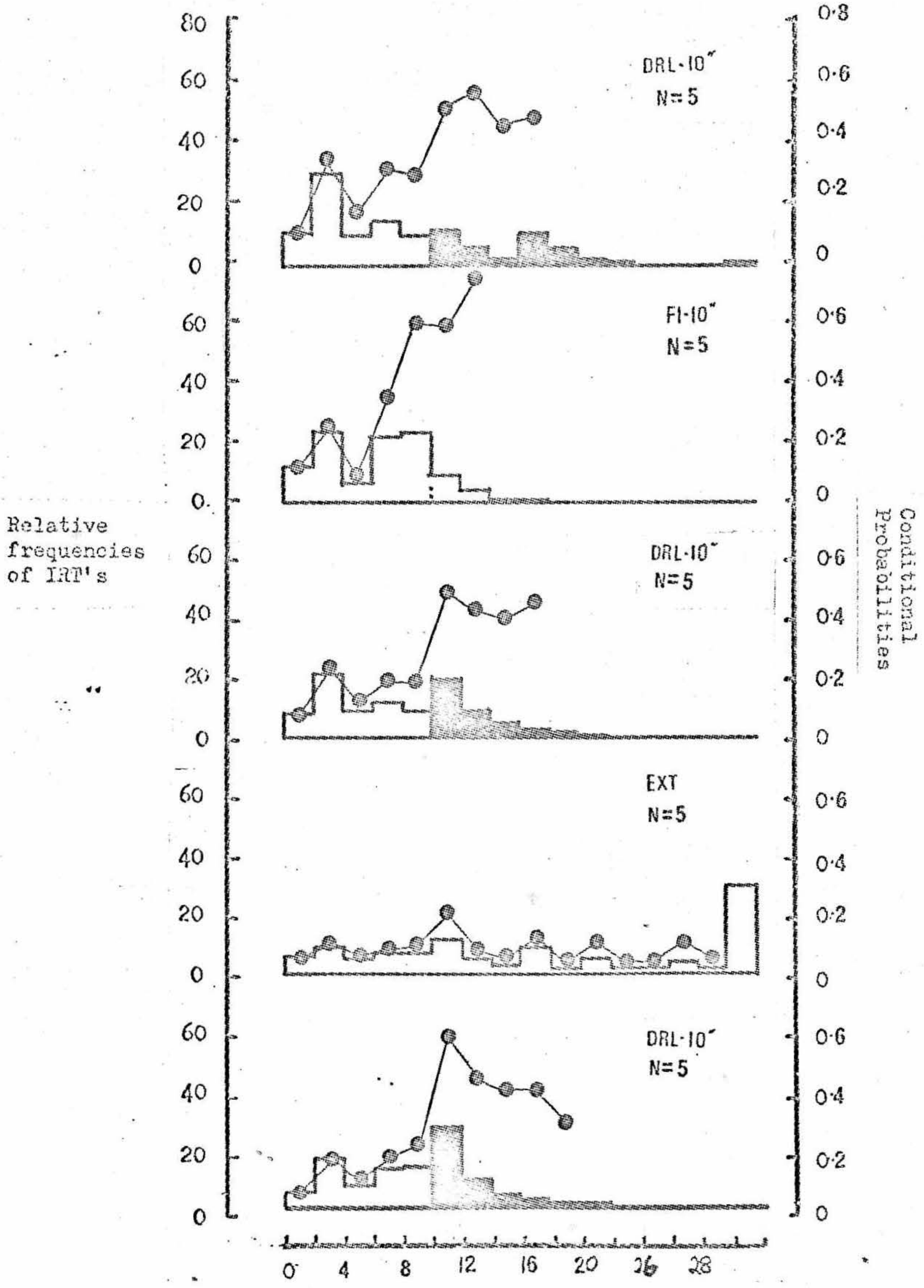


Figure 103 Relative frequencies and conditional probabilities of interresponse times in two-second categories for Subject 24. The last category contains all interresponse times greater than thirty-seconds.

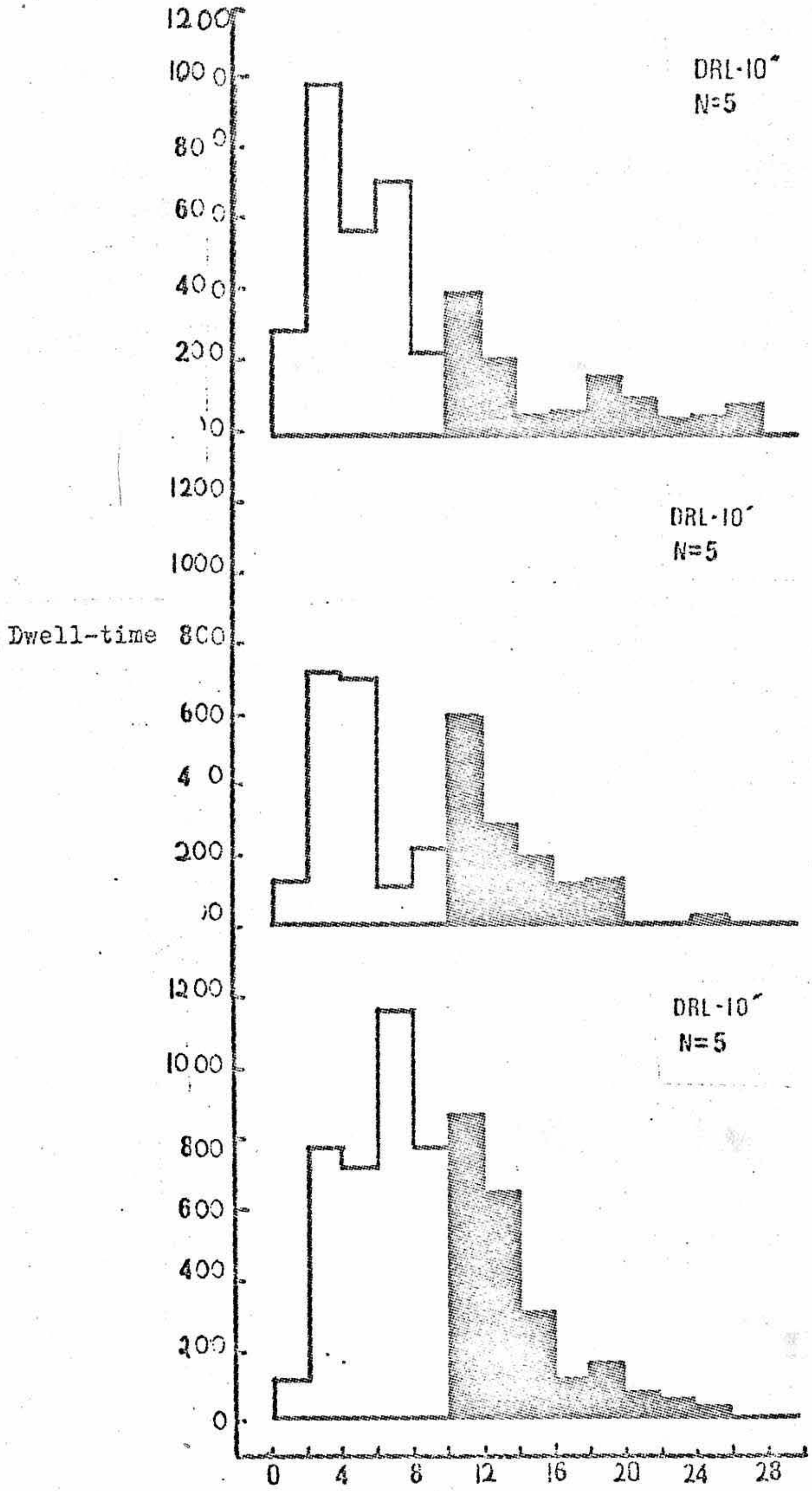


Figure 104 Total dwell time in two-second interresponse time categories for Subject 24.

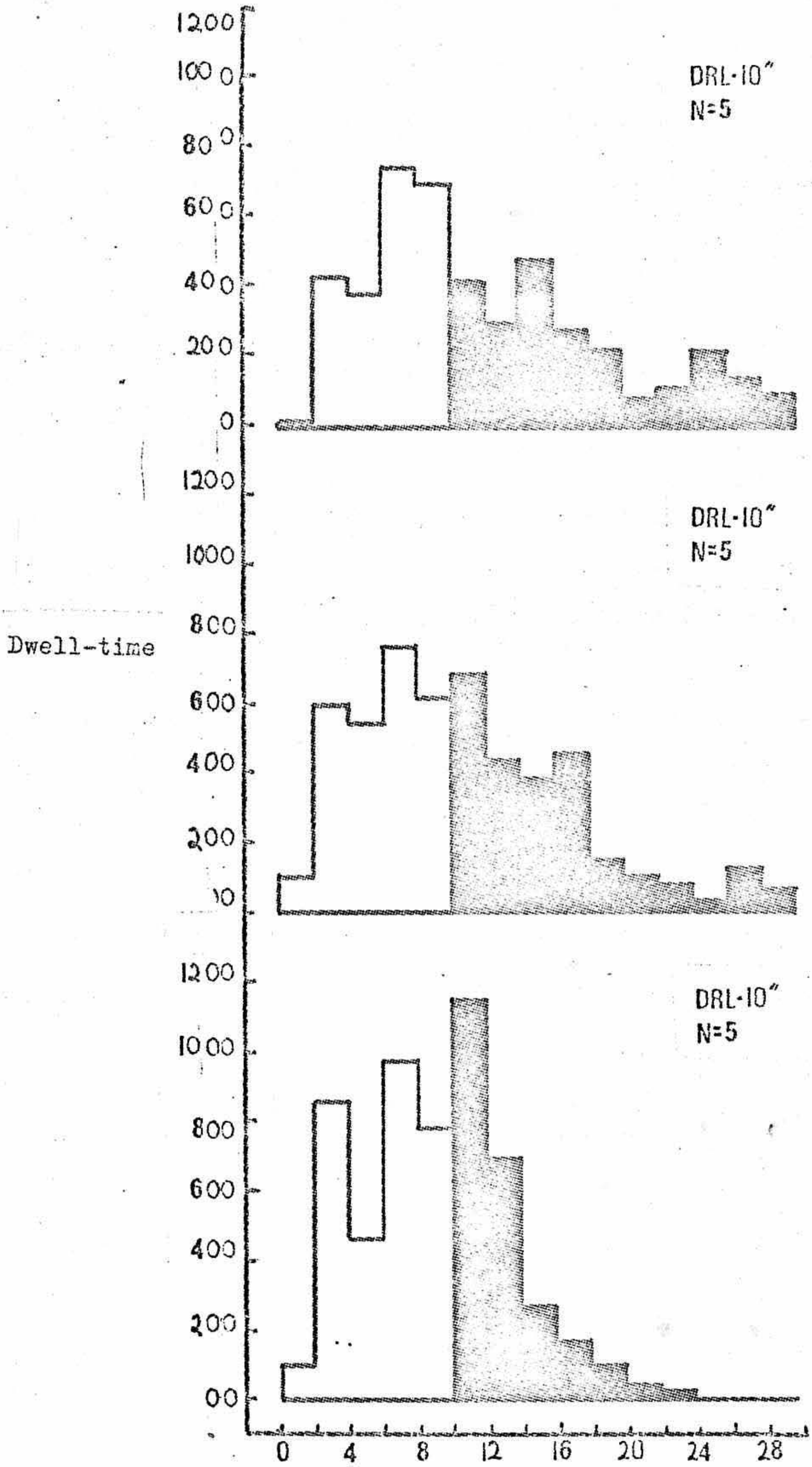


Figure 105 Total dwell time in two-second interresponse time categories for Subject 24.

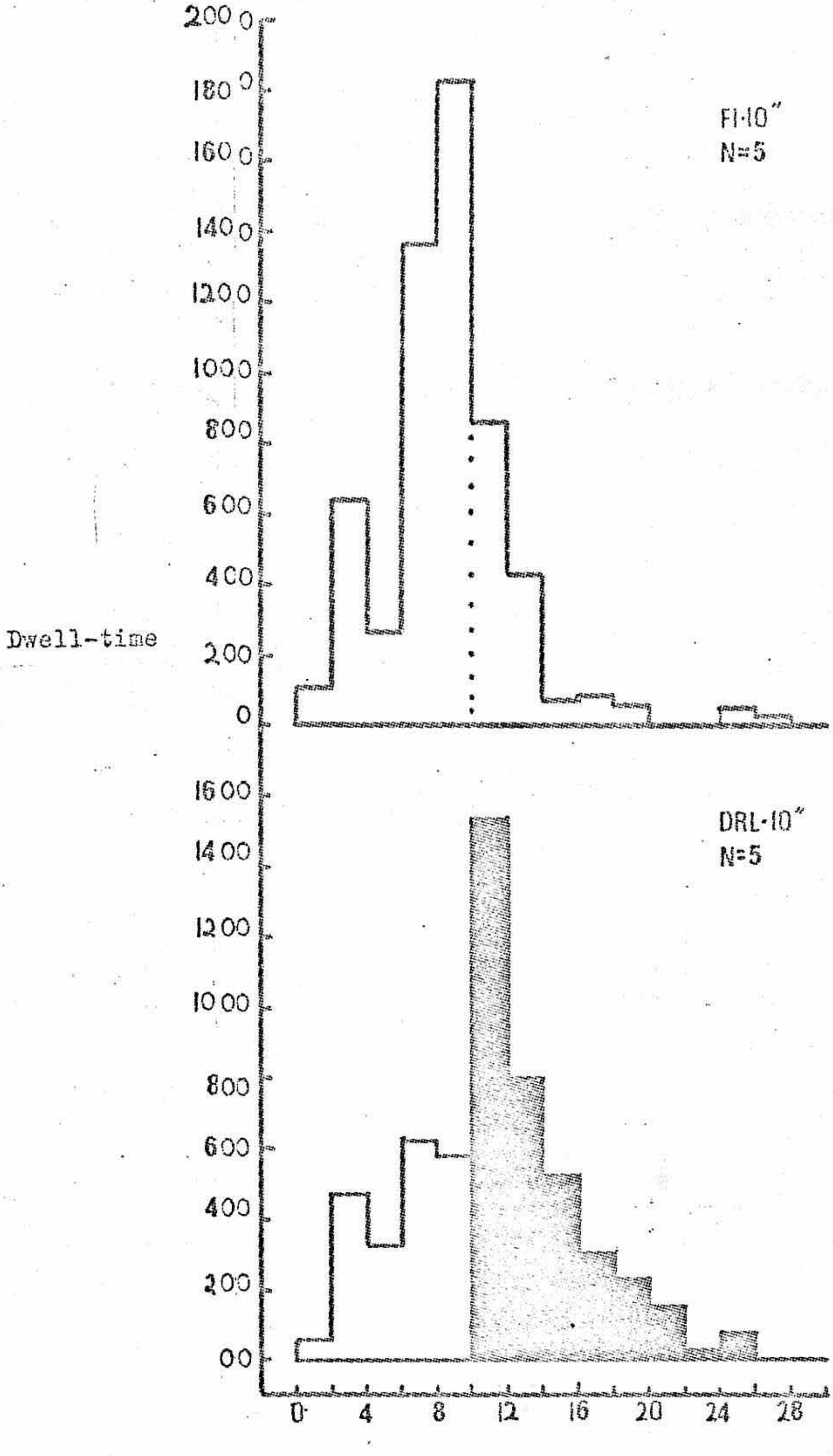


Figure 106. Total dwell time in two-second interresponse time categories for Subject 24.

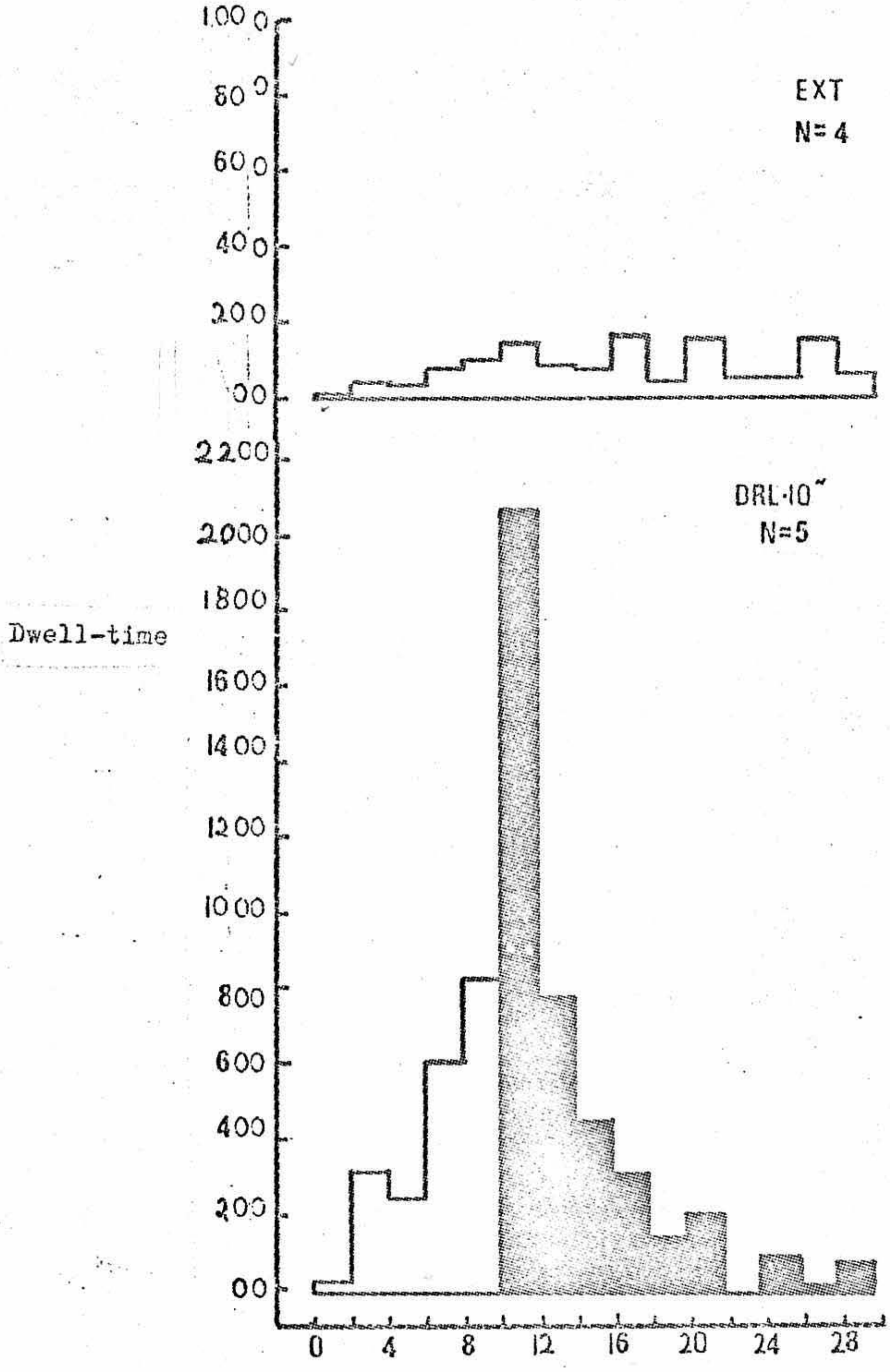


Figure 107 Total dwell time in two-second interresponse time categories for Subject 24.

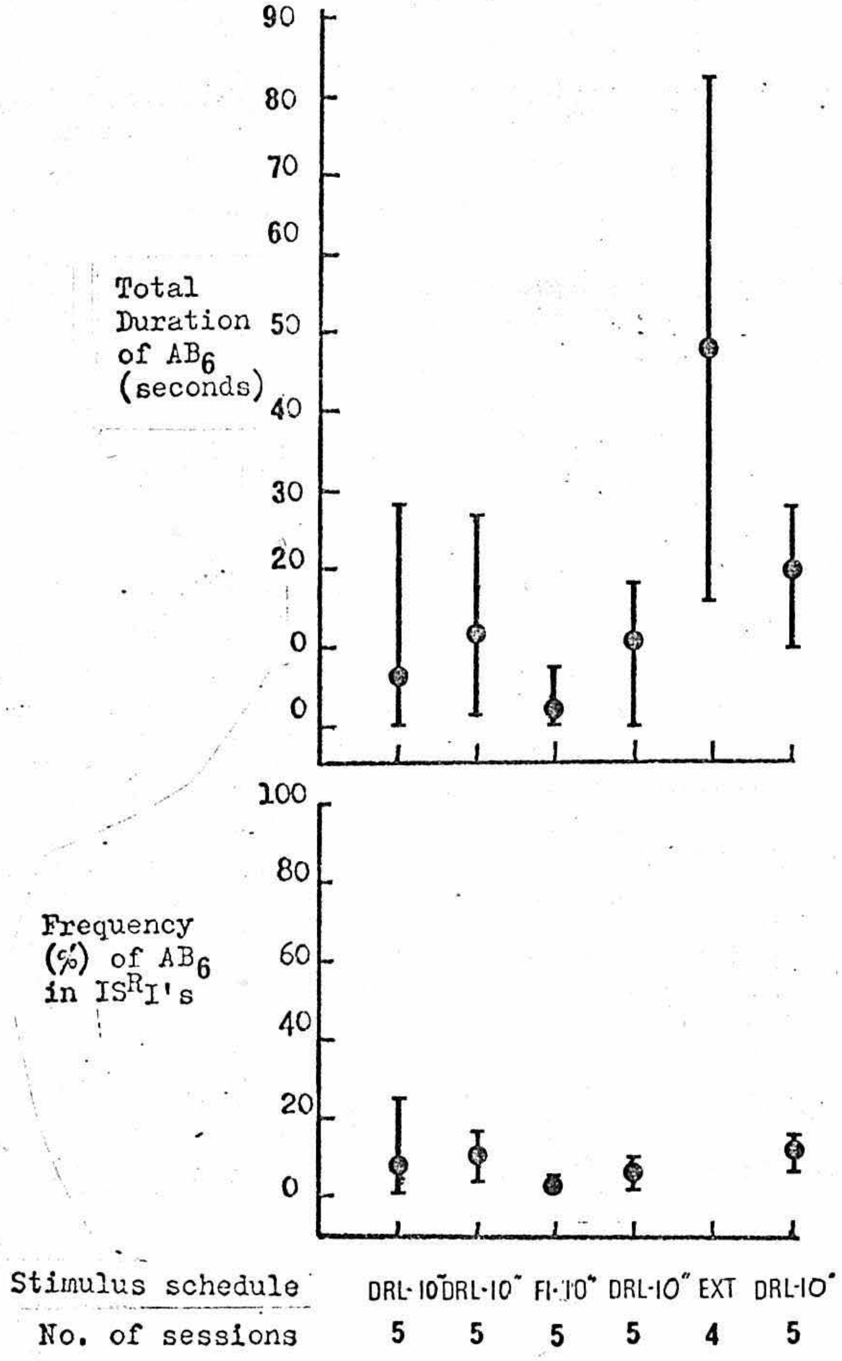


Figure 108 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_6, for Subject 24

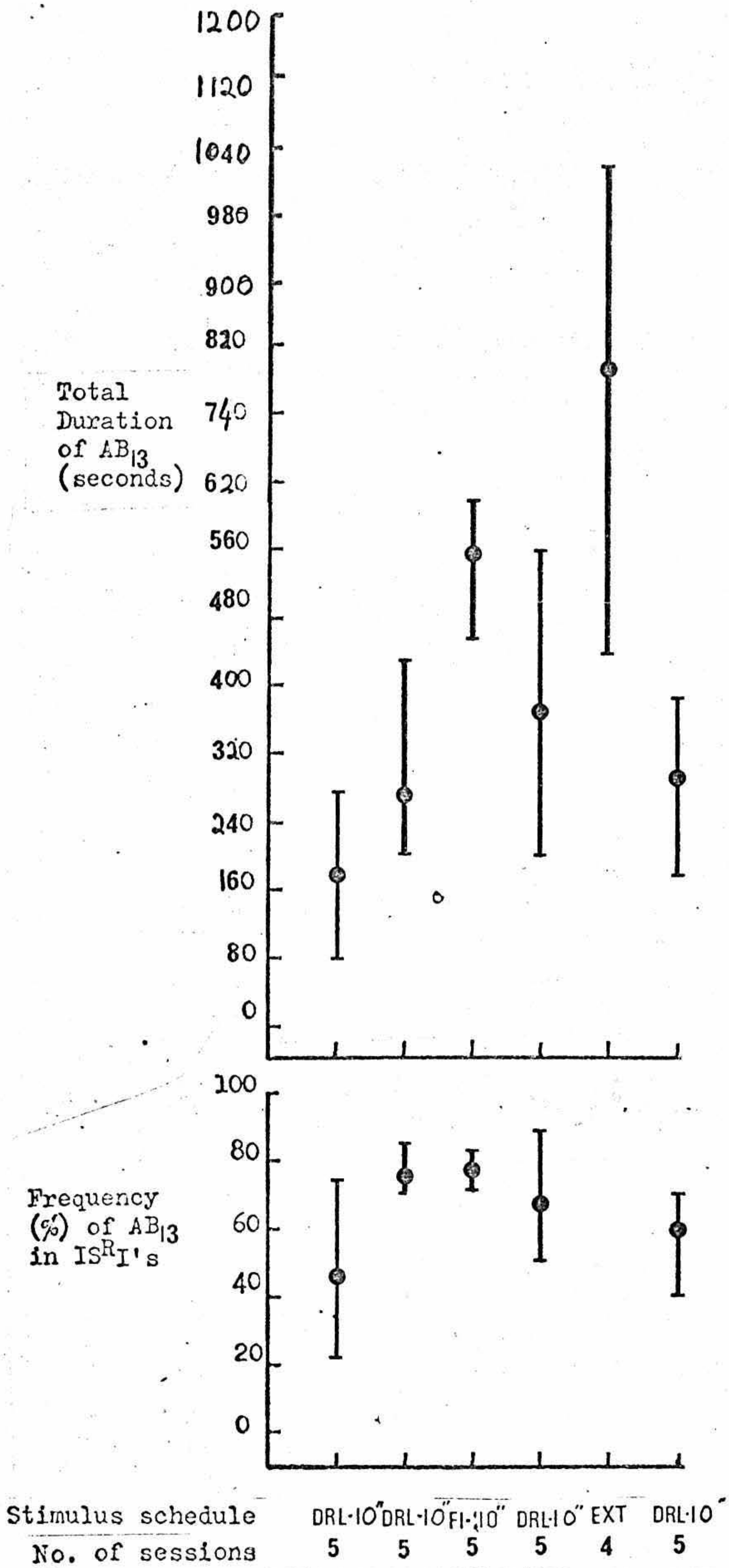


Figure 109 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_{13} for Subject 24

differential reinforcement of low rate sessions, but was almost zero in fixed-interval sessions. The duration of AB_{13} was slightly lower in differential reinforcement of low rate sessions than in fixed-interval sessions, but the frequency of occurrence in inter-stimulus intervals was roughly equivalent in the two conditions.

Figure 110 shows the frequencies of occurrence of bouts occurring of AB_6 and AB_{13} in type X and type Y periods. In both fixed-interval and differential reinforcement of low rate sessions AB_6 had a slightly higher frequency of occurrence in type Y periods and AB_{13} had a slightly higher frequency of occurrence in type X periods.

Distributions of mean bout lengths of AB_{13} are shown in figure 111. The median bout lengths have been shaded in each condition. In the differential reinforcement of low rates sessions, the median bout lengths always fell in the five-to ten-second category. This shifted to the first five-second category in the fixed-interval sessions, and to the fifteen-to twenty-second category in the extinction sessions. A much flatter distribution of bout lengths was obtained in extinction. A comparison of the first and final blocks of differential reinforcement of low rate sessions in figure 111 reveals that although the median bout length of AB_{13} remained unaltered, the modal bout length moved from the first to the second five-

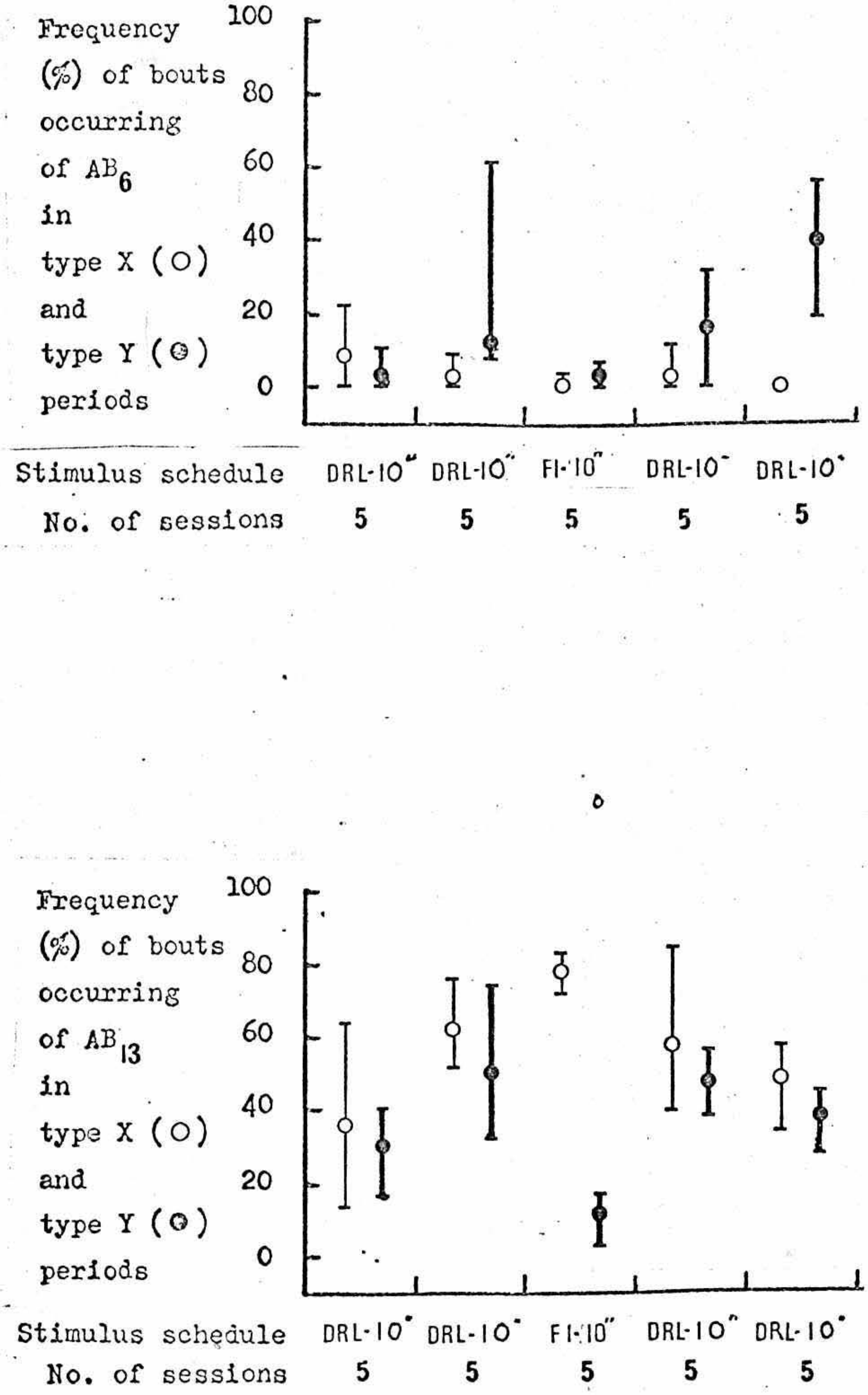


Figure 110 Means and ranges of frequencies of bouts occurring of AB_6 and AB_{13} in type X and type Y periods for Subject 24

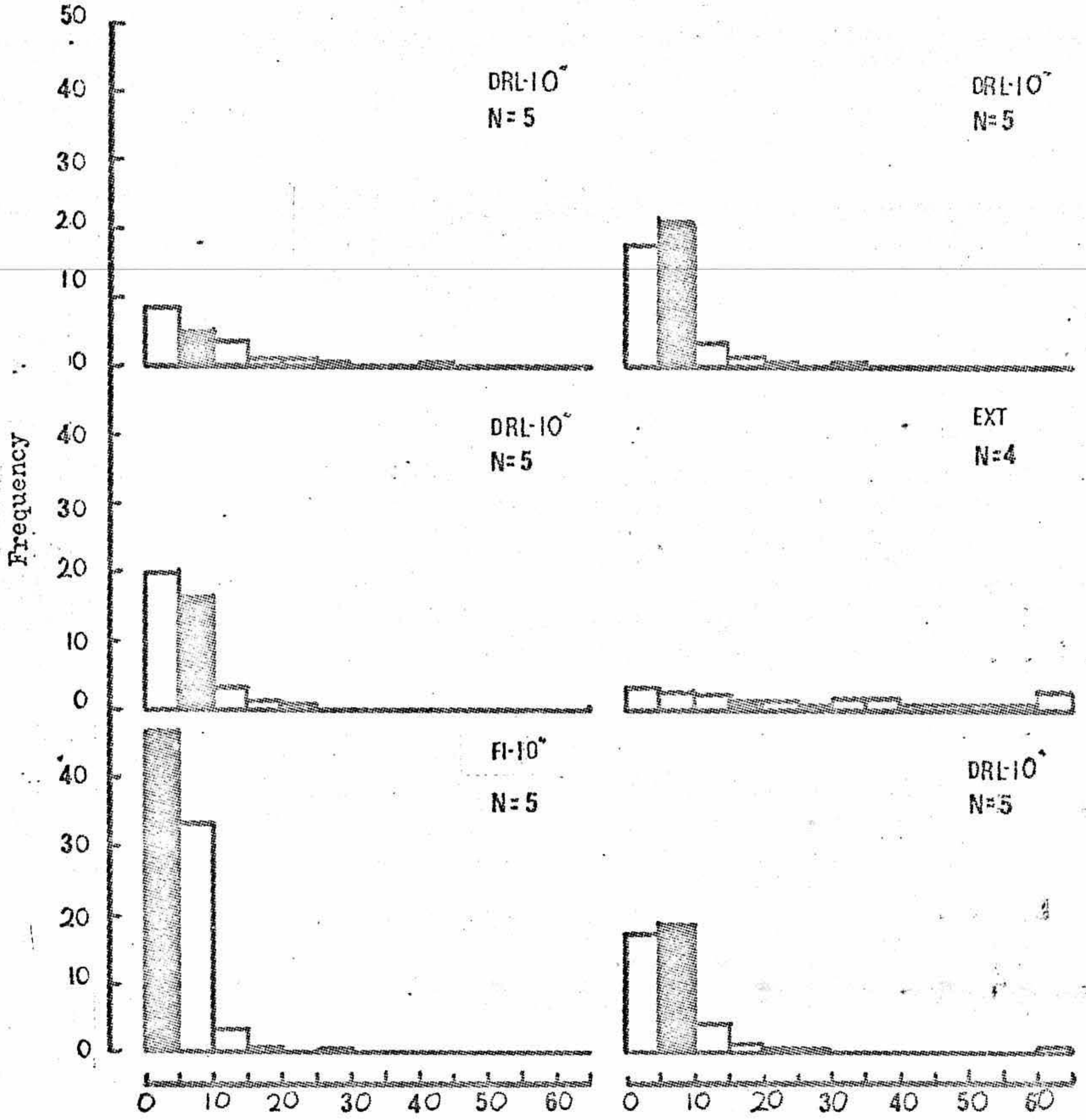


Figure 111 Mean frequency of bout lengths of AB$_{13}$ in five-second categories for Subject 24 The last category contains all bout lengths greater than sixty-seconds. The median bout length category is shaded.

second category.

Discussion

All three distributions of interresponse times revealed the gradual development of a temporal discrimination (Weiss, 1970) under the differential reinforcement of low rate schedule. The differences in the patterning of lever-press responses under the three conditions were similar to that produced by animals under similar conditions (Ferster and Skinner, 1957). Unlike animal studies, however, the overall rate of responding did not increase when the schedule was switched to fixed-interval.

A similarity can be seen between the interresponse-time distributions and the distributions of bout lengths of AB_{13}. Total durations of AB_{13} were higher in both extinction and fixed-interval sessions than in differential reinforcement of low rate sessions, but the bout length distributions were different. Fixed-interval sessions had many short bouts of AB_{13} and extinction sessions produced fewer, but longer, bout lengths. It appeared that the schedules of stimulation were related to the reduction of total duration and to changes in the temporal distributions of AB_{13}.

The duration of AB_6 was also reduced by the introduction of schedules of stimulation. With AB_6 however, lower durations and frequencies were found in the fixed-interval sessions relative to the differential reinforcement of low rate sessions, incontrast to AB_{13}. The two alternative behaviours also showed differences in temporal loci relative to stimulus deliveries.

CHAPTER 17

EFFECTS OF ACCESS TO A CONCURRENT ACTIVITY ON FIXED-RATIO PERFORMANCE

CHAPTER 17

EFFECTS OF ACCESS TO A CONCURRENT ACTIVITY ON FIXED-RATIO PERFORMANCE.

Introduction

A variable that has been shown to interact with schedule of stimulation to determine the pattern of responding in humans is that of concurrent tasks that the subject may, or must, perform (Laties and Weiss, 1962, 1963; Sanders, 1969; Frazier and Bitetto, 1969; Poppen, 1972; Gonzalez and Waller, 1974). Laties and Weiss (1963) obtained longer post-stimulus pauses and some changes in rates of responding when they required their subjects to perform a subtraction task while button-pushing under fixed-interval schedules. Similarly, Gonzalez and Waller (1974) reported longer post-stimulus pauses when free access to reading material was introduced in a situation where handwriting produced counts on a counter for monetary exchange under a fixed-interval schedule. However, reading material had no effect on performance under a fixed-ratio schedule for the same subject.

Some animal studies have reported that changes in availability of alternative activities can produce changes in responding under schedules of stimulation (e.g. Laties et al, 1963). Staddon and Ayres (1976) have shown that changes in the availability of alternative activities for rats under a fixed-time 30-seconds food presentation schedule produced changes in the overall frequencies and temporal loci of other alternative behaviours.

This experiment investigated the effects on lever-pressing and on alternative behaviour of providing continuous free access to another alternative activity with a retarded subject on a fixed-ratio schedule.

Subject

Subject 11 served in this experiment which immediately followed that reported in Chapter 13.

Apparatus and Procedure

The schedule of stimulation used throughout this experiment was fixed-ratio 20 of five-second slide presentations. After the first five sessions a bowl of sweets was made freely available for five sessions. This was followed by a further five sessions with no sweets available.

Results

Response rates, post-stimulus pauses frequencies of pauses greater than ten seconds are shown in figure 112. These were related to the availability of sweets, there being higher response rates, shorter post-stimulus pauses and lower frequencies of long pauses when access to sweets was not available. The duration and frequency of occurrence of AB_7 in inter-stimulus intervals when sweets were available is shown in figure 113.

Figure 114 shows the total durations and frequencies of occurrence of AB_3 in inter-stimulus intervals, and the durations and frequencies of bouts occurring of AB_3 in type X and type Y periods. These figures were well scattered in each condition but showed a reduction in total duration and frequency of occurrence in inter-stimulus intervals when access to sweets was available. However, the temporal loci of AB_3 with respect to slide presentations were unaltered by the availability of sweets.

Discussion

Introduction of the availability of a concurrent activity, eating sweets, reduced the rate of lever-pressing and produced longer post-stimulus pauses. This contrasts with the finding of Gonzalez and Waller (1974) that access to a concurrent activity, reading, had no effect on fixed-ratio performance. However, considerable differences between subjects, responses and stimuli exist between the two studies.

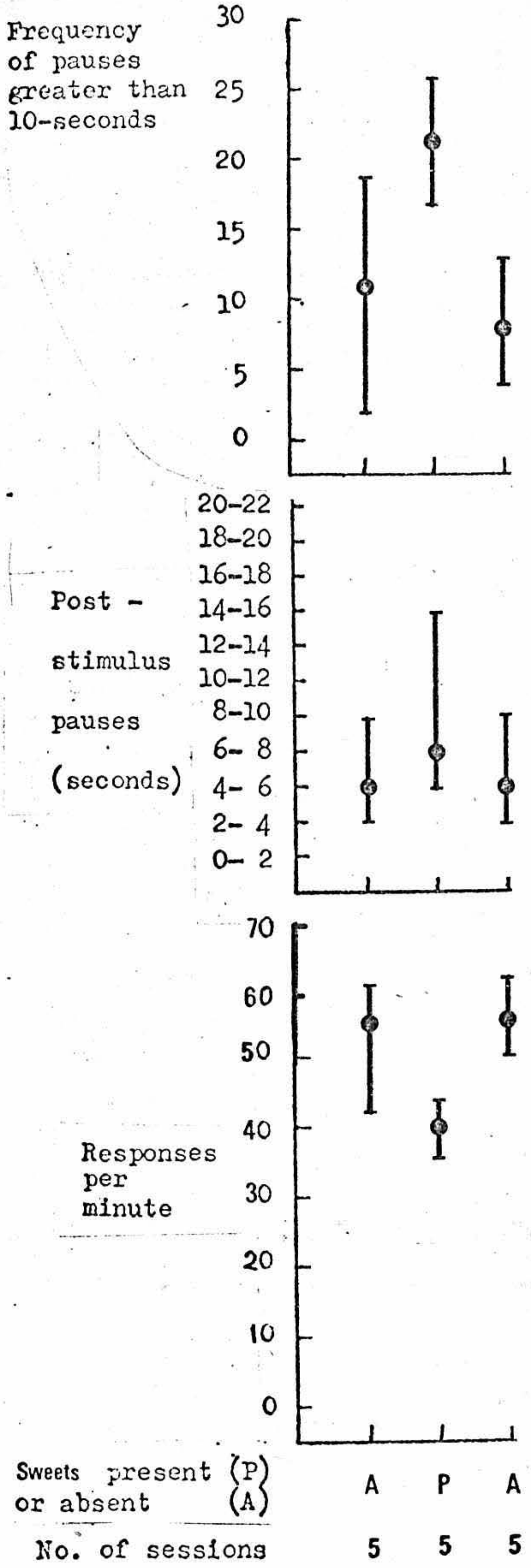


Figure 112. Means and ranges of response rate and pauses greater than ten-seconds, and medians and inter-quartile ranges of post-stimulus pauses for Subject 11.

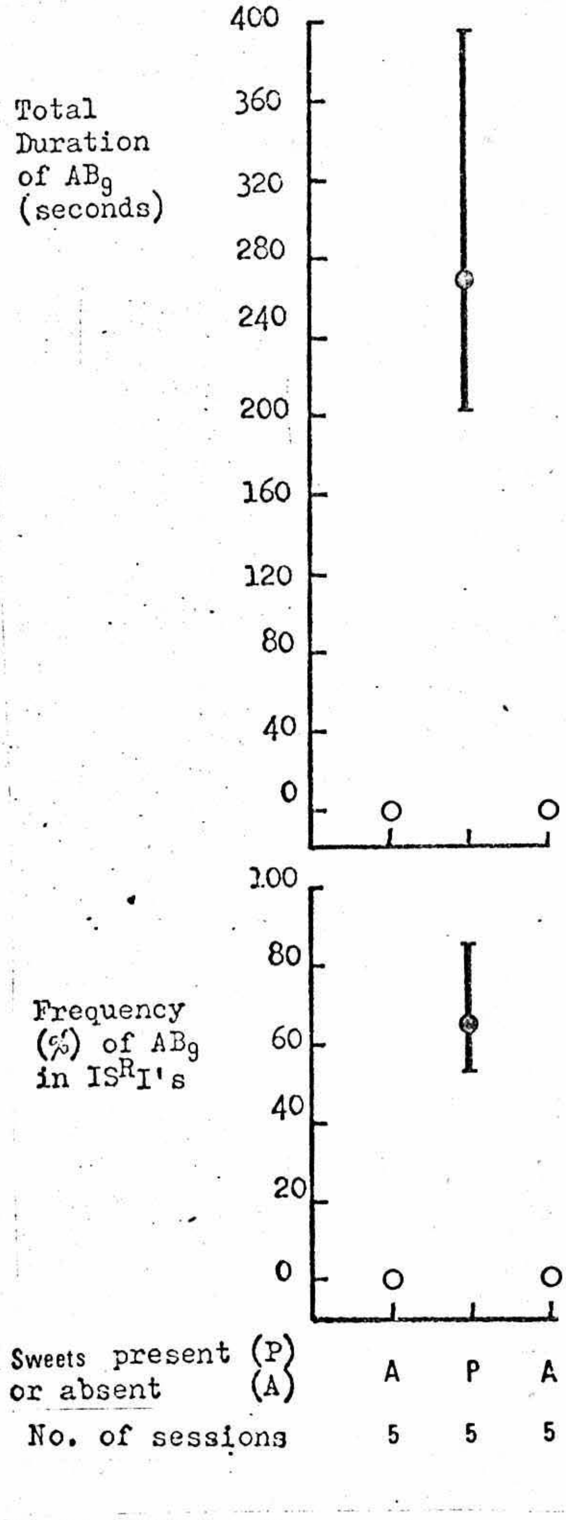


Figure 113 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_9 for Subject 11

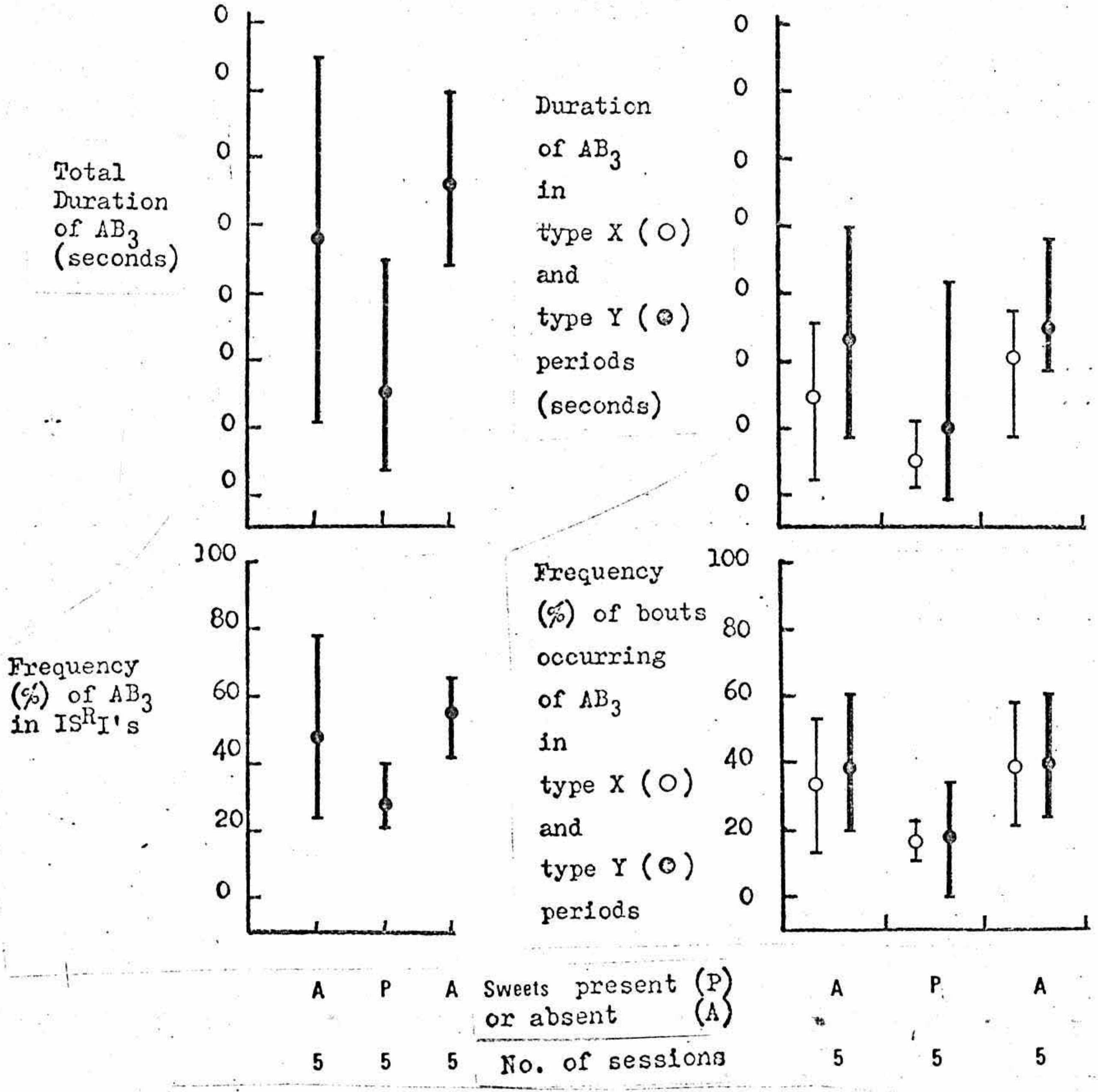


Figure 114 Means and ranges of total duration and frequency of occurrence in inter-stimulus intervals of AB_3 for Subject 11 and Means and ranges of durations and frequencies of bouts occurring of AB_3 in type X and type Y periods for Subject 11

AB_9 not only reduced lever-pressing but also AB_3. The availability of an alternative activity produced behaviour (AB_9) which competed with both of the other two well defined behaviours, lever-pressing and AB_3. However, considering that large proportions of sessions with sweets available were devoted to emitting AB_9, the reductions of response rate and AB_3 duration were relatively small. It appears that, as Staddon and Ayres (1976) reported with rats, changes in other behaviours were not simply related to the duration of AB_9. The availability of sweets most probably produced behaviour (AB_9) that not only competed with the two well defined other behaviours (lever-pressing and AB_3) but also with other behaviours that were not well defined. That is, AB_9 also competed with the neither behaviour (NB) class in Goldiamond's (1975) terminology.

CHAPTER 18

GENERAL DISCUSSION AND CONCLUDING COMMENTS

CHAPTER 18

GENERAL DISCUSSION AND CONCLUDING COMMENTS

A brief summary of the experimental findings is presented in Table 7. Despite considerable variability within and between subjects and conditions, the findings were orderly. For every subject the experiments uncovered many functional relationships between elements of the behaviour stream. In particular, it was sometimes found to be the case that although the target behaviour/ descriptive operant showed little or no change when an independent variable was manipulated, it did not necessarily mean that the variable had no effect on behaviour.

Two features of performance were similar in all experiments. These were the frequency of over-runs of responding and the frequency of responses during stimulus presentations. It appeared that these aspects of responding were in fact transitory and

TABLE 7: Summary of Results

Subject	1	3
Lever-pressing	Response rates were lower in extinction relative to FT - 20" conditions	Response rate increased with fixed-ratio value up to FR60 and then a decrease up to FR100. Initial rates not recovered when FR20 reintroduced. Post-stimulus pauses increased with fixed-ratio value.
Alternative behaviours	AB_1 - Unrelated to experimental conditions Higher durations in type Y periods	AB_3 Unrelated to schedule parameters. Higher durations and frequencies in type Y periods
	AB_2 - Durations in FT - 20" were higher than in extinction. Higher durations in type Y periods. Bout lengths unrelated to experimental conditions.	AB_4 - Duration decreased slightly as fixed-ratio was increased and increased slightly when FR20 was reintroduced. Higher frequencies and durations in type Y periods. Median bout-lengths increased from first to second five-second category at FR100.

TABLE 7.

Subject	5	10
Lever-pressing	Lower response rates in fixed-time relative to fixed-interval and extinction conditions. Steady decrease in response rate and increase in post-stimulus pauses with increases in fixed-ratio value	Response rate varied more between sessions using the same stimulus than between stimulus conditions. Lowest rates were obtained in extinction and consistently high rates produced when slides and verbal approval were used in the same session. Longer post-stimulus pauses produced with sweets and music than with slides or verbal approval.
Alternative Behaviours	AB_3 - Unrelated to fixed-ratio value. Relatively higher durations and frequencies in fixed-time than fixed-interval and extinction conditions. Durations were longer in type X periods in FI - 20" and longer in type Y periods in FT - 20". Bout lengths were unrelated to experimental conditions.	AB_3 - Low durations and frequencies in all sessions but predominantly emitted in type X periods. Slightly higher duration in the slide-and-verbal approval condition. This behaviour was related to the change of stimulus in the latter sessions.
		AB_6 - Unrelated to stimulus type but occurred predominantly in type X periods
	AB_5 - Duration and frequencies increased with FR value. Higher frequencies and durations in FT then FI and extinction condition. Longer durations in type X periods. Bout lengths unrelated to experimental conditions.	AB_7 - Unrelated to stimulus type

TABLE 7

Subject	11	12
Lever-pressing	Response rates were unrelated to stimulus type, nor were they related to the schedule of stimulation when FI, FT and extinction were compared.	Response rates were variable and unrelated to schedule of stimulation nor were they related to changes of FI value. Post-stimulus pauses did not reveal a relationship with FI value
Alternative Behaviours	AB_3 Frequency and durations were unrelated to stimulus type and schedule of stimulation. The behaviour was equally distributed between type X and type Y periods. Median bout-length increased with number of sessions. AB_8 - Unrelated to stimulus type but generally higher in frequency and duration in type Y periods. Bout lengths were also unrelated to stimulus type AB_9 - Unrelated to stimulus type. Durations, frequencies, and number of sweets eaten decreased with number of sessions. However, lowest figures were recorded in extinction. Frequencies of start times were higher in type X periods	AB_6 - occurred only in fixed-time and extinction sessions and never in FI. Highest frequencies when no lever present. AB_{10} - Unrelated to schedule of stimulation (FI, FT, and extinction) but highest durations were recorded in FI -10" relative to other FI values. Equally scattered in type X and type Y periods. AB_{11} - never occurred in extinction but otherwise was unrelated to schedule of stimulation. Occurred almost entirely in type X periods and all bouts were of less than five seconds duration.

TABLE 7

Subject	17	20
Lever-pressing	A relatively large increase in response rate occurred when neck-tickling was introduced as a stimulus. This then decreased slightly with further sessions and was unrelated to changes in the duration of tickling. The rate then remained at roughly the same value for all stimulus changes dropping slightly in extinction	Response rates were variable and unrelated to FI value, but post-stimulus pauses increased with FI. Rates were lower in FT than in FI conditions.
Alternative behaviours	AB_3 -Slightly higher frequencies in neck tickling and red-light sessions relative to other stimuli. Total durations and frequencies unrelated to stimulus duration. However, durations and frequencies were slightly higher in type X periods at one- and five-seconds stimulus durations, and higher in type Y periods at ten-seconds duration.	AB_3 - Higher durations in FT than extinction conditions. Durations and frequencies increased with FI value. Higher frequencies and durations in type X periods in all conditions, but an increase in frequency and duration in type Y periods produced in FT conditions.
	AB_6 - Durations and frequencies higher in slide and extinction sessions than when sweets used as stimulus. With neck tickling both the stimulus duration and number of sessions were involved in determining durations and frequencies. Durations showed discrepancies between first and second blocks of red-light sessions (i.e. before and after pairing with neck-tickling.	AB_{12}- Higher durations in FT than extinction conditions with highest durations occuring when no lever present. Durations increased with FI value. Higher durations and frequencies in type Y periods.

TABLE 7

Subject	24	25
Lever-pressing	Response rates equal in DRL and FI conditions but lower in extinction. Modal dwelling time and relative frequency was found in a lower IRT category in FI relative to DRL	Main response rate was slightly higher at a lower force requirement. Over-runs and responding during stimulus presentation were higher in frequency at the lower force requirement.
Alternative behaviours	AB_6 - occurred more frequently in DRL than FI. Highest durations occurred in extinction	AB_3 Durations and frequencies were unrelated to amount of effort required on the lever, and increased with the number of sessions.
	AB_{13} - Occurred more frequently in FI than DRL. Highest durations occurred in extinction. Median bout lengths were longer in DRL than FI. Bout lengths were longer in extinction.	

TABLE 7

Subject	26
Lever-pressing	Overall rates of responding did not vary significantly with changes in schedule of stimulation
Alternative behaviours	AB_3 - Higher duration in FT than extinction conditions. Highest durations and frequencies occurred in type Y periods. Bout lengths were unrelated to schedule of stimulation. In extinction the duration decreased through successive three-minute intervals in each session. In all other conditions it was equally distributed in duration throughout the sessions AB_{14} - Unrelated to schedule of stimulation. Occurred predominantly in type Y periods.

tended to decrease in frequency with the number of sessions. For example, Subject 3, who had produced high frequencies of over-runs of responding in a previous study (Woods, 1973) never over-ran the delivery of a stimulus in this study. There was, however, one exception to this general rule. Subject 20, reported in Chapter 10, showed a gradual increase in the frequencies of over-runs of responding and a gradual increase in the frequency of responses during stimulus presentations with the number of sessions.

"Self-stimulatory" behaviours have usually shown an increase in frequency and/or duration when extinction has replaced a schedule of stimulation with retarded subjects (e.g. Hollis, 1968; Baumeister and Forehand, 1971). This was not always the case, however, in the present study. With subject 1 (Chapter 9) the duration of AB_2 (waving finger in front of face), which has been described as a self-stimulatory behaviour frequently observed with retardates (Williams, 1975; Kaufman and Levitt, 1965) showed a higher frequency of occurrence when schedules of stimulation were in effect than in extinction.

Several dimensions of behaviour that have been examined in this thesis have revealed orderliness. However, to say that all the orderly aspects of behaviour showed functional relationships with experimental variables raises a conceptual question. What constitutes a functional relationship?. Functional analysis is a method of enquiry that is used in many sciences. Functional relationships, rather than causal relationships, are found in the vocabulary of most scientific disciplines (Toulmin, 1953).

> 'The terms "cause" and "effect" are no longer widely used in science. They have been associated with so many theories of the structure and operation of the universe that they mean more than scientists want to say. The terms which replace them, however, refer to the same factual core A "cause" becomes a "change in an independent variable" and an "effect" a "change in a dependent variable. The old "cause-and-effect connection" becomes a "functional relation". The new terms do not suggest how a cause causes its effect they merely assert that different events tend to occur in a certain order'. (Skinner, 1953 p. 23.)

Probability of behaviour emerged as a basic dependent variable early in the development of the experimental analysis of behaviour (Skinner, 1931). Functional relationships are usually said to exist when predictable changes in probability of behaviour result with changes in independent variables. Skinner (1966b) proposed that a dimension of behaviour which is often used as an index of behavioural probability is the rate of occurrence of a behavioural event. However, he (Skinner, 1966a) notes that rate is not necessarily the same as probability of behaviour, and it may often be the case that other dimensions of behaviour more accurately describe changes in probability of occurrence. In the present study several dimensions of behaviour were examined;- rate, frequency, total duration, bout lengths, temporal loci, etc. It was often the case that some of these dimensions remained unaltered or varied in a way that was unpredictable or lacking in order. It was not predictable at the outset which dimensions would vary with the experimental manipulations nor how they would vary.

Table 7 contains examples of how various dimensions of the alternative behaviours changed with the experimental manipulations in such a way that it could be concluded that a functional relationship between that dimension of the behaviour and the independant variable existed. However, besides these empirically demonstrated functional relationships, other orderly aspects of behaviour were revealed. Certain dimensions of behaviour did not change with changes in the experimental variables, but nevertheless showed consistencies relative to other dimensions/behaviours/ subjects. An example of such was AB_{11} for Subject 12. In Chapter 12, AB_{11} occurred predominantly in the periods immediately after stimulus presentation. The temporal loci of AB_{11} did not change with (i.e. did not show a functional relationship with) the experimental variable but, nevertheless, showed a consistency which contrasts significantly with the temporal loci of other alternative behaviours that were examined under similar conditions (e.g. AB_{14} for Subject 20).

Several dimensions of behaviour that appeared to be independent of experimental manipulations, were found to change in an orderly manner as further sessions were carried out. For example, with Subject 25 in Chapter 14 the durations and frequencies of AB_3 in inter-stimulus intervals were unrelated to amount of effort required on the lever, but were found to increase with the number of sessions. It could have been the case, however, that the dimension of behaviour which changed with the number of sessions was in fact a function of variables that were not monitored in the study, but which also changed with further sessions.

The failure to find functional relationships between some well-defined classes of alternative behaviour and experimental manipulations may not necessarily mean that functional relationships did not exist. This could have been due to differences between descriptive and functional classes of behaviour. AB_3, for example, is an extremely broad descriptive class of behaviour. Skinner (1957) points out that there are many different functional classes of verbal behaviour. Hence the failure to find a functional relationship between the descriptive class, AB_3, and the experimental variables manipulated for Subject 11 in Chapter 10 could have been due to the fact that several functional classes of verbal behaviour were confounded in one descriptive class.

Many of the behaviours examined in this study were not being emitted for the first time by subjects. Weiner (1964b, 1969a, 1969b, 1970a) has shown that the functional relationships in the history of behaviours are likely to play a significant part in determining how that behaviour will in future be related to elements of the behaviour stream. The subjects used in this study brought their behavioural histories with them to the experiments. These histories involved not only the "reinforcement histories" of the descriptive operants and alternative behaviours that were examined, but also histories of interrelations of these behaviours with other alternatives in the behaviour stream (c.f. Goldiamond, 1975). Although data concerning the histories were not available, it is recognised that the extent to which they entered into the behavioural outcomes could have been considerable.

The present experiments confirm the existence of complex interrelations between behaviours in what is regarded by many as a simplified situation. In this work temporal analyses of behaviours were attempted. It is likely, however, that sequential analyses of the interrelations between the well defined classes of behaviour would have revealed further complexity (c.f. Staddon, 1972b).

Previous studies of alternative behaviours have sub-classified them according to temporal loci and to their relative frequencies between conditions of stimulation and extinction. Adjunctive behaviours are usually characterised by their excessiveness under schedules of reinforcement relative to extinction conditions. This classification is similar to Staddon's (1976) interim activities which are usually found to occur in the period immediately after stimulation. Staddon (1976) distinguishes a further sub-class of alternative behaviours which he calls "other behaviours" or "preferred activities". These behaviours usually occur with higher frequencies in extinction conditions than when a schedule of stimulation is in effect and their temporal loci under schedules of stimulation is usually towards the middle of inter-stimulus intervals.

In the present study there were some alternative behaviours that could be said to be similar to adjunctive behaviours or interim activities. For example, AB_{11} for Subject 12 never occurred in extinction and nearly always occurred immediately after stimulus delivery. Furthermore, it took several sessions before it developed.Similarly, there were some alternative behaviours which occurred with higher frequencies in extinction conditions than under schedules of stimulation. For example, AB_{13} for Subject 24 was much higher in duration in extinction than under schedules of stimulation. This could be said to be a "preferred activity" in Staddon's (1976) terminology. However, not every alternative behaviour fell into such neat categories. Some alternative behaviours which appeared to be "schedule related" and occurred with higher durations under schedules of stimulation relative to extinction, did not occur predominantly in the periods immediately after stimulus presentation (e.g. AB_2 for Subject 1).

There were other factors that were found to be related to various dimensions of alternative behaviours. Stimulus duration was related to total durations, bout lengths and temporal loci of AB_6 for Subject 17. The availability of a manipulandum was a major determinant of the duration and temporal loci of AB_3 for Subject 5. The schedule type and parameters were found to be related to total duration and bout lengths of AB_{13} for Subject 24, and to durations and temporal loci of AB_4 for Subject 5. These, and many other examples, suggest that categorisation of alternative behaviour according to one or two dimensions is misleading. It was impossible to predict the results for one dimension of alternative behaviour from examination of the outcomes for other dimensions. Each dimension of an alternative behaviour had to be examined separately. Each dimension could or could not have a functional relationship with the independent variables. The form of functional relationships could only be determined by experiment.

Concluding comments

This study has examined some aspects of transition amongst elements of the behaviour stream of retardates under schedules of stimulation. By examining both descriptive operants and well-defined alternative behaviours, several functional relationships were uncovered within the apparant variability. The findings revealed that variability in the behaviour of the retarded is not just simply the result of different reinforcers having different potencies, or different functions, for different people. Many interactions among behavioural alternatives were involved, most of which were unpredictable and could only be discovered by carrying out the experiments.

In Goldiamond's (1975) alternative sets formulation, one subset of behaviours, neither behaviour, which is defined by its exclusion from the well defined operant and alternative behaviours, was by definition unobserved. Nevertheless, just as the well-defined alternative behaviours were shown to be involved in the outcome of other aspects of the behaviour stream, some of the neither behaviours could have been involved in determining the outcome of the monitored behaviours. As a species we would expect the neither behaviours to include private events within the individual which are, at present, outside the range of observation. Indeed, both response and stimulus elements of the behaviour stream could include covert events. Although this consideration does not explain aspects of variability in the behaviour of the retarded, it warns against idle postulation of indigenous causes of variability.

On a cautious note, it could be said that some of the findings warn against use of behaviour modification "techniques". As Kachanoff et al (1973) and Goldiamond (1975) have previously suggested, the inadvertent development of inappropriate (and even aversive) behaviours, through the use of a unilinear system of intervention which fails to consider the alternatives, is a possibility. Clearly the applied analysis of behaviour can only begin to guard against such undesirable outcomes by extending its framework to include as much as possible of the total organisation of behaviour.

Finally, it could be said that what appeared as disarrayed variability was in fact lawful complexity. As the complexity of the behaviour stream is further investigated it becomes clear that the desire to discover generalities must complement the discovery of complex, and often idiosyncratic, interrelations amongst elements of the behaviour stream.

> 'As experimental control is extended to more continuous and inclusive elements of behaviour , it will become necessary to find the orderliness within the increasingly apparent variability of behaviour. We cannot as yet antitipate what problems await us here, nor what forms their solutions will take. The only certainty is that it is our science's business to find both those problems and their solutions (Schoenfeld, Cole, Lang and Mankoff, 1973, p. 161).

APPENDIX I

SOME EXAMPLES OF "SPONTANEOUS EXTINCTION"

APPENDIX I

SOME EXAMPLES OF "SPONTANEOUS EXTINCTION".

Introduction

In Chapter 3 it was noted how operant conditioning research with the retarded has frequently met with the problem of finding stimuli which will function as effective and durable"reinforcers". The present study was no exception. For most subjects a number of different stimuli and combinations of stimuli were tried as "reinforcers" before a suitable one was found. Once an "effective" stimulus had been found it was often the case that as further sessions were carried out the effectiveness would gradually decrease. This effect has also been reported in studies with normal children (e.g. Long, 1959) which have often resorted to changing the stimulus in order to "revive" the performance (e.g. Long et al, 1958; Stoddard, 1962).

Besides a gradual waning in performance that is said to be associated with a stimulus of poor reinforcing durability, another form of decrease in reinforcer efficacy with retarded subjects has been reported by Rice and McDaniel (1966) and Rice et al (1967). This is a phenonomenon they refer to as "spontaneous extinction". Their subjects were "vegetative" profoundly retarded subjects who received various forms of stimulation for touching or pulling a suspended ring. With some subjects they reported that after many sessions of responding at a high rate, a rapid decline in rate to almost zero would occur over one or two sessions. All attempts to recover the high rate through changes of schedule or stimulus proved to be of no avail. For example, one subject's response rate declined from a steady four-hundred responses per hour, which had been maintained over ninety-six sessions, to six responses per hour, over one session. Other reports of this spontaneous and irreversible effect have not appeared in the literature.

Examples

In the present study several subjects who had to be rejected showed the gradual decline in respones rate that is usually associated with a stimulus of poor durability. Subject 22, for whom five-seconds of stimultaneous slides and pop-music produced the steady decline in rate shown in figure 115, was an example. A similar gradual decrease in effectiveness of slides plus music was found with Subject 13. However, with her it was not a decline

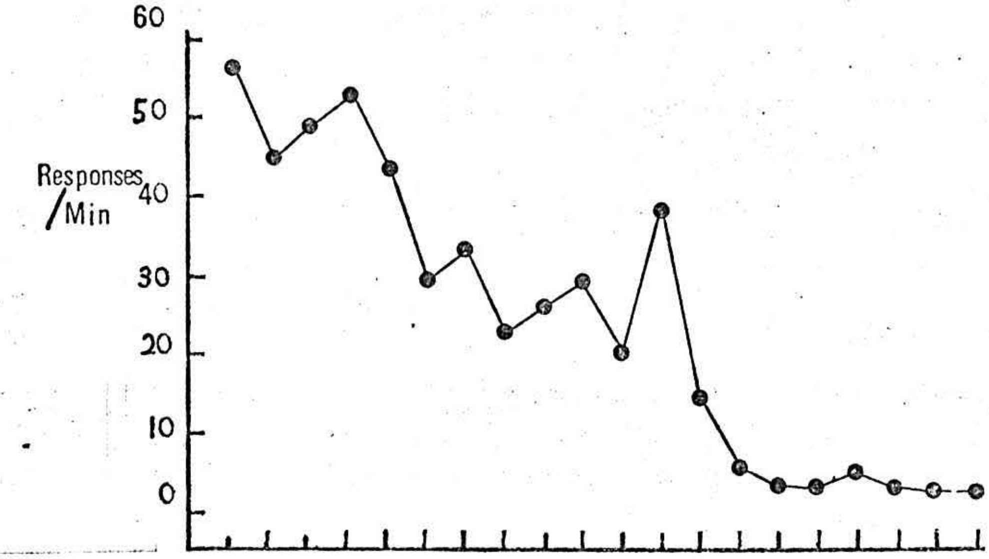


Figure 115. Mean response rate in successive sessions for Subject 22. All sessions were of fifteen-minutes duration.

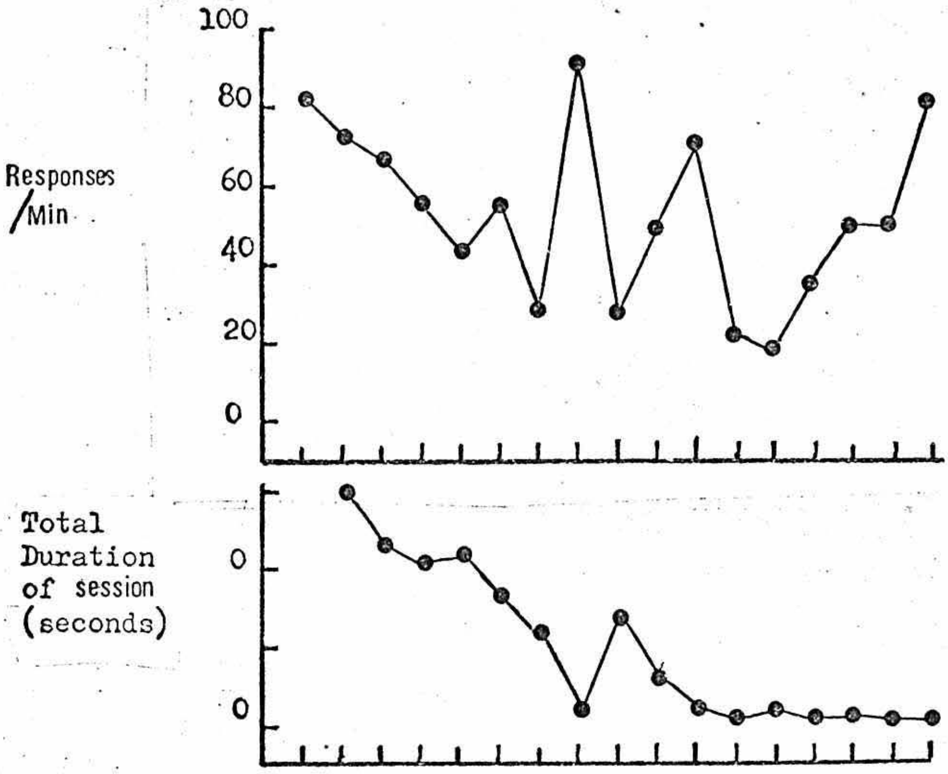


Figure 116. Mean response rates in successive sessions and durations of sessions for Subject 13.

in response rate that occurred, but a gradual decrease in the amount of time she spent in the experimental room before getting up and leaving (see figure 116). Subject 21, who was blind, attended for six sessions in which pop-music was delivered on a fixed-interval 10-seconds session. She produced a steady rate or responding in each session (see figure 117). Following this, however, she refused to enter the experimental room again even though she was tried at intervals over eighteen months and taken there by six different people.

With three subjects something similar to "spontaneous extinction" occurred. Subjects 16 and 23 were given fixed-interval 10-seconds sessions of slide and music presentation. After several sessions the response rate sudden ly declined and even though several different stimuli were tried on a continuous schedule, the rate was not recovered. There was a slight increase in rate for Subject 16, when slides of herself and a picture of a house she had painted were used but this proved not to be durable. The response rates for Subject 16, and 23 are shown in figures 118, and 119 respectively.

A similar "spontaneous extinction" effect was obtained with Subject 19 for whom slides were presented on a fixed-interval 10-seconds schedule. With Subject 19, however, an alternative behaviour (AB_8) was also recorded. Interestingly, when the decline in response rate occurred, there was a corresponding increase in AB_8. This data is shown in figure 120.

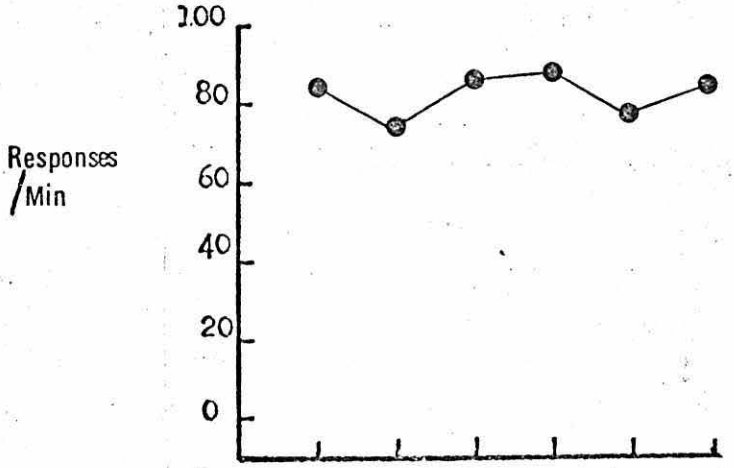


Figure 117. Mean response rates in successive sessions for Subject 21.

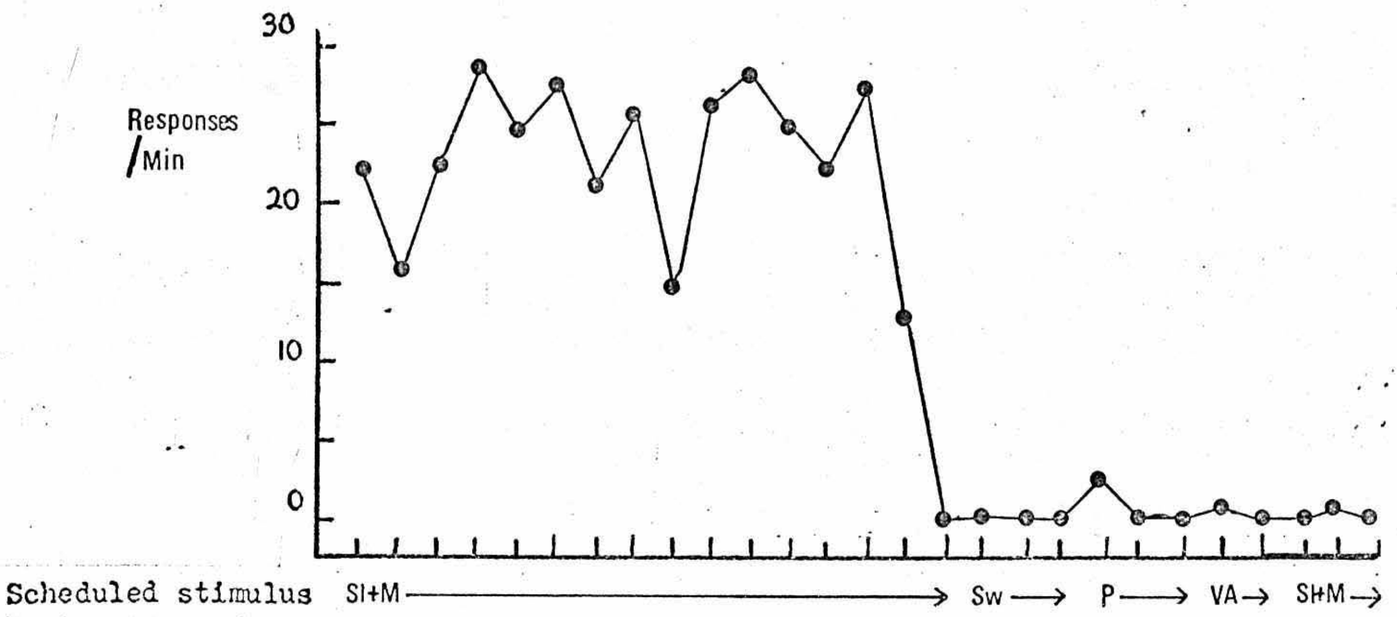


Figure 118. Mean response rate in successive sessions for Subject 16. Slides and music were used initially and later sweets (SW), slides of herself and her pictures (P), and verbal approval (VA) were used as stimuli before slides and music (Sl & M) were reintroduced.

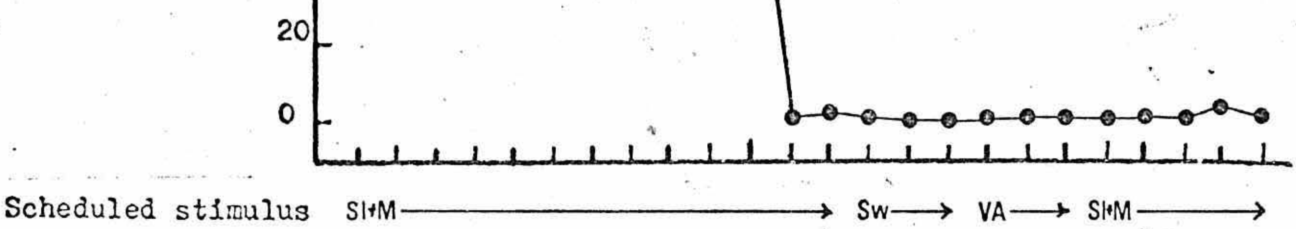


Figure 119. Mean response rates for Subject 23. Slides and music were used initially and later sweets (Sw) and verbal approval (VA) were used as stimuli before slides and music (Sl & M) were reintroduced.

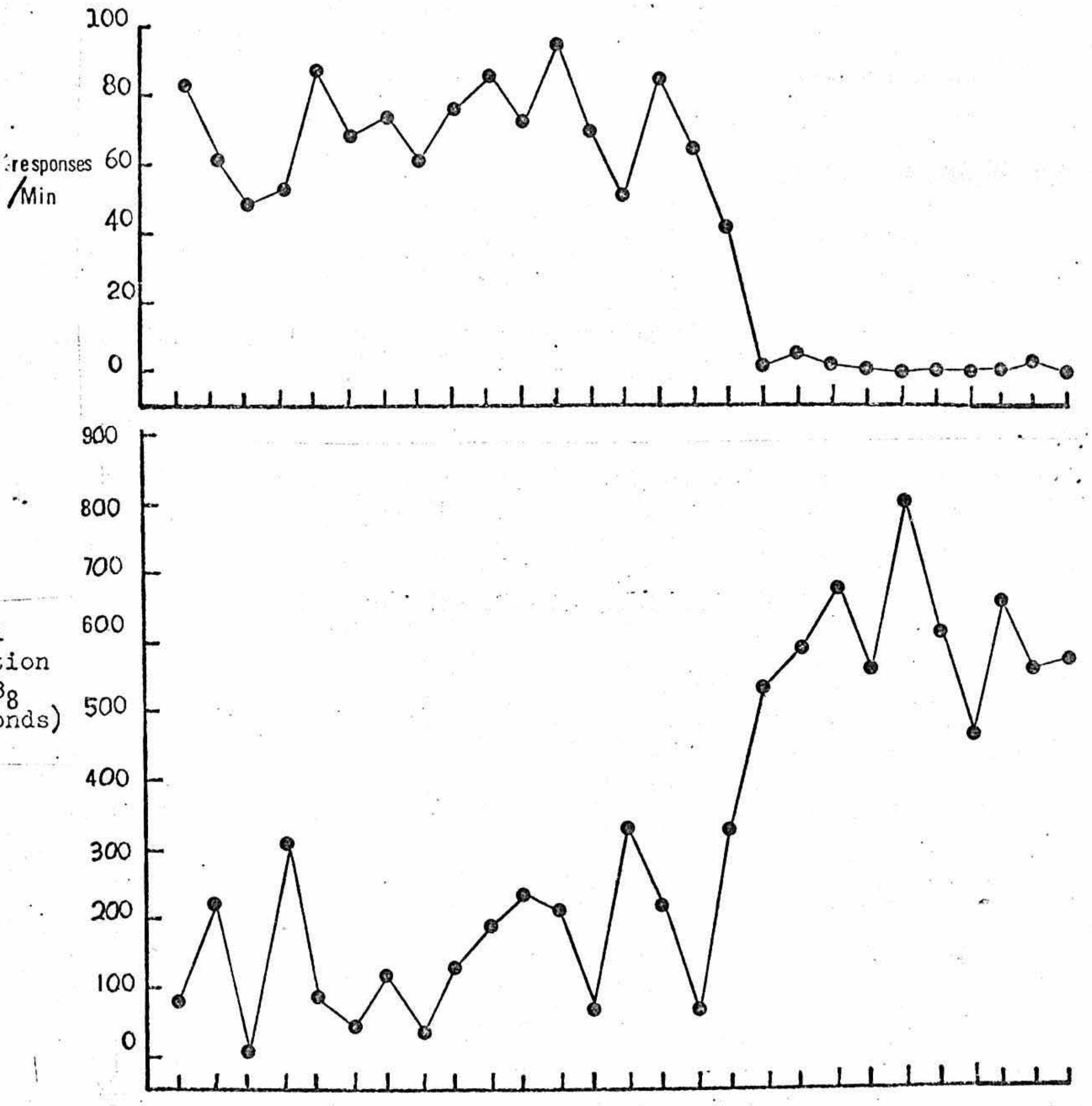


Figure 120. Mean response rates and total durations of AB_8 for Subject 19 in successive sessions.

The author does not contend that the gradual diminution of response rate produced by some subjects (and generally accredited to the gradual decrease in the maintaining function of the stimulus) and "spontaneous extinction" are separate behavioural processes or phenomena.The only distinguishing feature is the rate of decline in the response rate. It could be that both are a function of similar variables and differ only in the rate of change of stimulus function.

APPENDIX II

INTER-OBSERVER RELIABILITY CHECKS
(RAW DATA)

APPENDIX II

INTER-OBSERVER RELIABILITY CHECKS
(RAW DATA)

Three observers helped in the assessment of inter-observer reliability - O_1, O_2, and O_3. The total durations and frequencies of occurrence in inter-stimulus intervals of alternative behaviours recorded by the experimenter (E) and the observers are shown in Table 8.

TABLE 8

Subject	Alternative Behaviour	Observer	Total Durations		Number of occurrences in IS^RT's	
			O	E	O	E.
1	AB_1	O_1	50 secs	58 secs	7	7
		O_1	54 secs	59 secs	17	18
		O_1	8 secs	9 secs	3	3
		O_2	25 secs	29 secs	8	8
		O_3	2 secs	2secs	1	1
1	AB_2	O_1	326 secs	335 secs	22	22
		O_1	399 secs	407 secs	13	13
		O_1	7 secs	8 secs	3	3
		O_2	150 secs	168 secs	6	6
		O_3	108 secs	119 secs	16	16

TABLE 8

Subject	Alternative Behaviour	Observer	Total Durations		Number of occurrences in $IS^R I$'s	
			O	E	O	E
3	AB_3	O_1	10 secs	11 secs	8	8
		O_1	58 secs	62 secs	13	13
		O_2	13 secs	14 secs	6	6
		O_3	90 secs	98 secs	12	12
		O_3	91 secs	96 secs	4	4
3	AB_4	O_1	71 secs	78 secs	15	15
		O_1	80 secs	89 secs	13	13
		O_1	56 secs	66 secs	7	7
		O_2	23 secs	24 secs	4	4
		O_3	17 secs	19 secs	3	3

TABLE 8

Subject	Alternative Behaviour	Observer	Total Durations		Number of occurrences in ISR^{R}I's	
			O	E	O	E
5	AB_3	O_1	197 secs	202 secs	14	14
		O_2	154 secs	168 secs	7	7
		O_2	126 secs	146 secs	3	3
		O_2	196 secs	229 secs	23	27
		O_3	404 secs	427 secs	27	28
5	AB_5	O_1	160 secs	179 secs	11	11
		O_2	18 secs	19 secs	5	5
		O_3	1 sec	1 sec	1	1
		O_3	2 secs	2 secs	2	2
		O_3	7 secs	7 secs	4	4

<u>TABLE 8</u>

Subject	Alternative behaviour	Observer	Total Durations		Number of occurrences in $IS^{R}I$'s	
			O	E	O	E
10	AB_3	O_1	13 secs	14 secs	10	10
		O_2	10 secs	10 secs	7	7
		O_2	3 secs	3 secs	3	3
		O_2	3 secs	3 secs	4	4
		O_3	1 sec	1 sec	1	1
10	AB_6	O_1	3 secs	3 secs	3	3
		O_1	4 secs	5 secs	1	1
		O_2	2 secs	2 secs	1	1
		O_3	7 secs	8 secs	4	4
		O_3	3 secs	3 secs	1	1

TABLE 8

Subject	Alternative Behaviour	Observer	Total Durations		Number of occurrences in IS^RI's	
			O	E	O	E
11	AB_3	O_1	101 secs	133 secs	22	23
		O_1	60 secs	79 secs	22	23
		O_1	49 secs	51 secs	15	15
		O_2	93 secs	103 secs	26	27
		O_3	40 secs	41 secs	11	11
11	AB_8	O_1	91 secs	99 secs	17	17
		O_2	35 secs	41 secs	11	11
		O_3	159 secs	178 secs	17	18
		O_3	151 secs	156 secs	21	21
		O_3	202 secs	204 secs	20	20

TABLE 8

Subject	Alternative behaviour	Observer	Total durations		Number of occurrences in $IS^{R}I$'s	
			O	E	O	E
11	AB_9	O_1	82 secs	88 secs	11	11
		O_2	100 secs	100 secs	10	10
		O_3	155 secs	158 secs	18	18
		O_3	72 secs	75 secs	9	9
		O_3	42 secs	49 secs	10	10
12	AB_{10}	O_1	39 secs	40 secs	10	10
		O_1	70 secs	84 secs	12	12
		O_2	256 secs	287 secs	35	36
		O_3	74 secs	81 secs	16	16
		O_3	139 secs	150 secs	4	4

TABLE 8

Subject	Alternative behaviour	Observer	Total durations		Number of occurrences in $IS^{R}I$'s	
			O	E	O	E
12	AB_{11}	O_1	11 secs	11 secs	6	6
		O_2	28 secs	28 secs	15	15
		O_2	23 secs	24 secs	13	13
		O_2	7 secs	7 secs	4	4
		O_3	6secs	6 secs	3	3
17	AB_3	O_1	15 secs	15 secs	9	9
		O_2	62 secs	68 secs	14	14
		O_2	13 secs	13 secs	12	12
		O_2	2 secs	2 secs	2	2
		O_3	9 secs	9 secs	6	6

TABLE 8

Subject	Alternative behaviour	Observer	Total durations		Number of occurrences in $IS^{R}I$'s	
			O	E	O	E
17	AB_6	O_1	9 secs	9 secs	2	2
		O_2	0 secs	0 secs	0	0
		O_2	10 secs	11 secs	2	2
		O_2	12 secs	13 secs	3	3
		O_3	32 secs	39 secs	13	13
20	AB_3	O_1	203 secs	216 secs	28	29
		O_2	204 secs	220 secs	25	25
		O_2	196 secs	209 secs	32	33
		O_2	39 secs	44 secs	6	6
		O_3	117 secs	123 secs	25	25

TABLE 8

Subject	Alternative behaviour	Observer	Total durations		Number of occurrences in IS^RI's	
			O	E	O	E
20	AB_{12}	O_1	38 secs	45 secs	3	3
		O_2	0 secs	0 secs	0	0
		O_3	17 secs	18 secs	3	3
		O_3	354 secs	385 secs	24	24
		O_3	0 secs	0 secs	0	0
24	AB_6	O_1	14 secs	15 secs	4	4
		O_2	7 secs	7 secs	2	2
		O_3	10 secs	11 secs	4	4
		O_3	21 secs	28 secs	7	7
		O_3	14 secs	16 secs	5	5

TABLE 8

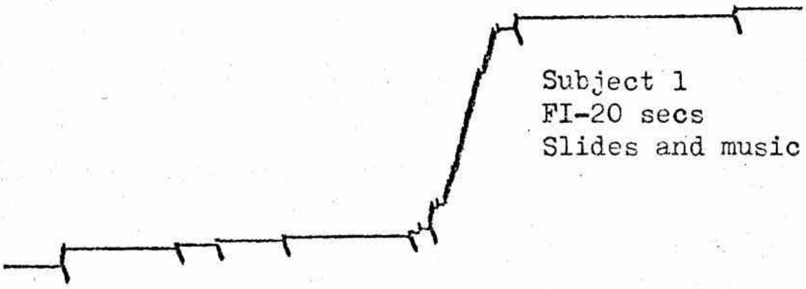
Subject	Alternative behaviour	Observer	Total Durations		Number of occurrences in IS^RI's	
			O	E	O	E
24	AB_{13}	O_1	211 secs	223 secs	31	31
		O_2	571 secs	596 secs	91	94
		O_3	196 secs	206 secs	32	32
		O_3	351 secs	378 secs	39	40
		O_3	327 secs	389 secs	36	36
25	AB_3	O_1	18 secs	19 secs	6	6
		O_2	40 secs	44 secs	35	35
		O_2	45 secs	46 secs	30	30
		O_2	91 secs	97 secs	43	43
		O_3	182 secs	185 secs	41	41

TABLE 8

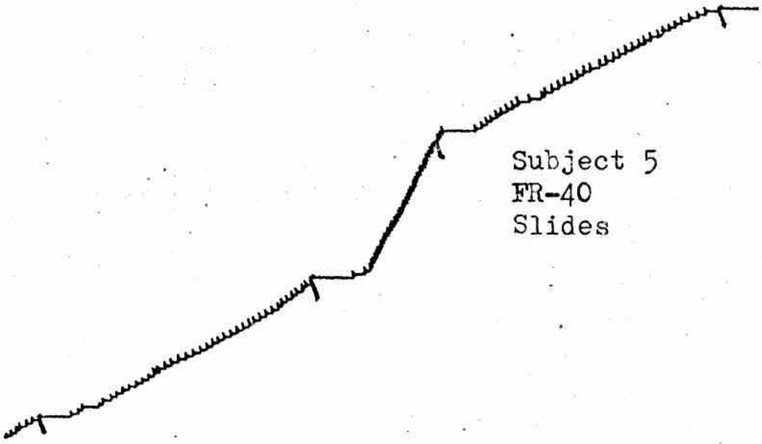
Subject	Alternative behaviour	Observer	Total Durations		Number of occurrences in IS^{R}I's	
			O	E	O	E
26	AB$_3$	O_1	42 secs	45 secs	7	7
		O_2	40 secs	41 secs	11	11
		O_2	133 secs	140 secs	25	25
		O_2	162 secs	176 secs	29	30
		O_3	151 secs	177 secs	38	41
26	AB$_{14}$	O_1	69 secs	81 secs	15	18
		O_2	54 secs	89 secs	22	26
		O_2	72 secs	75 secs	25	25
		O_3	31 secs	46 secs	13	14
		O_3	54 secs	56 secs	25	25

APPENDIX III

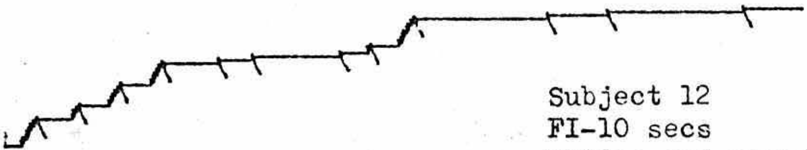
SOME EXAMPLE CUMULATIVE AND EVENT RECORDS



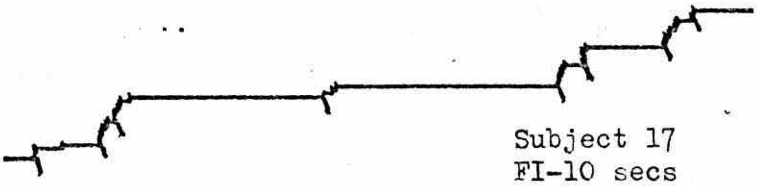
Subject 1
FI-20 secs
Slides and music



Subject 5
FR-40
Slides

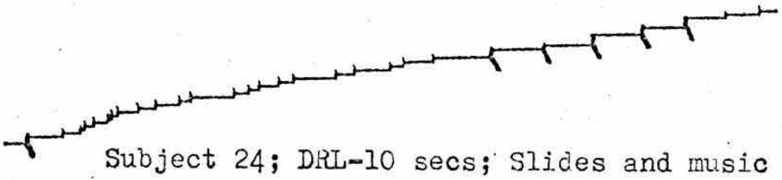


Subject 12
FI-10 secs
Slides and music

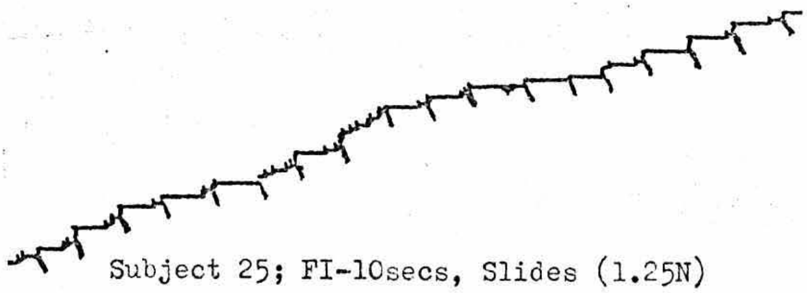


Subject 17
FI-10 secs
Neck-tickle (5 secs)

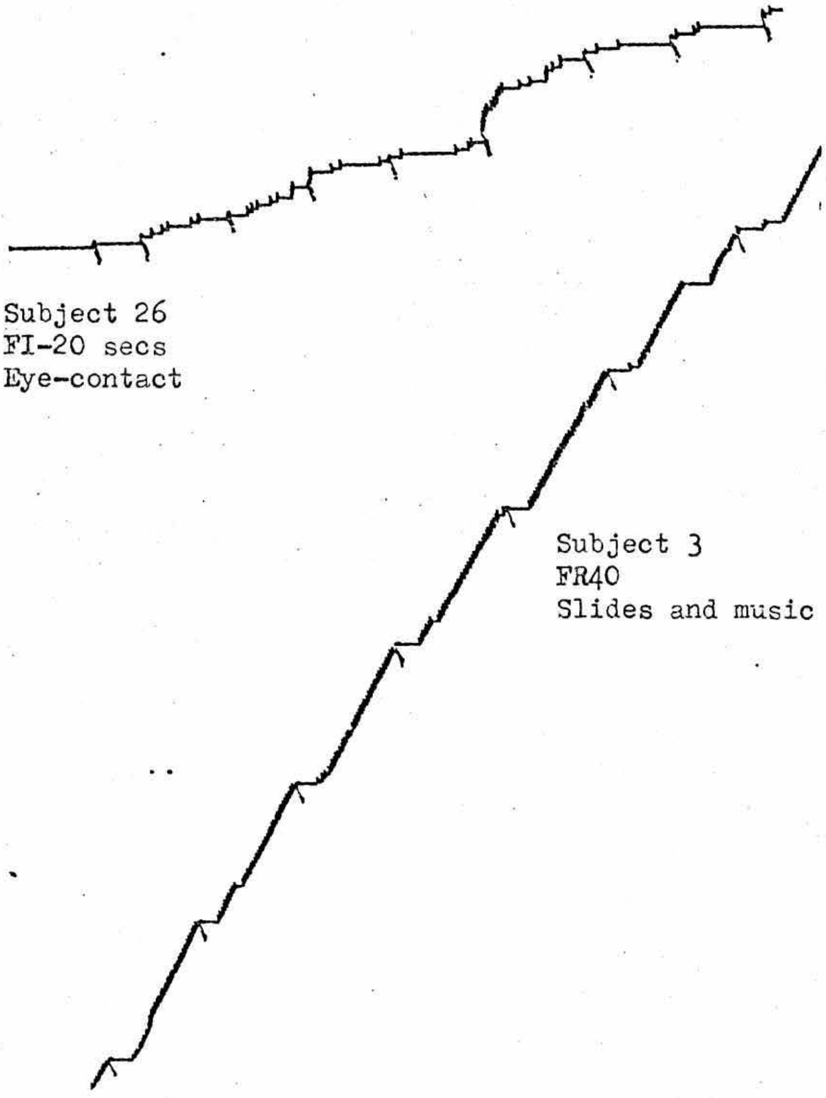
Figure 121.



Subject 24; DRL-10 secs; Slides and music



Subject 25; FI-10secs, Slides (1.25N)



Subject 26
FI-20 secs
Eye-contact

Subject 3
FR40
Slides and music

Figure 122.

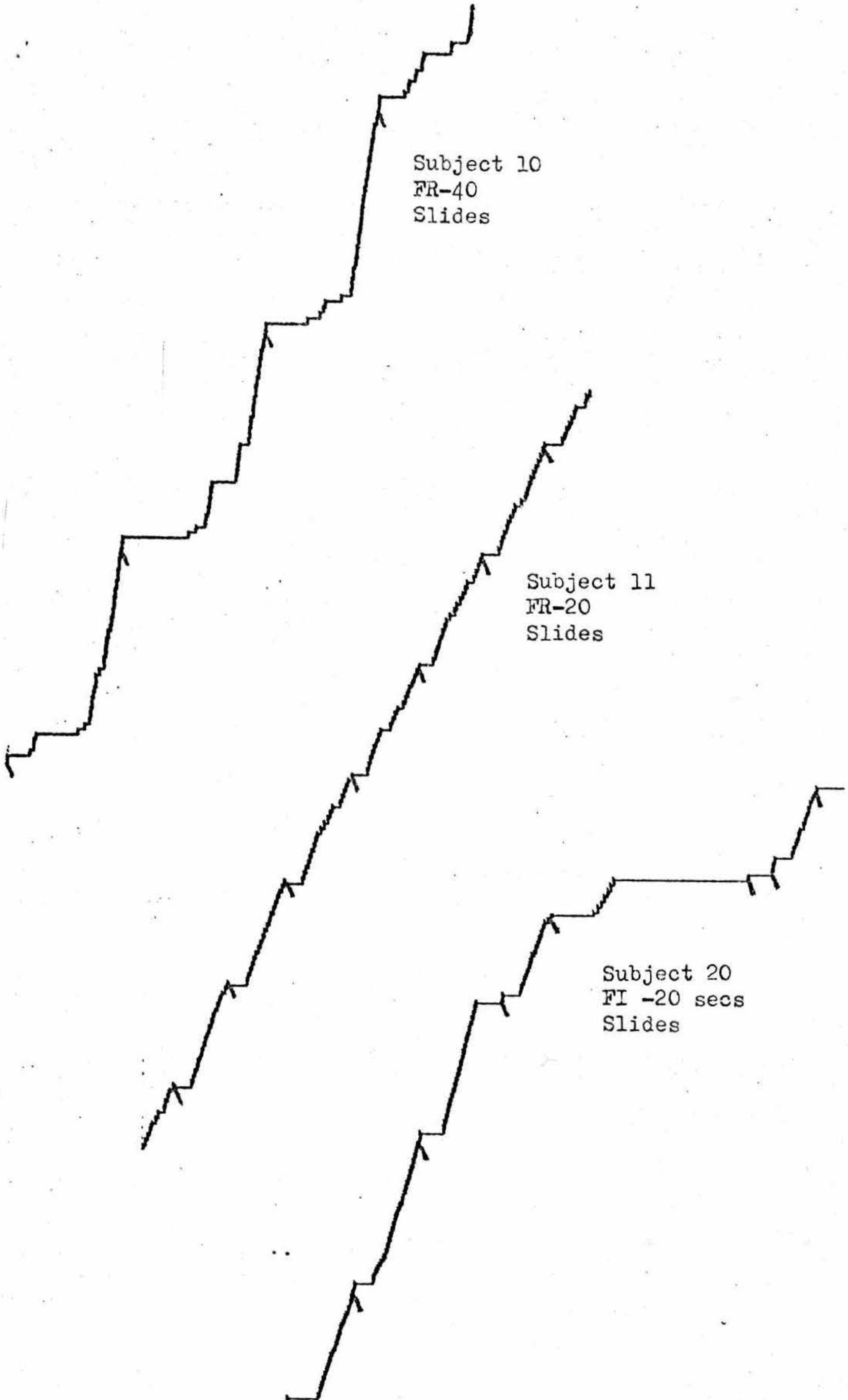
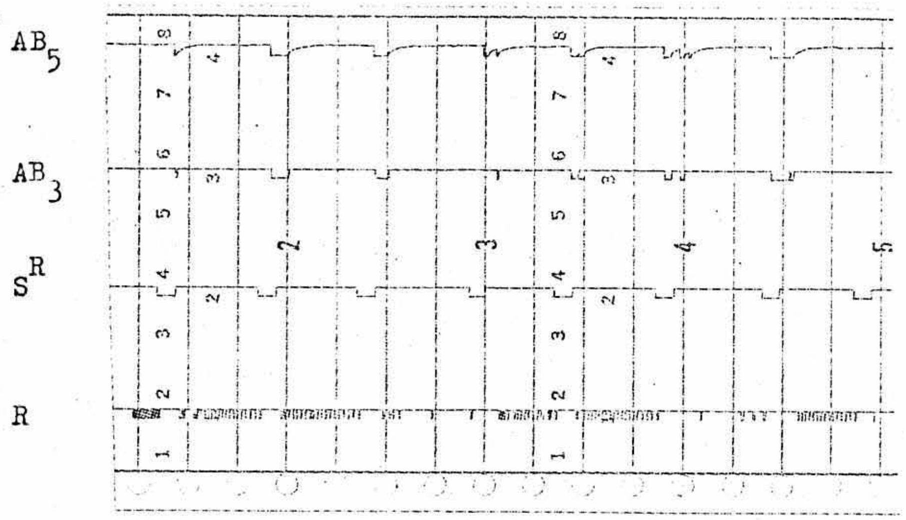
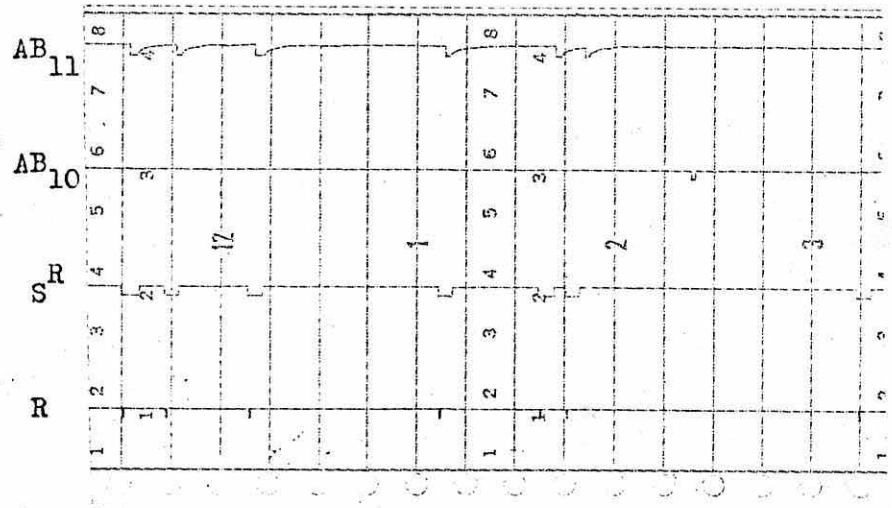

Subject 10
FR-40
Slides
Subject 11
FR-20
Slides
Subject 20
FI -20 secs
Slides

Figure 123

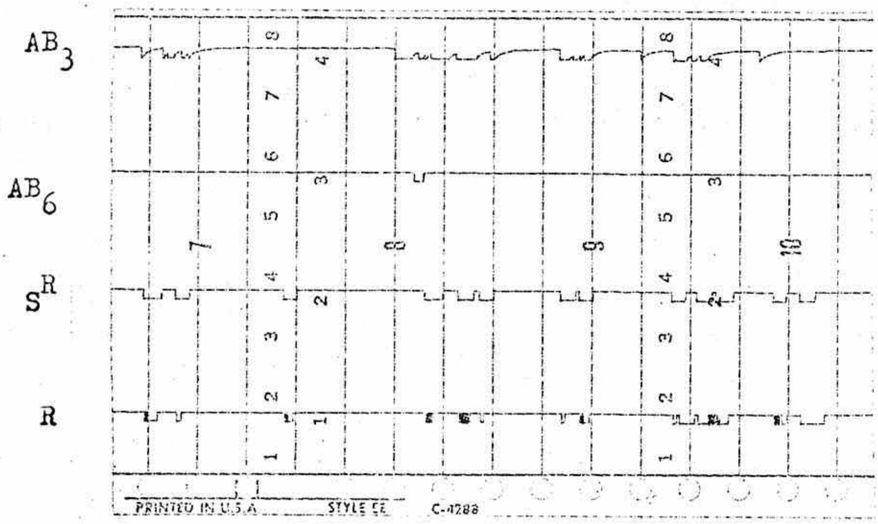


Subject 5; FI-30 secs; slides

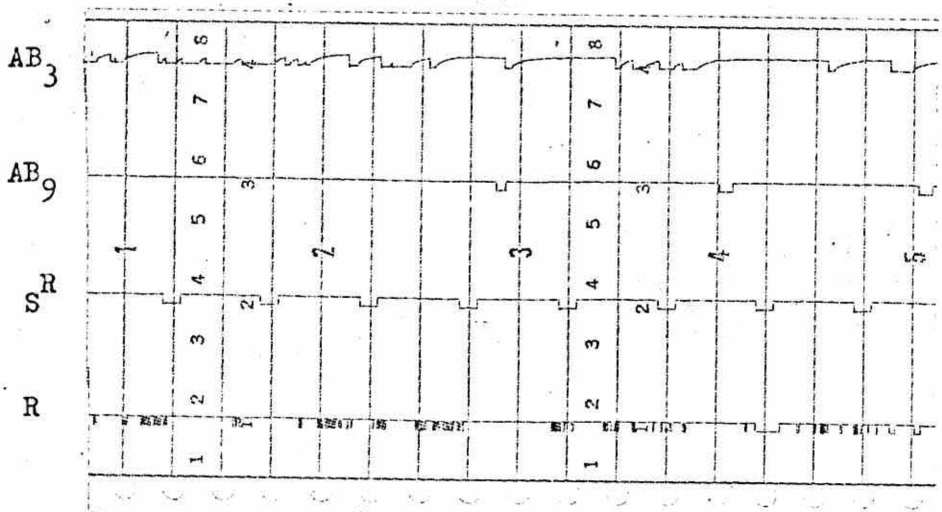


Subject 12, FI-10secs;Slides and music.

Figure 124.



Subject 17, FI - 10 secs; Slides



Subject 11; FT-30 secs; Slides

Figure 125

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