THE USE OF VARIABLE RATIO REINFORCEMENT IN A TOKEN PROGRAM WITH CHRONIC PSYCHIATRIC PATIENTS

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C O N T E N T S

A B S T R A C T

A token reinforcement program, involving verbal participation in a weekly quiz, was established on a ward of 36 chronic, male, psychiatric patients. Variable ratio schedules of 20%, 33%, 66% and 80% were used to observe their effects on verbal response rate, and to compare these rates with 100% CRF and an extinction phase. The results did not lend support to the hypothesis that verbal response rate would vary according to the different VR schedules of reinforcement. However, results did indicate that the VR schedules produced significantly different rates of verbal participation as compared with verbal response rate during 100% CRF and extinction, supporting, in the latter case, an inverse relationship between the ratio of reinforcement and maintenance of responding during extinction. Deficiencies in the experimental design, and implications of the findings in the study, are discussed.

CHAPTER ONE

I N T R O D U C T I O N

A. PROBLEM

The intention of a ward token economy is to rehabilitate chronic psychiatric patients back into the outside community. To this end, token economies in psychiatric wards share three characteristics: first, simple self-care behaviors necessary for effective every-day functioning are specified; second, an exchange unit (the token) is selected, and its presentation made contingent upon the occurence of the specified desired behaviors; third, tokens may be exchanged for the opportunity to indulge in preferred activities (e.g., smoking, reading, etc.). This type of system differs markedly from that of the typical chronic ward, where patients are literally rewarded for doing little or nothing, and which consequently can produce abnormal patterns of behavior, commonly termed "institutionalisation".

In terms of the token economy being an attempt to approximate conditions in the community, an important factor to be considered here is the carry-over of the conditioned behavior from the ward setting to the outside community; in short, is it possible to develop a resistance to extinction within the token system, so that once in the community, the patient will not relapse into an institutional way of life once more?

The purpose of this thesis was to apply variable ratio schedules of reinforcement within a token program, namely a quiz program, and to observe the patients' resistance to extinction of verbal participation, once the tokens had been removed.

B. TOKEN PROGRAMS WITHIN WARD SETTINGS

The advent of ward-based token economy programs within psychiatric hospital settings came about mainly through the very thorough and systematic work of Ayllon and Azrin (1965, 1968). Various criticisms have been levelled against Ayllon and Azrin's work (see Davison, 1969; Kazdin, 1973a) and although they are indeed significant, these criticisms will be referred to at a later point where relevant, and not at this present juncture.

Kazdin and Bootzin (1972) state that

> "as of December, 1969 there were 27 on-going token economy programs within Veterans Administration hospitals alone, involving 937 patients."
>
> (p. 348)

As Liberman (1968) has surveyed major token economy projects in California, so have Turton and Gathercole (1972) in the United Kingdom and Eire. The latter surveyors wrote of eight current token economy programs. These figures give some indication of the efficacy as well as the popularity of token economy systems, and how much projects have spread since Ayllon and Azrin's (1965) research at Anna State Hospital, Illinois.

Prior to their 1965 study, three studies pertinent to the final actualisation of a fully fledged ward wide token program will be briefly mentioned. In 1959, Ayllon and Michael reported the various strategies used by psychiatric nurses to reduce undesirable behaviors among long-term schizophrenic patients. The various ploys used included: stimulus satiation (for hoarding of articles), reinforcement of incompatible behavior (reducing violent behavior by reinforcing normal social approaches), escape and avoidance conditioning (to teach self-feeding, making the spilling of food an aversive stimulus), extinction (ignoring undesirable visits to the ward office), and extinction combined with reinforcement for incompatible behavior (reducing psychotic talk). Positive results were obtained using all of these various strategies.

Ayllon and Haughton (1962) carried out three field experiments on controlling the behavior of hospitalized patients with food. The most relevant of these experiments was that where patients, first, had to drop a coin into a can in order to gain access to the dining room; then secondly, food reinforcement was made contingent upon the patients co-operating with one another through the depressing of two buttons simultaneously in order to obtain the penny required for gaining access. In this experiment, it was noted that situation-appropriate verbal interaction increased among the patients as they dealt with the new problem-solving situation.

Ayllon and Azrin (1964) found that reinforcement was not effective unless the reinforcement procedure was accompanied by instructions that specified the basis for the reinforcement. In order to teach 18 chronic, female, psychotic patients to pick up all the usual eating utensils prior to entering the cafeteria, it was discovered that although instructions alone increased the frequency of desired behaviors to between 40 and 70 percent, instructions (such as "Please pick up your knife, fork, and spoon, and you have a choice of ..." p. 323) together with the reinforcers (extra food) boosted the percentage to between 90 and 100 percent, therefore indicating the superiority of the combination of procedures.

Ayllon and Azrin's (1965) unique and extensive study was based upon the use of Premack's (1959, 1965) principle of reinforcement whereby if Behavior A occurs at a greater frequency than Behavior B, then the frequency of Behavior B may be increased by making Behavior A contingent upon the occurrence of Behavior B. As compared with earlier studies where attention was focused upon a single response or applying the method to a single patient at one time (Ayllon and Michael, 1959; Ayllon, 1963; Wolf, Risley and Mees, 1964), Ayllon and Azrin systematically carried out a ward-based token economy, within a controlled setting, using approximately 45 female mental patients (median age of about 50 years, and median years of hospitalization of about 16 years). In this study (which is elucidated upon by Ayllon and Azrin (1968))

six experiments were reported which demonstrate the effectiveness of the token economy system. Following the Premack principle, the variety of reinforcers was extended considerably to include leave from the ward, privacy, religious services, canteen items, recreational activities, and interactions with staff.

To evaluate the effectiveness of the reinforcement procedures, the within-subject ABA design was used in which the frequency of the target behavior was alternately reinforced and not reinforced in consecutive phases of the experiment. The six experiments showed the following results: (1) that tokens were effective in controlling the voluntary choice of non-preferred jobs; (2) noncontingent delivery of tokens, i.e.,tokens given before patients began their day's work, resulted in a cessation of job attendance, showing clearly the critical nature of the response-reinforcement relationship; (3) the control of on-ward activities of patients was manifested by near-zero work performance when reinforcement was made non-contingent upon on-ward activities; (4) the removal of tokens from the ward economy while still leaving the back-up reinforcers freely available led to significant decline in job performance; ten patients out of 36 continued working in the absence of tokens, albeit at a reduced level. One possible explanation for this phenomenon is that they were attempting to attain social interaction with the attendants (see Ayllon and Azrin, 1968, p. 261); (5) the choice of

preferred or non-preferred jobs was determined by the relative number of tokens being paid for that job, and not by any reinforcement intrinsic to the jobs; (6) the contingencies could be set both by oral and by written instructions from the staff, i.e., orally conveyed instructions played no major role in determining the patients' choice of job assignment, hence one concludes once more the effectiveness of the tokens in the decision-making process.

Ayllon and Azrin (1965) concluded from the results of their six specific experiments that

> "the reinforcement procedure was effective in maintaining desired performance. In each experiment, the performance fell to a near-zero level when the established response reinforcement relation was discontinued. On the other hand, reintroduction of the reinforcement procedure restored performance almost immediately and maintained it at a high level for as long as the reinforcement procedure was in effect."
>
> (p. 381)

Neither the patients' age, IQ, length of hospitalization, nor diagnosis, was a limiting factor in the effectiveness of the reinforcement program.

There are, however, one or two points worthy of note about the Ayllon and Azrin experiments. In the experiment in which on-ward job activities were manipulated, there were a few very regressed patients who remained unaffected by the changes in contingencies; and for all the patients in the same experiment, self-care behaviors seemed almost impervious to the tokens,

indicating a significant amount of intrinsic reinforcement not controlled for in this experiment. Also, Kazdin (1973a) has pointed out that in evaluating the results of token programs, extraneous factors that co-vary with experimental conditions must be carefully considered. One factor relevant to the Ayllon and Azrin experiments is that of the possible co-varying of instructions with conditions. Different instructions preceded each experimental phase, and it would be incorrect to claim that the rapid changes noted in the different experiments were attributed purely to the reinforcement contingencies. Ayllon and Azrin (1964), Packard (1970), and Fernandez, Fisher, and Ryan (1973) indicated how instructions, although generally insufficient to sustain performance relative to contingent back-up reinforcers, are effective in initiating behavior change.

Once the lead had been established by Ayllon and Azrin, token economies increased dramatically in number. Atthowe and Krasner (1968) devised a token program the purpose of which was to

> "change the chronic patients' aberrant behavior, especially that behavior judged to be apathetic, overly dependent, detrimental, or annoying to others". (p. 37)

Sixty predominantly chronic schizophrenic male patients were studied over a period of two years. The actual token economy was instituted for a period of eleven months; during this time, patients were

given explicit instructions about change in routine, including explanations of the contingencies for various behaviors. As the patients progressed, delay in reinforcement was instituted, viz., tokens were distributed on a weekly basis rather than immediately following an activity. A unique feature of this token system was that of permitting patients to earn their way off the system. Target behaviors within the system were varied, e.g., bed-wetting, shaving, dress, aggressive behavior, etc.

In this within-subjects design significant increases were observed in attending group activities, going on passes, utilizing the ward canteen, self-care behaviors and so on. Although social interaction was not one of the target behaviors, the authors found that this behavior was significantly increased after the introduction of a token economy. For ten percent of the sample, the tokens had no appreciable effect and the authors note that these patients had previously been " 'catatonically' withdrawn and isolated" (p. 41). (See also Krasner, 1970.)

Schaefer and Martin (1966) also attempted to modify social interaction and apathy, and their study is of particular interest because it is one of the few in which a randomly assigned group was included. (Compare Samuels and Henderson, 1970.) The three behaviors to be changed were personal hygiene, social interaction, and work performance. Lists of individual

behaviors were also drawn up and the respective contingencies and manner of reinforcement were specified. Over a three month period, results indicated that patients on contingent token reinforcement significantly decreased on apathy ratings (as observed by the nursing staff) over time and were significantly more improved than the control patients at the conclusion of the study. Details of this program are given in Gericke (1965), Bruce (1966), and Schaefer and Martin (1969). Gericke describes how, early in the program, some patients worked so much that it became necessary to introduce a variable ratio schedule of token reinforcement. Gericke wrote that,

> "since our long-term goal is to wean the patients away from the artificial support of token reinforcement, we welcomed every opportunity to introduce a variable ratio reinforcement; we replaced tokens by other types of reinforcement, such as friendly praise from the nurse to a patient for doing a job well."
>
> (p.6)

Other ward token systems include those set up by Steffy, Hart, Craw, Lorney, Marlett, and Marlett (1969) on a closed ward at a psychiatric hospital in Toronto; Ellsworth (1969) describes a token program for patients on a locked ward; Henderson (1969, 1970, 1971) devised a token economy for psychotic men, using a "dual reinforcement" procedure whereby inappropriate behavior was fined and positive verbal and motor behavior rewarded, the tokens being delivered on a fixed interval basis. In his latter studies,

Henderson (1970, 1971) set up a token program within the community, thus permitting the use of community resources. Lloyd and Abel (1970) and Lloyd and Garlington (1968) set up a token economy for 52 chronic schizophrenic patients, and in the latter study contingencies were varied for self-care behaviors showing that although

> "the absolute magnitude of the changes between the different experimental conditions was not great, it was consistent both within and between patients",
>
> (p. 409)

thus indicating that the program exerted some control over the behavior. Hunt, Fitzhugh and Fitzhugh (1968), Roberts and Perry (1970), and McConahey (1972) have established token systems with mental retardates on a ward basis.

Finally, Winkler (1970a, 1970b, 1971) established a token system for the reduction of institutionalized behavior in a ward of 66 female patients, the majority of whom were diagnosed as chronic schizophrenics, with a mean age of 49 and an average period of hospitalization of twelve years. This study demonstrated the control of the tokens when made contingent upon behaviors such as attendance at morning exercises, self-help skills, and coming to meals. Behavior which was recorded but not under token contingencies, particularly violence and noise, was found to decrease after the program was in effect. Fines were also used

to demonstrate the effectiveness of the program. In separate experiments the control of the system was indicated by a return of the target behaviors when tokens were discontinued, made non-contingent, or when fines were lifted. Individual reinforcement schedules were also utilized within the total token system (Winkler, 1971).

The studies quoted above illustrate amply the efficacy of the token reinforcement system. However, as mentioned before, there are a number of methodological weaknesses in several of the above studies (see Kazdin and Bootzin, 1972; Davison, 1969; Kazdin, 1973a); for example, the confounding of instructions and reinforcement contingencies, the lack of control groups, the absence of reversal designs, and so on. However, these faults cannot detract from the overall remarkable effectiveness of the token reinforcement program, and the very positive benefits that patients derive from such a system. Studies such as that of Schaefer and Martin (1966) go far to overcome some of the more major faults within the designs of token programs, for not only did their controls receive tokens and live on the same ward as the experimental subjects, they also received contingent praise for desirable behaviors. More recently Shean and Zeidberg (1971) carried out a similarly designed experiment to that of Schaefer and Martin. In the latter study, a token economy was established in a chronic, male, psychiatric ward, with a control group matched for

age, diagnosis and length of hospitalization established in an identical ward in the same hospital. These two groups were compared on ward behavior rating scales and other indices of behavioral adjustment. Results indicated significant improvement on rating scales and other indices for the experimental subjects.

C. A BRIEF HISTORY OF THE DEVELOPMENT OF THE TOKEN SYSTEM

Token reinforcement studies began experimentally in the mid-1930's when Wolfe (1936) and Cowles (1937) taught chimps to place chips or tokens in a slot to obtain grapes. They found that the chimps were able to learn a weight-lifting task with only poker chips as reinforcers, and thus they established that the tokens acquired secondary reinforcing properties.

Kelleher (1958) further demonstrated, using fixed ratio reinforcement, that chimps would learn tasks when tokens which were exchangeable for food were made contingent upon correct responses. It was found that these tokens were powerful discriminative stimuli as well as conditioned reinforcers.

Kelleher (1957) also trained chimps on a fixed interval schedule of token reinforcement under which they were required to accumulate groups of tokens before exchange. The data obtained in both the above studies by Kelleher were very similar to those obtained

with pigeons on extended chained FI and FR schedules. In fact, Kelleher (1966) considers schedules of token reinforcement to be special cases of long behavioral chains (chained schedules) in which the delivery of the tokens acts as a reinforcer at the end of each component.

Since these early studies using token reinforcement techniques, there has been, over the last decade or so, a proliferation of research on token systems and the therapeutic effects of token economies. The basić principles behind token reinforcement systems have been in operation for centuries, e.g., in 1529 Erasmus advocated cherries and cakes as rewards in teaching children Latin and Greek (Skinner, 1966), and Maconochie made use of a "mark system" at the Norfolk Island convict settlement in the 1840's (Eysenck, 1970). However, despite the centuries-old use of these principles, it has only been within the last two decades or so that an attempt has been made to distribute such rewards on a systematic and frequent basis. The early studies by Wolfe and Cowles may be regarded as a starting point for research in this area; since that time research techniques have become increasingly more sophisticated and thorough, so that now token reinforcement techniques are being applied not merely to one or two infrahuman subjects but to whole wards in mental institutions, to school classrooms, to corrective centres, adolescent units, and many other settings.

As Atthowe (1973) states,

> "whether the goals of token programs have been easier management, habilitation or rehabilitation or whether the population of customers were chronic or acute psychotics, felons, the physically disabled or problem and normal children, the conclusion remains that contingent, token reinforcement programs are powerful techniques for modifying on-going behavior when properly applied."
>
> (p. 646)

The background of the token economy program lies primarily in the early operant work of Skinner (1938). Working with animals in the experimental laboratory, laws of behavior were derived which apply to organisms from lowest to highest. The basic ingredient of the operant conditioning paradigm is the use of environmental cues to reinforce behavior with a view to strengthening desirable behavior. Probably its first deliberate application to disturbed or deviant behavior was Fuller's (1949) operant conditioning of a "vegetative idiot", where, via successive approximations with sugar-milk as reinforcer, he shaped the movement of the right arm.

Present day studies, using the token reinforcement technique, are far removed, in terms of complexity, from that of Fuller's application of basic operant laws of behavior. Thus, a brief review will be made of some of the other areas in which token systems are used.

Since their introduction, there have been a

number of reviews of the therapeutic use of tokens (Atthowe, 1966; Ball, 1969; Burchard, 1967; Davison, 1969; Kazdin and Bootzin, 1972; Kelleher and Gollub, 1962; Krasner, 1968; Liberman, 1968; Lloyd and Abel, 1970; O'Leary and Drabman, 1971; Schaefer and Martin, 1969), as well as reviews on the methodological techniques (Kazdin, 1973a; O'Leary and Drabman, 1971). The proliferation of literature on the use of token reinforcement procedures is also exemplified by bibliographies on this subject (Kazdin, 1972; Krasner, Atthowe and Silva, 1969).

(i) Token Reinforcement in the Classroom

Token reinforcement programs in classrooms have increased rapidly in number and popularity as a therapeutic procedure. When the instruction to teachers to use attention, praise and approval as social reinforcers (Ward and Baker, 1968; Becker, Madsen, Arnold and Thomas, 1967) has failed to alleviate classroom problems, token systems have often proven to be a more effective technique. O'Leary and Drabman (1971) carried out an extensive review of classroom token programs, hence just a sample of relevant studies will be cited here.

It was probably the study by Staats, Finlay, Minke, Wolf and Brooks (1964) that initiated the classroom token systems that have been reported over the ensuing years. In this study, four-year-old

children were presented with stimulus materials for discrimination and reading tasks, and for correct responses were reinforced with tokens which could be exchanged for a wide variety of edibles and toys.

Since 1964, token systems have been employed for a multitude of problems within the classroom setting. O'Leary and Becker (1967) were the first to use a token reinforcement program to control a large class of emotionally disturbed children. Over the two-month token period disruptive behavior was reduced by more than 60%. However, there was in this study a confounding of the effects of increased teacher attention and instructions with the token reinforcement contingencies. Other studies involving an attempt to decrease disruptive behavior include those by Hall, Panyan, Rabon and Broden (1968), Kuypers, Becker and O'Leary (1968), McLaughlin and Malaby (1972), Meichenbaum, Bowers and Ross (1968), and O'Leary, Becker, Evans and Saudargas (1969).

Token systems have also been used to increase study behavior (Bushell, Wrobel and Michaelis, 1968; Broden, Hall, Dunlap and Clark, 1970), to increase academic achievement (Birnbrauer, Wolf, Kidder and Tague, 1965; Hewett, Taylor and Artuso, 1969; Wolf, Giles and Hall, 1968), and to increase ontask behavior (Walker and Buckley, 1968). As is the case with token programs within psychiatric settings, changes in behavior, other than the actual target

behavior, have also been noted within classroom programs. For example, O'Leary et al. (1969) found that during the token phases of their study, attendance appeared to be improved; and Wolf et al. (1968) found that children were in favour of having a remedial token program on regular school holidays.

(ii) Token Reinforcement with the Mentally Retarded

Token reinforcement programs are becoming an increasingly common method of therapeutic intervention with the mentally retarded.

Girardeau and Spradlin (1964) carried out one of the earliest ward-wide token programs at the Parsons State Hospital, where a group of moderately and severely retarded girls were reinforced with tokens for several self-care, grooming, and social behaviors. Individualized criteria for performance were set to reward improvement, and individualized contingencies were used for behavior problems of particular individuals. After four-and-one-half months of the token program, significant progress was noted. Other token programs designed for self-care behaviors include studies by Musick and Luckey (1970), Roberts and Perry (1970), Bourgeois (1968), and Hunt, Fitzhugh and Fitzhugh (1968).

Within the workshop setting, token programs are

also proving effective (Hunt and Zimmerman, 1969; Logan, Kinsinger, Shelton and Brown, 1971; Zimmerman, Stuckey, Garlick and Miller, 1969). In the study by Zimmerman et al. (1969), it was made evident that feedback (the number of tokens they would have earned if the token program had started) alone can improve performance, but that token reinforcement increases performance even further. In effect, a differentiation was made between the information value of tokens and their reinforcement value.

(iii) Token Programs with Autistic and Schizophrenic Children

Operant techniques have for some time also been applied to autistic and schizophrenic children with, in most cases, very effective results. The first attempts using operant procedures with autistic children were by Ferster and DeMyer (1961, 1962). In these two studies, the authors were attempting to carry out an experimental analysis of behavior rather than a basic therapeutic intervention. Bartlett, Ora, Brown and Butler (1971) demonstrated the control exerted by tokens over the psychotic speech of a twelve-year-old autistic child. Martin, England, Kaprowy, Kilgour and Pilek (1968) used a token reinforcement program with ten autistic children in order to train them to function as a group in a kindergarten class under supervision of one teacher. After sixty three-hour sessions, the children would

sit quietly in a classroom, respond to various comments, commands and questions, and some of the children would carry out specific tasks with a minimum of supervision from one teacher. Recently, Fjellstedt and Sulzer-Azaroff (1973) reduced the response latency of following directions of an emotionally disturbed eight-year old boy by means of a token system.

The efficacy of token reinforcement programs is clearly established in the areas of research cited above, but there are other areas where token programs have established their worth: delinquents and pre-delinquents (Bailey, Wolf and Phillips, 1970; Boren and Colman, 1970; Burchard, 1967; Lachenmeyer, 1969; Phillips, Phillips, Fixsen and Wolf, 1971; Tyler, 1967; Tyler and Brown, 1968); weight reduction (Harmatz and Lapuc, 1968; Upper and Newton, 1971); marital treatment (Stuart, 1968, 1969); remedial reading (Staats, Minke and Butts, 1970); self-recording within a token economy structure (Knapczyk and Livingston, 1973); stuttering (Ingham and Andrews, 1973; Rickard and Mundy, 1965; Browning, 1967); the reduction of social withdrawal (Walker and Hops, 1972); reduction of neurotic symptoms (Hersen and Eisler, 1973; Agras, Leitenberg, Wincze, Butz and Callahan, 1970); school dropouts (Clark, Lachowicz and Wolf, 1968); parent use of tokens within the home setting (Christophersen, Arnold, Hill and Quilitch, 1972; Tharp and Wetzel, 1969; Stuart, 1971); deconditioning

of delusional responses (Patterson and Teigen, 1973); nursery school children (Baker, Stanish and Fraser, 1972); and alcoholics (Narrol, 1967).

D. MANIPULATION OF VARIOUS REINFORCEMENT SCHEDULES WITHIN TOKEN PROGRAMS

Despite the fact that token economies have now been in existence for some ten years or more, studies involving the systematic manipulation of the various schedules of reinforcement have been almost non-existent. Continuous reinforcement appears to be the order of the day with most token programs, and few researchers have shown any inclination to investigate just how the various schedules of reinforcement influence the patterns of response of patients involved in token programs. As Kazdin and Bootzin (1972) point out in their review of token economy systems,

> "although there is abundant literature on the effects of schedules of reinforcement on extinction, schedules are seldom varied in token economies. So little is known about the effects of schedules of reinforcement in token economies, that it is an obvious next step for research in the area. This is particularly so since reinforcement is seldom dispensed according to a ratio schedule. In the typical token economy, much behavior both appropriate and inappropriate, goes undetected."
>
> (p. 363)

In contrast to this statement, the attitude of

Ayllon and Azrin (1968) typifies the above situation:

> "Although much is known about schedules of intermittent reinforcement, most of this information appeared to be irrelevant to the practical objective of providing miximum motivation, since non-intermittent reinforcement was found in practice to be most effective."
>
> (p. 17)

Schroeder (1972) states,

> "if the principles of scheduling are to be of more than incidental use in applied behavior analysis, research must be done that relates reinforcement parameters found in the laboratory to field situations."
>
> (p. 431)

Studies of schedules of reinforcement involving human subjects are not common. Staats et al. (1964) investigated the reading responses of children under several reinforcement schedules and reported that, generally, higher response rates were produced under intermittent schedules. The Staats et al. study was one of the first attempts to apply a variable ratio (VR) schedule to human behavior. Orlando and Bijou (1960) also used this schedule in their work with developmentally retarded children, and Salzinger et al. (1962) reported applying the same schedule to speech rate in normal children.

In 1958, Long, Hammack, May and Campbell undertook a comprehensive investigation of the effects of various schedules of reinforcement (fixed ratios, fixed intervals, and variable intervals) on the operant behavior of normal children. Analyses of the

schedule data indicated that in most instances the performance of children was similar to that reported in animal studies; hence, it was concluded that experimental control can be gained over the behavior of children, as that of lower organisms.

Orlando and Bijou (1960) used the four basic schedules and two multiple schedules with 46 institutionalized retarded children, and observed that the patterns of behavior generated by each type of schedule closely approximated that of infrahuman subjects. Higher response rates were associated with lower ratios, longer intervals, and variable rather than fixed schedules. With reference to performance under the VR schedule, the retarded subjects produced high rates of responding roughly proportional to the size of the ratio; pauses were infrequent, short, and random with respect to time of reinforcement. These characteristics were quite resistant to change when a shift of schedule occurred.

Ellis, Barnett and Pryer (1960) found that even defectives with IQs of below 30 were sensitive to schedule changes (the schedules used being fixed interval, and fixed ratio). Spradlin, Girardeau and Corte (1965) observed similar control of reinforcement schedules (FR and FI) over an operant knob-pulling response with severely and profoundly retarded subjects. Once again, the responses of the subjects on FR schedules generally resembled those of a lower

organism; subjects on an FI schedule made far fewer responses than did those on a ratio schedule.

Lindsley (1956) and Lindsley (1960) found with psychotic adults that the sum of pauses greater than ten seconds was related to the depth of psychosis. The data in the Ellis et al. (1960) study indicated that this particular measure may be related to intelligence level. They concluded that the overall rate of responses was related to chronological age and mental age; and that such subjects can be sustained for long periods on very high ratios for edible or cigarette rewards.

FR schedules were used by Hutchinson and Azrin (1961) to establish a conditioned response with five chronic psychotic patients and in this study, too, the results closely resembled those of infrahuman subjects (Ferster and Skinner, 1957) and normal humans (Holland, 1958). The temporal pattern of responding was generally bivalued, i.e., the subjects either responded at a very high rate, or not at all. It was also observed in accordance with animal studies, that the overall rate of responding increased as the number of responses required for reinforcement was raised.

Ferster and DeMyer (1961) brought under control the behavior of two autistic children using food and token reinforcement on FR and VI schedules of reinforcement. Both schedules produced characteristic results. Tokens were administered on a VI:8(mins) by

Broden et al. (1970) to increase study behaviors and reduce inappropriate behavior within a special education class. Gradually the VI schedule was extended so that study for the entire class interval was required for reinforcement. Wolf et al. (1970) used a VI:20(secs.) schedule to signal token reinforcement for in-seat behavior, a reversal design indicating that the timer controlled the behavior of most students. Meichenbaum et al. (1968) employed an FI:10(mins) to supply feedback (slips of paper) indicating frequency of appropriate behavior for a group of female adolescents, these slips later being exchangeable for money. Tokens were also delivered on an VI basis by Henderson (1969) to reward positive verbal and motor behaviors with psychotic males.

Evans and Spradlin (1966) observed twelve retarded males on an experimental task, using three contingency phases (FR:50, noncontingent reinforcement, and the reinstatement of FR:50). The number of responses was significantly higher under the ratio schedule; however, responding was quite high under noncontingent reinforcement, and also instructions to perform the response without presenting reinforcement led to a high rate of responding.

Zifferblatt (1972) studied the effects of three schedules of reinforcement (FR 1:1, 3:1, and 5:1) on two complementary dependent variables, work and social behavior. Results indicated that token

reinforcement produced higher rates of social behavior while both token and social reinforcements were equally effective in controlling work behavior. As the investigation progressed, social reinforcement at FR5:1 schedule appeared to have difficulty maintaining rate control for both work and social behavior, probably because of ratio strain. However, there was no rate decrements for token reinforcement at FR5:1. The strength of token reinforcement over social reinforcement was indicated both at higher ratio schedules as well as producing higher rates of social behavior at all ratio schedules. Zifferblatt cautions the reader, however, by suggesting that the social reinforcement history of this group of patients (behavior disorders) may be quite different from that of a normal population. It is worthy of note that Barton (1972) showed the superiority of token reinforcement over candy reinforcement also, in the operant conditioning of social speech with severely retarded women.

Ballagh (1973) compared the effects of different FR schedules of reinforcement with continuous reinforcement with a group of chronic, male psychiatric patients. The results did not fully support the hypothesis that an inverse relationship exists between the percentage of reinforcement and resistance of responding to extinction. However, a number of factors were cited as possible contributors to the results obtained, particularly the unequal difficulty

of the questions used in the quiz sessions, which constituted the token program.

E. CHARACTERISTICS OF THE VARIABLE RATIO SCHEDULE

When a VR schedule is in effect, the number of responses required for reinforcement varies unpredictably. The value of a variable ratio is the average, or mean, number of responses per reinforcement. VR schedules produce a variety of performances, depending upon the distribution of the number of responses required for reinforcement. During maintenance, very high and nearly constant rates of responding are produced by VR schedules - the more rapidly one works the more frequently one is reinforced. Large amounts of work per reinforcement can be tolerated; however, to avoid premature extinction, the organism must approach such conditions gradually by first being exposed to less stringent requirements. An important feature with respect to ratio reinforcement is that it does not have self-corrective properties; any reduction in response rate simply delays reinforcement, and hence the less one responds the less one gets, and therefore the less one responds in the future.

During extinction after VR reinforcement, depending on the distribution of ratios, a very high number of responses at a high sustained rate may be emitted. The effectiveness of partial compared with continuous reinforcement has been well established,

and as Jenkins and Stanley (1951) have stated:

> "The practical question of how best to build a response to withstand elimination in the absence of primary reinforcement is clearly answered by these data: Administer the reinforcements according to a partial regime".
>
> (p. 222)

The effectiveness of partial reinforcement applies across widely differing organisms as exemplified by Fisher and Cole (1968), Melvin and Baumeister (1969), and Baumeister and Hawkins (1966).

F. STUDIES OF VARIABLE RATIO REINFORCEMENT.

Several studies already mentioned have used the VR schedule effectively with various populations (Staats et al., 1964; Orlando and Bijou, 1960; Salzginer et al., 1962).

In 1958, Kanfer investigated the effect of reinforcement schedules and differences between experimenters on verbal responding and concluded that,

> "with regard to economy of the reinforcing operations, it was found that maintenance of a high response rate could be achieved with only about half as many reinforcements under a ratio schedule as under interval schedules."
>
> (p. 450)

Schroeder (1972) arrived at the same conclusion after having manipulated contingencies of reinforcement in an automated Sheltered Workshop. The data indicated that the use of ratio rather than interval

schedules was more effective in maintaining behavior when the required effort per response was low. As Schroeder points out, with ratio schedules, the average frequency of reinforcement depends on the average inter response time which, in turn, is determined by rate of responding by the subject. Thus, the subject can increase reinforcement rate even though the value of the ratio is increased.

Although intermittent reinforcement has been studied extensively both in the laboratory and in the field, few studies have examined such reinforcement in the context of token economy programs. Investigators have reported variation of reinforcement schedules during acquisition, as illustrated in a number of the studies already mentioned, but few have reported the effect of the schedules on performance in extinction.

Spradlin (1962) studied the effects of different percentages of reinforcement (50, 75, and 100 per cent) on extinction in severely mentally retarded children. The group receiving 100% reinforcement showed significantly faster extinction than the other two groups. The other groups did not differ significantly from each other in extinction. Spradlin gave several possible explanations for this lack of difference: that the percentage differences used were not large enough to produce the expected results, that severe retardates may require larger percentage differences than normals to show varying extinction rates, and that severe retardates require

more trials than normals to establish a differential reaction to percentages of reinforcement.

Dispensing tokens on a VR schedule for appropriate personal appearance behaviors, Hunt, Fitzhugh and Fitzhugh (1968) report that four of the twelve subjects showed improvement, appearance being better under intermittent rather than continuous reinforcement. (As for the remaining subjects, it is difficult to ascertain what the results indicate.) Haring and Hauck (1969) used continuous reinforcement followed by VR reinforcement, which was gradually thinned, to improve the reading skills of four elementary school boys. Performance under VR reinforcement was higher than for the baseline, but significantly lower than performance under continuous reinforcement for two of the subjects.

Within a token economy program, Winkler (1970b) used a VR schedule of 50% partial reinforcement on certain specified behaviors while other behaviors remained under continuous reinforcement. During extinction both the partially and continuously reinforced behaviors failed to diminish significantly.

Atthowe (1971) states that in order to increase the resistance of a response to extinction within the token economy paradigm, we must include such techniques from the experimental laboratory as,

> "intermittent reinforcement to maintain the habit after it has

> been established, overlearning, the creation of a variety of conditioned reinforcers, increasing the amount of work or gradually lengthening the chain of behaviors required to attain the reinforcement, ... (and) ... gradually reducing the magnitude of the reinforcer." (p. 2)

Two studies which indicate some degree of awareness of these problems are those of Gericke (1965) and Kazdin and Polster (1973).

Gericke's report, which is mentioned earlier, discussed the necessity to increase the number of responses needed to earn one token, thus in effect placing the patient on a VR schedule since he never knew exactly when or how much he was getting paid. Although this was indeed logical strategy, no extinction period was reported from this ongoing program and hence it is difficult to evaluate the exact impact of such a schedule. Kazdin and Polster, also working within an ongoing token program, investigated the use of intermittent reinforcement to enhance maintenance of social responses developed through token reinforcement. When reinforcement was withdrawn, the subject on the VR schedule continued to interact socially with peers whereas the subject previously on continuous reinforcement did not. In fact, resistance to extinction continued for a period of five weeks.

The intention of this thesis was to investigate further the use of variable ratio

schedules in a token reinforcement program and to observe the effectiveness of these schedules on resistance to extinction.

CHAPTER TWO

M E T H O D

A. RATIONALE

The efficacy of the token reinforcement program within psychiatric settings has been well established (Ayllon and Azrin, 1965; Lloyd and Abel, 1970), as has the secondary reinforcing properties of the token itself (Wolf, 1936; Barton, 1972).

Similarly, intermittent reinforcement has been shown to be superior to continuous reinforcement in the resistance of an organism to extinction, (Ferster and Skinner, 1957; Renner, 1964). Intermittent schedules of reinforcement are a powerful technique for generating and maintaining behavior, and Reynolds (1968) emphasizes this point:

> "The importance of schedules cannot be overestimated. No description, account, or explanation of any operant behavior of any organism is complete unless the schedule of reinforcement is specified. Schedules are the mainsprings of behavior control, and thus the study of schedules is central to the study of behavior."
>
> (p. 60)

However, as was evidenced in a review of the literature, in spite of the well-documented importance of the schedule effects, most token economies have paid little or no attention to this crucial variable.

In few cases does the schedule appear to be programmed in a systematic manner; and where intermittent schedules have been used, these have mostly been through reasons of expediency (e. g., Gericke, 1965) rather than a vital variable in modifying behavior.

Experimental evidence indicates that resistance to extinction is greater following schedules of ratio rather than interval reinforcement (Ferster and Skinner, 1957; Kanfer, 1958). The import of this evidence in relation to token reinforcement programs is obvious.

Because generalization from contingencies within a ward token program to contingencies within the community is an extremely difficult gap to bridge, intermittent reinforcement, and in particular ratio reinforcement, is potentially a powerful tool in the maintenance of responses established in a ward program. Also, such schedules replicate with a greater degree of authenticity conditions operating in the general community than does continuous reinforcement in a typical token program.

Prior to this present study being carried out, several other studies had been conducted on the same ward using token programs. In 1972, Horn and Black used token reinforcement to increase verbal participation in a social activity, viz., a weekly ward quiz. The subjects consisted of one group of 38 male patients. By means of an ABAB design, with

four sessions per phase, the results obtained indicated clearly the effectiveness of the token reinforcement on increase in verbal participation. Using a similar procedure, Samuel (1973) confirmed these results.

Ballagh (1973), using the same patient sample, conducted an experiment whereby tokens were dispensed on a fixed ratio schedule of reinforcement. The subjects were placed into four groups, and FR schedules of 100%, 66%, and 33% reinforcement were used in the quiz setting. The results, however, did not support the hypothesis of an inverse relationship between the ratio of reinforcement and maintenance of responding during extinction. However, the results did lend support to the view that high ratios of reinforcement are more effective for long-term, chronic patients than low ratios and that high ratio partial reinforcement (in this case 66% FR) may be as or more effective than continuous reinforcement. One possible explanation for the atypical results was the unequal difficulty of the questions used; in the present study, a standard open-end-type question was used to at least partially overcome this problem.

With FR schedules, the subject can learn when to expect to be reinforced, and hence extinction generally occurs at a more accelerated rate than it does under VR schedules of reinforcement, where the subject cannot predict when the next reinforcement will be received.

The intention of this thesis was to evaluate the effectiveness of different values of the VR schedule of reinforcement on the resistance to extinction of verbal response rate, of a group of chronic psychiatric patients. It was hypothesized:

(i) that verbal response rate would vary according to different variable ratio schedules of reinforcement, and that the lower the likelihood of reinforcement (e.g., VR20%), the higher the response rate;

(ii) that verbal response rate during a period of variable ratio reinforcement would be significantly higher than response rate during a phase of continuous reinforcement (i.e., 100% CRF), there being an inverse relationship between the ratio of reinforcement and verbal response rate; and

(iii) that extinction of the verbal response rate would be more gradual following a low (e.g., VR 20%), as compared with a high (e.g., VR 80%), value of variable ratio reinforcement, i.e., there would be a significant difference in verbal response rate between groups, during the extinction phase, as a consequence of varying prior VR schedules.

B. SUBJECTS

The subjects who participated in this experiment were 36 members of a ward of male, long-term psychiatric patients. Approximately 62% of these patients were diagnosed chronic or residual schizophrenics, the remaining diagnoses consisting of epilepsy and/or mental retardation and two Korsakoff syndrome patients. Their ages ranged from 35 to 79 years, the average age being 53.5 years. Length of hospitalization ranged from 6 months to 38 years, the average hospital stay being 16 years. During the 6 months of data collecting, only one patient was transferred from the ward, but this shift did not preclude him from continuing to attend the weekly quiz sessions; two patients were transferred to the ward after the experiment had begun, and although they were keen to participate in the quizzes, reasons had to be given as to why this was, regretfully, not possible. The majority of the patients were prescribed psychotropic medication, generally phenothiazine derivatives.

As in Ballagh's (1973) study, the patients were divided into four groups, each with nine subjects. By taking the mean number of verbal responses per session for each person during a study prior to Ballagh's, viz., Samuel (1973), the patients were divided into high, low, and non-responders and randomly assigned from each of these categories into the four groups.

Thus, as in a study by Barton (1972), an attempt was made to obtain an even distribution of high, low, and non-responders in each of the four groups.

Each subject was administered the Ravens Progressive Matrices and the Mill Hill Vocabulary Scale, the purpose being to later check whether or not the rate of verbal participation was related to intelligence in this particular sample. Of the 36 subjects, six did not wish to take these two tests. Raw scores ranged from 2 to 29 and 0 to 54 for the Progressive Matrices and the Mill Hill Vocabulary Scale, respectively. (See Appendix I for individual scores.)

C. SETTING

The patients in this experiment resided in a ward which had the characteristics consistent with the typical back-ward for chronic patients in a psychiatric hospital. It was well-appointed regarding patient comforts, and generally only minimal supervision was required by staff, who numbered 2 - 3 per day shift. The majority of these residents manifested the typical signs of institutionalisation, with low rate of verbal interaction, inactivity, little pride in dress and self-care skill, etc.

D. PROCEDURE

Each Tuesday and Wednesday morning the groups

(two per morning) attended the quiz sessions which lasted exactly 30 minutes per group. A notice which was placed on the dayroom notice-board let the residents know in advance which morning each week their quiz was to take place, and whether their group was first or second in order on each occasion. (See Appendix 2.) Attendance at the quiz was not compulsory, the residents being free to attend or leave their group quiz whenever they wished. In fact, of the 36 patients there were at least 5 patients who consistently did not attend the quizzes.

The quiz sessions were held in the ward dayroom, the residents seated in a semi-circle around a board on which was written by the experimenter the subjects' responses. The questions were of an open-ended type allowing multiple answers, e.g.,"Give me the name of anything beginning with the letter 'E'?" Thus, by employing this type of question, each subject in each group, and between groups, had as equal an opportunity as the other to make a response; and concomitantly, this format hopefully obviated to some extent the extraneous variable of varying educational and cultural backgrounds of the subjects.

An acceptable response was defined as: any answer which began with the given stimulus letter, any answer which had not previously been written on the answer board, and any answer which was not a neologism (within the experience of the experimenter).

When there were no responses to a particular letter for a period of 30 seconds (as timed by the experimenter), the experimenter then asked the group "Are there any more words beginning with the letter ... ?" If there were no responses within a 10 second interval following this request, the experimenter then said, "Well, let's go on to the next letter."

Each group was begun on a different letter, and it was always ensured that no two groups on one morning would clash with the same stimulus letter. A record was kept for each group of what letters had been used and what remained to be used as the stimuli.

When a correct response was made, the experimenter wrote the response on the board, reinforced the respondent with a token, and said "good". Before each session the subjects were reminded about the value of the tokens (see instructions below) in relation to the goods for which they were exchangeable, viz., cigarettes, chocolate, and various types of sweets.

E. TOKENS

The tokens used were circular plastic discs about the size of a fifty cent piece, and were the same as had been used in previous studies on the ward, where they had been established as being conditioned

reinforcers. Once the variable ratio schedules of token reinforcement were implemented, then a number of tokens the patients received had a 1 mm hole pierced through the centre of the disc, thus indicating to the subject that he had earned himself a "super token", i.e., a token which was cashable for "goodies" at the conclusion of the quiz. For each of the four variable ratio schedules used, the appropriate super token : ordinary token ratios were calculated for each VR value and then placed in four separate bags. Patients were not permitted to hold tokens over until another session, all tokens being cashed in at the end of each session. This was checked by comparing the number of responses recorded with the number of tokens handed in.

F. INSTRUCTIONS

There were three phases in this experiment, each with different instructions prior to the beginning of each phase. Prior to the first phase of continuous reinforcement, it was explained to the subjects that by participating in the quiz sessions and giving answers to the experimenter, they could earn tokens which would be exchangeable at the end of the session for cigarettes and chocolate. The exchange rate was four tokens for one cigarette and eight tokens for a bar of chocolate. (The exchange rates were made flexible but proportionally the values were held constant, e.g., two tokens for a small

packet of sweets, four tokens for half a bar of chocolate.) Following the principles outlined by Ayllon and Azrin (1968), these two reinforcers were used as they were behaviors that already existed in high strength prior to any of the experiments that were carried out on this ward.

In the second phase of the experiment, the introduction of four variable ratio schedules, the following instructions were given to each group in turn:

> "This morning we carry on as usual, but from now on we will have a mixture of supertokens and ordinary tokens, the supertokens being those with holes pierced through the centre of the tokens. From now on it is only the supertokens which can be exchanged for cigarettes and chocolates, which are the same price as before. The ordinary tokens have no value. We might call this a lucky dip system, just to add a bit of variety to what we've been doing so far. Do you all understand this new procedure?"

These instructions were repeated, in paraphrased form, at the beginning of each session.

Before the introduction of the extinction phase (or more correctly, a noncontingent reinforcement phase), the following directions were given:

"This morning there will be a change in the proceedings. At the end of the session each person present will receive either four cigarettes or two bars of chocolate. Ordinary tokens will be given out as usual but they will have no value. They will just show you how many words you have thought of. Do you all understand this new procedure?"

This instruction also was repeated in paraphrased form, at the beginning of each session. To answer any queries about the holed tokens, the standard reply was: "The super tokens are being counted up at present, and so we cannot use them."

Being aware of the confounding effects of instructions on performance (see Kazdin, 1973; Frazier, 1973), an attempt was made to keep the instructions, prior to the second and third phases of the experiment, as neutral as possible with regard to the imparting of information, to the patients, on the various reinforcement contingencies.

G. RELIABILITY

During the first five weeks of the experiment (i.e., the CRF phase), two observers were present for every session. They were physically separated such that one could not be influenced by the other.

Reliability was calculated by dividing the number of agreements on responses emitted by the

number of agreements plus disagreements. In this first phase of the study, reliability coefficients ranged from 95.3% to 100%, with an average of 98.3%.

Because the reliability figures were of high percentage for the CRF phase, reliability checks were taken just intermittently during the remaining two phases of the experiment (two recorders were present 22% of this time). The range of agreement was 92.2% to 100%, with an average of 98.03%.

When one observer only was present, the nature of the data collecting system afforded a separate reliability check whereby the number of responses recorded could be compared with the number of tokens collected by each patient each session.

However, one must be cautious of the accuracy of the reliability figures quoted, in the light of the recent findings by Romanczyk et al. (1973), who found that reliability measures were consistently and substantially inflated by knowledge that reliability was being assessed and by knowledge of which assessor was performing the assessment.

H. DESIGN

The subjects were randomly assigned to four groups, as explained above, thus giving a randomized block design. Sessions were held each Tuesday and Wednesday morning (between 10.30 a.m. and

11.45 a.m.), since Thursday was the patients' "store day", when they received cigarettes, chocolate, etc.

Overall, 26 sessions were held for each group. The length of each phase of the experiment was predetermined.

Phase 1.

In the first four sessions, each group received 100% contingent reinforcement, i.e.,one token was given for each correct response, and these were cashed in at the conclusion of the session. This phase was incorporated to try to establish a basic rate of response before the four groups were subjected to the various ratios of reinforcement. Also, it was hoped that there would be a statistically non-significant difference between the groups over this first phase, thus establishing the fact that the groups were relatively evenly matched with regard to response rate, and thus obviate the extraneous variable of differing response rates between groups.

Phase 2.

In the second phase, variable ratio reinforcement was introduced, each group experiencing four 30 minute sessions for each of the four different percentages of ratio reinforcement (20%, 33%, 66%, 80%). In this phase, the order in which the groups had their quiz session (i.e.,either Tuesday or

Wednesday morning, and either first or second on either morning) was randomly determined to preclude position effect (see Appendix 2).

The order in which each group experienced the four treatment levels was determined by the use of the Latin Square distribution of these four levels, with each level appearing no more than once in either row or column (see Table 1). By utilizing the Latin Square, at least partial control is gained with respect to the order effect (see Winer, 1970).

As in the first phase, upon each response the experiment reinforced the subject with a token and the word "good", and wrote the response on the board.

Phase 3.

In the third and final phase of the experiment, the extinction (non-contingent reinforcement) phase, six sessions were held for each group. The same reinforcement procedure was pursued as in the previous two phases, with the exception that the primary reinforcers were dispensed on a non-contingent basis, i.e., at the end of each session, all subjects present received their four cigarettes or two bars of chocolate regardless of test performance during the quiz. Also, in this phase, just the ordinary tokens, and no "super tokens", were dispensed.

The rationale behind this phase was that the non-contingent reinforcement of 'goodies' for all subjects present at each quiz session would alleviate possible frustration, particularly for those subjects who were typically very high responders; also it would hopefully ensure the return of subjects for their next session. The fact that this experiment was carried out in an applied setting appeared, in the experimenter's opinion, to necessitate such a procedure as just described. The crucial variable to be observed in this final phase was the effect of the valueless token on individual response rate.

A plan of the design is summarized in Table 1.

TABLE 1

Experimental Design.

	PHASE I	PHASE II	PHASE III
	CRF. 100%	VARIABLE RATIO	EXTINCTION (NCR)
	4 sessions	4 sessions per ratio	6 sessions
GP. 1	100%	80% 20% 66% 33%	NCR
GP. 2	100%	20% 80% 33% 66%	NCR
GP. 3	100%	33% 66% 20% 80%	NCR
GP. 4	100%	66% 33% 80% 20%	NCR

CHAPTER THREE

R E S U L T S.

A. CONTROL STATISTICS

(1) Correlational Analysis of Verbal Response Rate and IQ.

A correlational analysis was carried out to check the likelihood of a significant correlation between the total response rate for each subject and scores obtained on the Mill Hill Vocabulary Scale and the Raven's Progressive Matrices.

The Spearman rank correlation coefficient, of the formula

$$r_s = \frac{\sum x^2 + \sum y^2 - \sum d^2}{2\sqrt{x^2 \; y^2}}$$

was used as there were a considerable number of tied scores. (See Appendix 1 for raw scores on the above two tests.) In correlating total responses per subject with subject's scores on the Progressive Matrices, the obtained value was $r_s = .154$. The formula for $N > 10$,

$$t = r_s \sqrt{\frac{N - 2}{1 - r_s^2}}$$

was used to test the null hypothesis, the obtained value being .908. The critical value for a .01-level test

(two-tailed) is $t_{.99}(34) = 2.750$. Thus, no significant correlation existed between response rate and scores on the Progressive Matrices.

The same computational procedure was carried out between response rate and scores on the Mill Hill Vocabulary Scale. The obtained r_s in this case was .451, and, after the application of the latter formula, 2.94. In this case the critical value of 2.750 is exceeded, and therefore a statistically significant correlation exists between response rate and verbal intelligence, as measured on the Mill Hill Vocabulary Scale.

(2) Tests for Homogeneity of Variance.

Table 2 shows the mean, variance, and standard deviation for each of the four groups over all phases of the experiment. It can be seen from this table that the variance values differ to some considerable degree. Thus, a test for homogeneity of variance of treatment populations was carried out on the data collected over Phase 1 of the experiment, the 100% CRF phase. Using Hartley's method of Fmax (Winer, 1970) for estimating variance, an Fmax = 14.90 was obtained; $Fmax_{.99} = 49.0$, therefore the observed value of Fmax is less than the critical value for an .01-level test, and thus the null hypothesis of homogeneity of variance is accepted. The Cochran test for homogeneity of variance was also applied, since it uses more of the information in the sample data and thus is more sensitive to departures from homogeneity of variance than is the Hartley test (Winer 1970)

TABLE 2

Means, Variances, And Standard Deviations For Each Phase Of The Experiment. For The VR and NCR Phases, The Means, etc., Are Derived From The Total Verbal Response Rate Over Four Sessions And Six Sessions Respectively.

GROUPS		4 Sessions 100% CRF				Grand Mean 100% CRF	VR 20%	VR 33%	VR 66%	VR 80%	NCR
1	$\bar{X}$	25.2	38.0	37.6	33.2	33.5	40.45	46.65	51.01	39.9	41.30
	V	18.96	56.2	63.12	142.56	26.91	12.14	17.24	14.18	22.43	35.29
	SD	4.35	7.49	7.94	11.93	5.18	3.48	4.15	3.76	4.73	5.94
2	$\bar{X}$	27.4	24.0	27.0	29.16	26.89	25.59	33.08	39.52	26.18	34.83
	V	113.56	261.83	185.0	307.46	3.44	30.71	5.26	6.88	11.34	30.7
	SD	10.65	16.17	13.60	17.53	1.85	5.54	2.29	2.62	3.36	5.54
3	$\bar{X}$	17.83	28.6	23.57	33.0	25.75	32.77	34.37	27.93	25.44	25.6
	V	433.24	888.92	527.32	1239.3	32.03	28.63	22.42	21.30	9.43	16.03
	SD	20.81	29.82	22.96	35.21	5.66	5.35	4.73	4.61	3.07	4.003
4	$\bar{X}$	21.0	21.80	35.4	32.0	27.55	42.95	41.32	32.25	42.35	37.56
	V	162.2	85.36	453.84	517.2	39.34	5.94	27.91	21.66	27.74	17.68
	SD	12.63	9.24	21.30	22.74	6.27	2.43	5.28	4.65	5.26	4.21
Grand Treatment Means						28.42	35.44	38.85	37.68	33.46	34.67

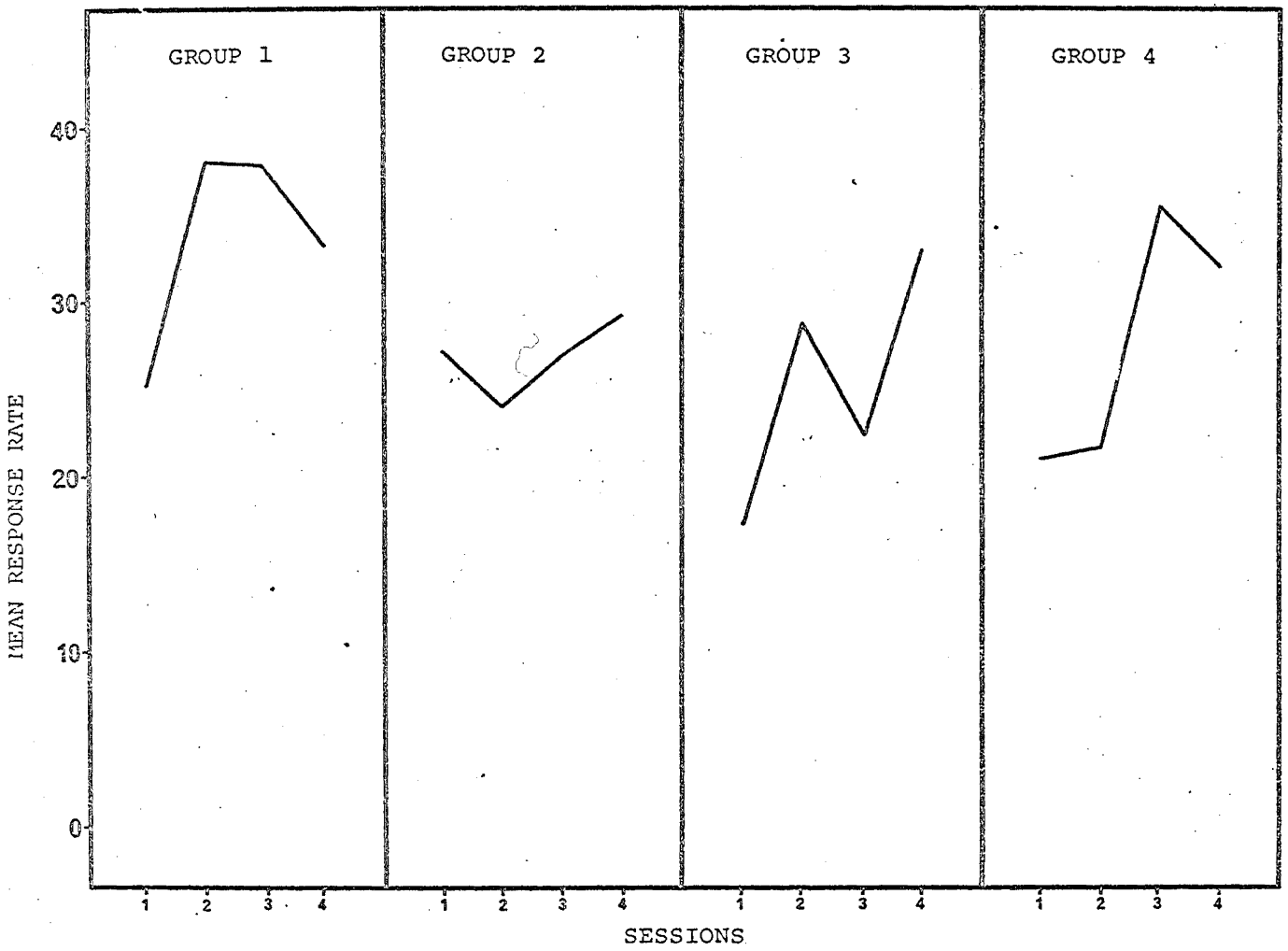

FIGURE 1

MEAN RESPONSE RATE FOR THE FOUR GROUPS OVER
FOUR SESSIONS OF 100% CONTINGENT REINFORCEMENT

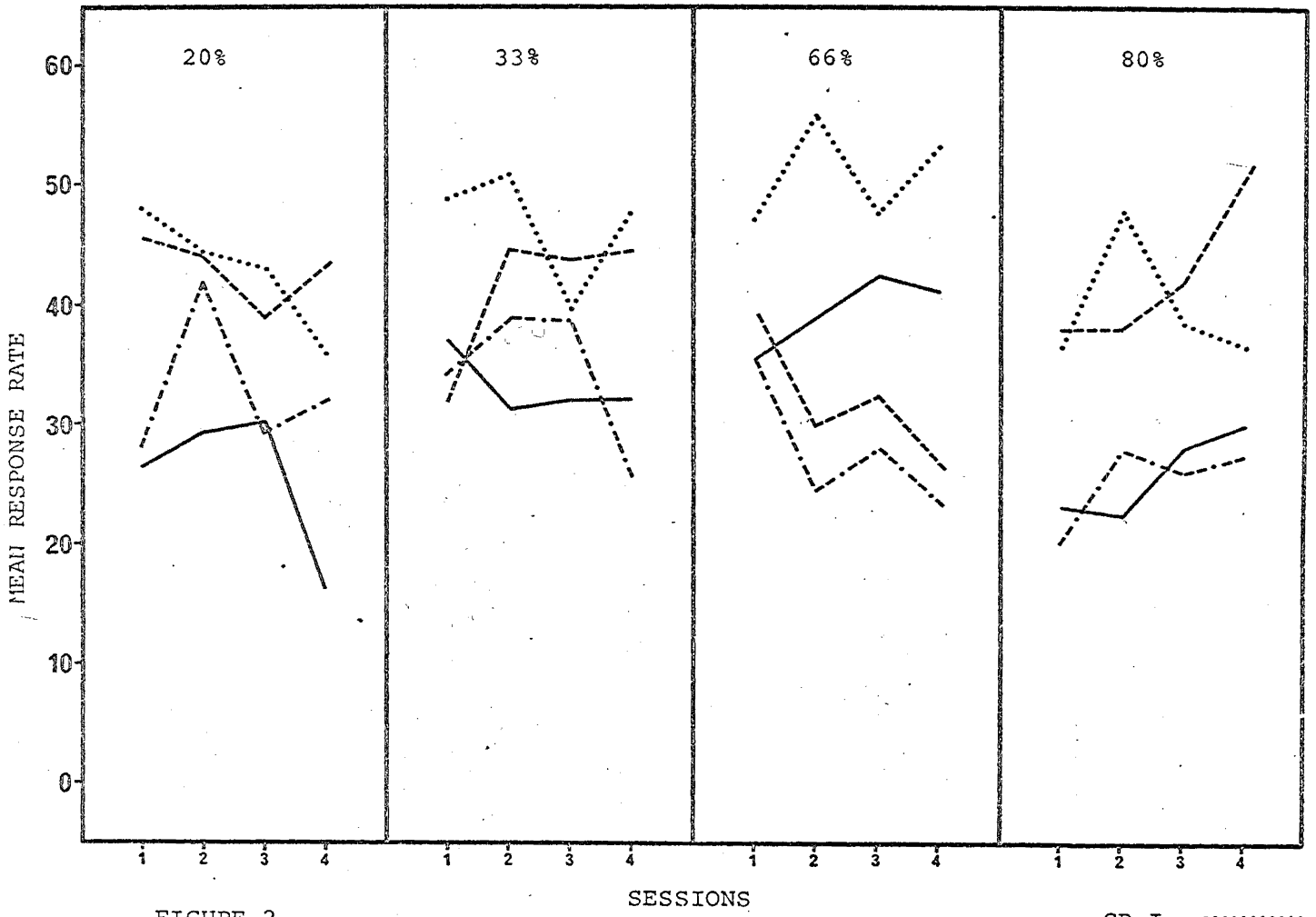

FIGURE 2

MEAN NUMBER OF RESPONSES OVER FOUR SESSIONS PER GROUP FOR EACH VARIABLE RATIO SCHEDULE OF REINFORCEMENT

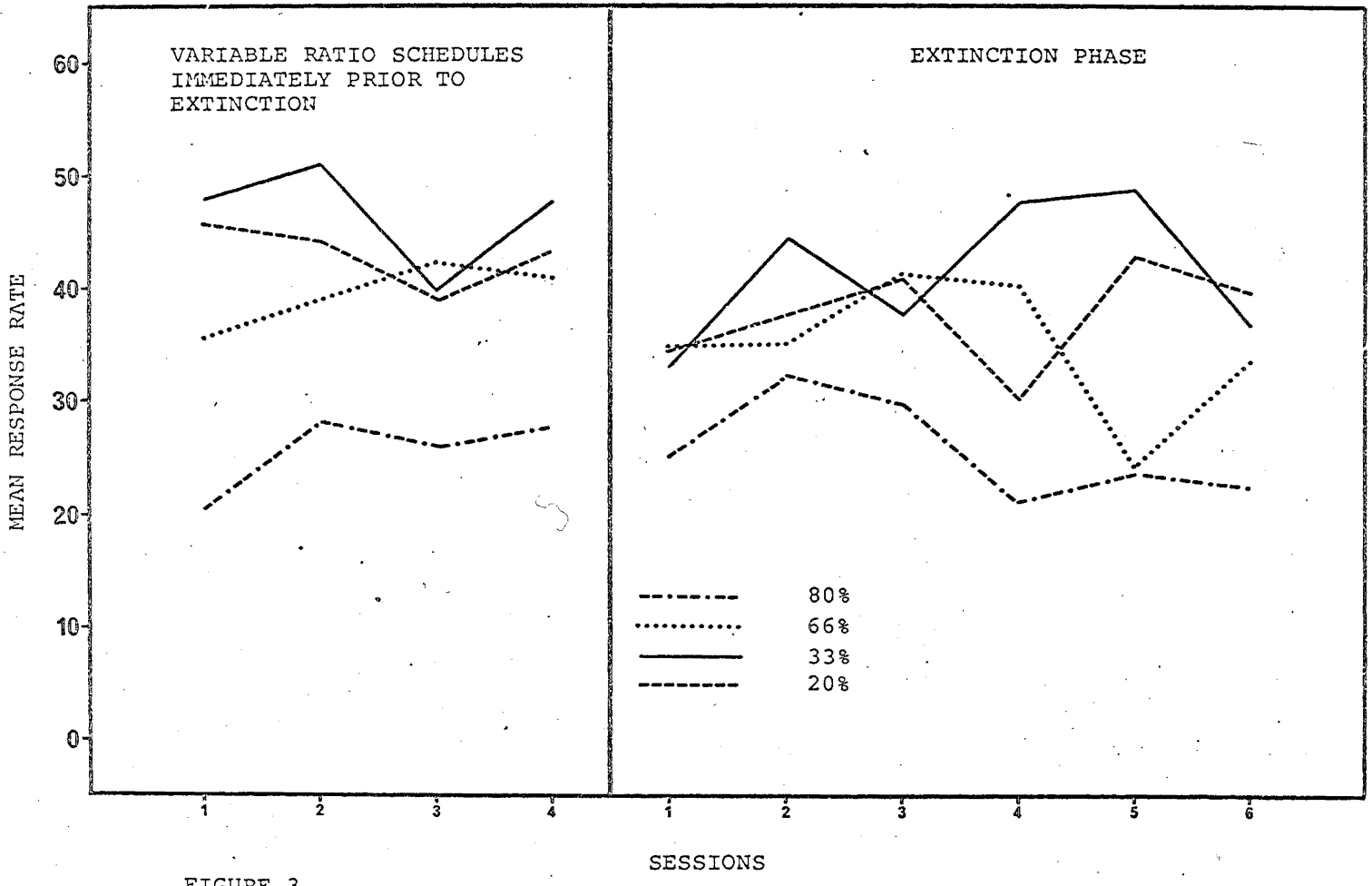

FIGURE 3

MEAN RESPONSE RATE FOR EACH VARIABLE RATIO SCHEDULE, OVER THE FINAL FOUR SESSIONS, PRIOR TO THE EXTINCTION PHASE

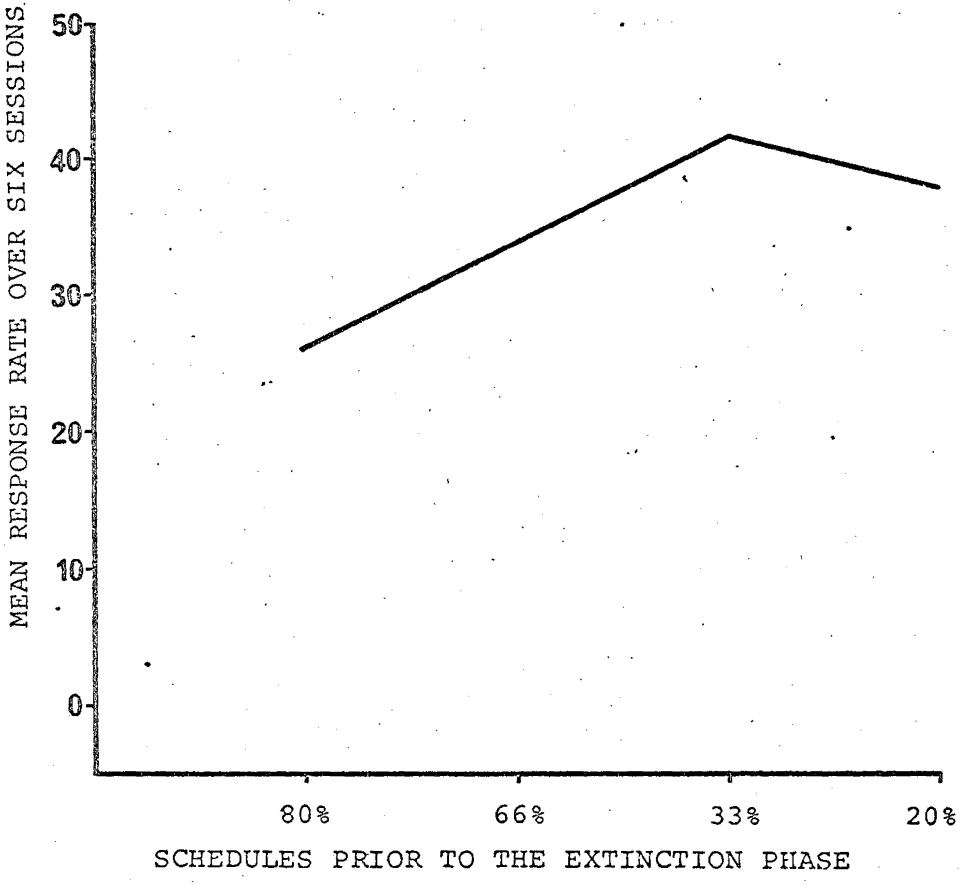

FIGURE 4

MEAN RESPONSE RATE, PER GROUP, DURING EXTINCTION, FOLLOWING THE FOUR SCHEDULES OF VARIABLE RATIO REINFORCEMENT

For this test a value of C = .776 was obtained; for $C_{.99}(3,4)$ = .721, therefore the null hypothesis of homogeneity of variance is rejected. However, because of the greater sensitivity of the latter test, and that heteroscedascity has wider consequences for the F test when differing numbers of subjects are employed in each treatment, it was decided that the parametric statistic, the F test, could be applied to this data.

Tests for homogeneity of variance were also applied to the data collected during the Second and Third Phases of the experiment, the Variable Ratio and Extinction Phases. For the Variable Ratio data, an Fmax value of 1.568 was obtained. The tabled value for $F_{max.01}(4,15)$ = 5.5, which is greater than the observed value, and thus the assumption of homogeneity of variance is accepted. A C value of .456 was also found not to reject the null hypothesis at the .01 level, with $C_{.99}(4,15)$ = .570. For the Variable Ratio phase, plus the Extinction phase, an Fmax of 1.353 was calculated, which also failed to reject the null hypothesis, with $F_{max}\ .01(4,23)$ = 4.3. Similarly, a C value of .341, for both the Variable Ratio and Extinction phases, did not reject the null hypothesis at the .01 level, $C_{.99}(4,23)$ = .488. Thus it could be safely assumed that the hypothesis of homogeneity of variance for the treatment populations was adequately established.

(3) A Check for Differences in Response Rates Between Groups.

In order to establish that there was no significant difference in response rate between the four groups over the 100% CRF phase (see Figure 1), a one-way analysis of variance was performed on the mean number of responses per session for each group over the four sessions of Phase 1. The results of this analysis are shown in Table 3. F obt.(3,12) = 1.422 $< F_{.99} = 5.95$, $p > .01$. Thus, the null hypothesis of no significant difference in rate of response between the four groups is accepted.

TABLE 3.

The Results of An Analysis of Variance For The Mean Number Of Responses Per Group During 100% CRF.

Source	SS	df	MS	F
Groups	144.13	3	48.04	1.422
Error	405.36	12	33.78	
Total	549.49	15		

However, because the assumption of homogeneity of variance for the 100% CRF data was rejected using the Cochrane test, a non-parametric test, the Kruskal-Wallis one way Analysis of Variance, was also applied to this data. The probability associated with the occurence under the

null hypothesis of a value H = 3.86, (3), is P > .20. Thus, the assumption of similarity of response rates between groups is substantiated.

The experimenter could therefore assume that prior to Phase 2 of the experiment, no group differed significantly from another on rate of verbal response.

B. STATISTICAL ANALYSIS OF THE EXPERIMENTAL HYPOTHESES

Hypothesis (i).

The hypothesis that verbal response rate would vary according to the different variable ratio reinforcement schedules, and that the lower the ratio of reinforcement, the higher the response rate, was tested by performing a one-way analysis of variance (repeated measures) for the mean number of responses per session (there being 16 sessions, in total, for each VR treatment) for the four VR schedules. The results of this analysis are shown in Table 4. (See page 59 for Table 4.)

TABLE 4.

The Results Of An Analysis Of Variance (Repeated Measures) For The Mean Number Of Responses Per Session For Each Of The Four Variable Ratio Schedules.

Source	SS	df	MS	F
Between Blocks	2596.47	15		
Within Blocks	2250.66	48		
Treatment	278.87	3	92.95	2.12
Error	1971.79	45	43.81	
Total	4847.13	63		

F obt. (3,45) = 2.12 $< F_{.95}$ (3,40) = 2.84, $p >$ .05. The observed F ratio of 2.12 is non-significant at the .05 level, and, therefore, the hypothesis of differences in rate of response over the varying schedules of reinforcement is rejected. The mean verbal response rates for each group under the four treatment levels of VR reinforcement are plotted in Figure 2.

Hypothesis (ii).

To test the prediction that verbal response rate during the phase of VR reinforcement would be significantly higher than response rate during the CRF phase, a one-way analysis of variance was performed on the mean response rate of each of the sixteen sessions within each of the five treatment levels, i.e., 100% CRF, and VR-20%, -33%

-66%, and -80%. The results of this analysis are summarised in Table 5.

Table 5.

The Results Of An Analysis Of Variance (Repeated Measures) For The Mean Number of Responses Per Session For The 100% CRF And The Four VR Schedules.

Source	SS	df	MS	F
Between Blocks	2650.09	15		
Within Blocks	3545.44	64		
Treatment	1077.78	4	269.44	6.552*
Error	2467.66	60	41.12	
Total	6195.53	79		

*$p < .01$

F obt. $(4,60) = 6.552 > F_{.99}(4,60) = 3.65$, $p < .01$. With the significant F ratio indicating that differences do exist between the CRF phase and the VR phase, the Dunnett procedure for comparing means with a control was employed to test which of the possible differences were in fact significant. This technique was chosen because the requirement of orthogonal comparisons was met, and because it is a multiple range test for making k-1 comparisons among k means (including the control mean), thus making it a more convenient procedure than multiple t tests for significant differences.

Using the following formula

$$d' = t\,D\,a; k, v\sqrt{MS\ error\ (\frac{1}{nj} - \frac{1}{nj'})}$$

a $t_{.99}$ statistic of 6.342 was derived, with df = 5,60 (one-tailed test). Table 6 indicates the differences between each of the treatment means (VR schedule means) and the control mean (100% CRF).

TABLE 6.

The Obtained Differences Between The Total Mean For 100% CRF And The Total Means For Each Of The Four Variable Ratio Schedule Treatments.

	100% CRF	VR 20%	33%	66%	80%
Means	28.42	35.43	38.85	37.68	33.43
d		7.01*	10.43*	9.26*	4.07

*p < .01

Comparing each d value in Table 6 with the derived value of 6.342, three of the four mean differences are significant at the .01 level. Thus, the hypothesis predicting a significant difference in response rate between the 100% CRF phase and the VR phase is accepted. The d value which failed to reach the critical level, that for VR 80%, could be expected since it more closely approximates the 100% CRF than do the remaining three VR schedules.

Hypothesis (iii).

To test the hypothesis that extinction of the verbal response rate would be more gradual following a VR schedule with a low (e.g.,VR 20%), as compared with a high (e.g.,VR 80%), likelihood of reinforcement, a one-way analysis of variance was carried out on the mean rates of response over six sessions of the extinction (NCR) phase. Figure 3 shows the response rate for each group over their respective VR schedule of reinforcement immediately prior to the extinction phase, and similarly, their respective patterns of response during the six sessions of the extinction phase. The results of variance are summarised in Table 7.

TABLE 7.

The Results Of An Analysis Of Variance Of The Mean Rates Of Response For Each Group During The Phase Of Extinction.

Source	SS	df	MS	F
Groups	807.04	3	269.01	8.739*
Error	604.52	20	30.226	
Total	1411.56	23		

*$p < .01$

F obt. $(3,20) = 8.739 > F_{.99} = 4.94$, $p < .01$. The predicted difference in rates of response between the groups during the extinction phase is thus accepted.

In Table 8 is shown the estimated differences

between the means of each group, and where the number of pairwise comparisons is $[k(k-1)]/2 = 6$ pairwise comparisons.

TABLE 8.

Differences Between The Means Of Each Group During The Extinction Phase.

Group	Prior VR Schedule		$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
3	80%	$\bar{x}_1$ 25.60	-	9.23	15.7*	11.96*
2	66%	$\bar{x}_2$ 34.83		-	6.47	2.73
1	33%	$\bar{x}_3$ 41.30			-	3.74
4	20%	$\bar{x}_4$ 37.56				-

*$p < .01$

To test for significant differences between means for the six possible pairwise comparisons, Dunn's multiple comparison procedure was used for this purpose. For this method, a greater difference between means is required, as compared with the multiple t procedure, before the null hypothesis can be rejected.

Using the formula

$$d = t' D\alpha/2 \; ; \; c,v\sqrt{\text{MS error}\left[\frac{(cj)^2}{nj} + \frac{(cj')^2}{nj} + \cdots + \frac{(cj'')^2}{nj}\right]}$$

the difference d that a comparison must exceed in order to be declared significant, with the critical level set at .01, is 11.49. With reference to Table 8, two of the six pairwise comparisons are found to be significant

at the .01 level. The two comparisons are:

(i) mean response rate, during extinction, for Group 1 (VR 33% prior to extinction) is significantly higher than that for Group 3 (VR 80% prior to extinction); and

(ii) mean response rate, during extinction, for Group 4 (VR 20% prior to extinction) is significantly higher than that for Group 3 (VR 80% prior to extinction).

A graph of the mean verbal response rates for each VR treatment level over the NCR phase is given in Figure 4. In accordance with the prediction in Hypothesis (iii), the graph does indicate a trend whereby the lower the likelihood of reinforcement during the treatment level immediately prior to the NCR phase, the higher the verbal response rate during the latter phase. Inspection of Figure 4 indicates that a straight line would provide a good fit to the points, hence a test for trend was applied to the data. The test for linear trend is given by

$$F = \frac{\text{linear component}}{\text{MS error}}$$

F obt.$(1,20) = 17.81 > F_{.99}(1,20) = 8.10$, $p < .01$; thus, the linear trend is statistically significant, with 67% of the variation in verbal response rate, during extinction, being calculated as predictable from a linear regression equation. However, 268.64 units of variation

were calculated not to be predicted by the linear regression equation, thus implying the possibility that the quadratic or cubic trend might be statistically significant.

An overall measure of deviations from linearity is given by the formula

$$F = \frac{SSnonlin / (k-2)}{MS\ error}$$

F obt.(2,20) = 4.44 $< F_{.99}(2,20) = 5.85$, $p > .01$, the data therefore indicating no significant deviations from linearity. However, although the test for departure from linearity is not significant, it is possible that the linear, quadratic, and cubic trend components all contribute to the overall trend.

Replacing the tabled linear coefficients for those of the quadratic and cubic coefficients (for k = 4, x = 4), the following values were derived. The F statistic for quadratic trend was 8.33 which exceeds the critical value for a .01-level test with F (1,20) = 8.10. Thus, the increase in predictability due to the quadratic component is significantly different from zero. The component of variation corresponding to the cubic trend was calculated at 16.65, the F statistic for this component being .5508; as the critical value for a .01-level test is 8.10, the sample data indicate that the cubic component does not increase the predictability by an amount which is significantly different from zero.

In conclusion, the linear trend is not the only trend that is significantly greater than zero; the quadratic trend is also statistically significant in predicting the relationship between the two variables concerned. Hence, rate of verbal participation during extinction, in relation to prior VR schedules of reinforcement, could not be predicted from a first-degree (linear) equation alone.

CHAPTER FOUR

D I S C U S S I O N.

The primary intention of this study was to establish whether or not a group of chronic, psychiatric patients would show maintenance of a response during a period of extinction, following various ratios of variable ratio reinforcement.

The first hypothesis, that verbal response rate would vary according to the different VR reinforcement schedules, was not supported in this study. The grand treatment means in Table 2 indicate, to some degree, the predicted trend, i.e., the lower the ratio of reinforcement, the higher the response rate, but the differences between the treatment means failed to reach statistical significance. A number of reasons may be put forward as to why this hypothesis was rejected with this particular group of subjects. Firstly, the sizes of the groups were relatively small, nine subjects in each. This factor had the potential of producing a high degree of variability in response rate within each group, depending upon the presence or absence of a particular member in a group, whether or not one of the subjects fell asleep during the session, the possible effect of medication change, etc. Secondly, these subjects were not experimentally naive in that they had experienced other token programs prior to the present study; this could have potentiated a "warm-up" effect

on these subjects, and hence they continued to respond, individually, more or less at an optimal level, following the first phase (CRF) of this experiment. Thirdly, the groups experienced each VR schedule for just 4 sessions per ratio. Spradlin (1962) found with severely mentally retarded children that the number of acquisition trials was an important variable to consider when wanting to predict a certain trend (in Spradlin's case, different percentages of reinforcement and resistance to extinction). In the present study, using a sample of chronic, psychiatric patients, one might conclude that such a sample also may require a higher number of acquisition trials per ratio, than say a sample of normal subjects, in order to show differentiation of response rate in accord with the various schedules used. Ellis et al. (1960) concluded that although the character of response rate differed as a function of IQ and chronological age, the higher MA and higher CA subjects performing at higher overall rates, the results did indicate that the majority of subjects, even those of lowest intelligence (i.e., below IQ 30) were sensitive to schedule changes. The Ellis et al. experiment, however, was carried out over 15 daily half-hour sessions, and if a similar period of time had been allowed in the present study (instead of the four half-hour sessions spread over a four-week period for each group), then the differentiation reaction to the various ratios used may well have been more pronounced.

The second hypothesis, that verbal response rate during the phase of VR reinforcement would be higher than response rate during the CRF phase, was supported at the .01 level of significance. Further analysis showed that all the VR treatment means were significantly different from the CRF mean save the VR 80% value. Of the four VR treatment levels, it would be predicted that the 80% level would be more likely to be not significantly different from the CRF condition since it most closely approximates 100% reinforcement. It is possible that if a greater number of trials had been allotted to each condition, a greater differentiation of response rate to the 100% and VR 80% conditions may have resulted. It is also possible that the VR 80% condition was not sufficiently different from that of the CRF condition, for this particular sample, and hence the resultant lack of differential response to these two conditions.

The third hypothesis, that extinction of the verbal response rate would be more resistant the lower the VR value prior to the extinction phase, was also supported at the .01 level of significance. Of the six possible pairwise comparisons between the response rate for each VR schedule immediately prior to extinction and the response rate during the extinction phase, two comparisons were statistically significant, viz., the VR 33% level and the VR 20% level, when compared with the VR 80% level. The critical level was not reached for the other four comparisons, as shown in

Table 8. Thus, the VR values with the largest discrepancies proved to be the only ones to show statistically significant differences. As with the second hypothesis, the lack of significant differential reaction to the other VR levels, may have been due to the fact that the percentage differences used were not large enough to produce the expected results, hence only the most discrepant comparisons reached significance.

The predicted trend, during extinction, was closely approximated, as illustrated in Figure 4. Resistance to extinction accelerated from VR 80% through to VR 33%, and then negative acceleration occurred for the lowest VR value, VR 20%. A test for linear trend, however, was found to be not significantly different from the quadratic trend in predicting the relationship between resistance to extinction of verbal participation and prior VR schedules of reinforcement. In a laboratory experiment with pigeons, Hearst (1961) obtained similar results with an approximate linear relation between the two variables of VR reinforcement during conditioning and resistance to extinction. The VR values used were 1:1, 4:1, and 10:1, and the graphline for these values, during extinction, was positively accelerated through all three ratios.

Green, Landers and Squier (1959), working with human adults in a laboratory setting, found that their operant behavior could be brought under the control of various schedules of reinforcement (viz., VI, FI, FR,

and VR) within the context of a discrimination learning task, as opposed to a free operant situation. Variability of response increased as the FR value increased and this, the authors concluded, was due to "ratio strain", a common observation with FR schedules of reinforcement. The same relation did not hold for VR reinforcement. In the present study, one might conclude that the negative acceleration for VR 20% (see Figure 4) was also due to ratio strain. The figures in Table 2 indicate the possibility of ratio strain, whereby the grand treatment mean for VR 20% is less (but not significantly less) than those for VR 33% and VR 66%. Ratio strain is more apparent in Table 6, in which the VR treatment means are compared with the CRF mean; although all statistically significant, the largest difference is between VR 33% and CRF, and then VR 66% and VR 20%, in that order. Similarly, in Table 8, the VR 33% level produced the highest mean verbal response rate during the extinction phase, and secured the largest difference amongst the pairwise comparisons.

The results of Ballagh's (1973) study, using FR schedules of token reinforcement with the same group of subjects as the present study, indicated that the subjects responded most effectively at the ratio of 66% FR reinforcement, but this ratio did not differ significantly from the mean for the CRF condition. In the present study, employing VR reinforcement, this same group of patients responded most effectively at

the ratio of 33% VR reinforcement. This change would be expected under VR schedules of reinforcement since, typically, these schedules produce very high and generally constant rates of responding. The prediction that the ratio of 20% VR reinforcement would produce the highest response rate and be the most resistant to extinction, was not confirmed in this experiment. It appears, as mentioned above, that this result was possibly a consequence of ratio strain. This phenomenon has been found in animal studies (Felton and Lyon, 1966; Winograd, 1965) as well as in studies with human subjects (Zifferblatt, 1972).

It would, however, be incorrect to assume that the significant results obtained for the third hypothesis were due entirely to the manipulation of the various VR levels. The persistent high response rate during extinction could be attributed to a number of other factors:

(1) A Hawthorne effect could have been operating whereby the very presence of "outsiders" was sufficiently stimulating to produce a relatively constant and high response rate, perhaps as a means of impressing the experimenters. However, it is doubtful that such an effect would have had any significant impact on the subjects' response behavior after having experienced other similar token programs for approximately twelve months prior to this study. The problem of the Hawthorne Effect could mostly be checked by having the ward staff administer the entire program, as did

Glickman, Plutchik and Landau (1973) in an open-door psychiatric ward.

(2) It did seem apparent with some subjects that they did not fully comprehend the instructions given prior to each session during the extinction phase. The fact that one subject produced his greatest number of responses during an extinction session tends to lend support to this contention. There were, however, other subjects who, after the first two or three sessions in the extinction phase, were responding appropriately to the NCR phase by either not responding at all or making just a few responses.

(3) Somewhat related to the Hawthorne effect is the possible extraneous variable of uncontrolled social reinforcement. In the extinction phase, as well as in the first two phases of the experiment, the actual exchange of tokens could have been reinforcing in itself in that a social transaction occurred between the experimenter and the subject. The word, "Good", was also expressed by the experimenter, but over each phase of the experiment, whenever a response was emitted, thus making this reinforcing stimulus constant while the contingencies of token reinforcement were varied. This social reinforcement may have been sufficient in itself to maintain responding over the various phases, but it is doubtful that such a reinforcer would have had the same power as tokens, with back-up reinforcers, to maintain verbal

responding with this group of subjects. The combination of the word, "Good", and the writing up of each subject's responses on a board may have been more reinforcing, however. The recording of each response may have acted not only as a reinforcer but as a discriminative stimulus as well. To overcome these problems, an extinction phase in which the responses were not written up could be compared with one in which they were visibly recorded; and secondly, an extinction phase in which the word "good" was not used could be compared with one in which this verbal reinforcer was employed.

The problem of uncontrolled social reinforcement was apparent in the Ayllon and Azrin (1965) study, and Kazdin (1973a) has given examples of how this variable can provide a discriminative stimulus for probable reinforcement for a subject if an adjacent subject was receiving contingent reinforcement for a particular activity, such as attentive behavior. As Ribes-Inesta et al. (1973) have pointed out, few studies have attempted to assess the separate contribution of social reinforcement operations involved in dispensing tokens in a social setting. Following an experiment dealing with this problem, these authors made some noteworthy conclusions, viz., that

> "the importance of tokens may be related not to the control of the individual who receives them as

> reinforcers, but to the scheduling of the behavior of those who provide social reinforcement in the framework of a token system."
>
> (p. 128)

They also proffered a tentative explanation of why some children fail to come under the control of tokens, viz., that generally such children are poorly responsive to social stimuli, and because it is probable that token systems are dependent, in some instances, on social reinforcement, these children would hence fail to respond to such systems.

There are other extraneous variables which should be mentioned as possible confounders of the results obtained in this study. Behavior operates in the context of a variety of environmental stimuli (this being particularly relevant in the case of field studies), the stimuli acquiring over time a controlling function of the particular behaviors and reinforcement. In a psychiatric ward, such stimuli as other patients, the ward staff, the topography of the ward, etc., all may exercise stimulus control over the behavior of the subjects. Both DeVries (1968) and Higgs (1970) have shown that mere environmental amelioration produced short term and long term behavioral changes in chronic psychiatric patients. In the present study, the quiz sessions were held in the ward dayroom and therefore the subjects "in quiz" were subjected to various stimulus controls, such as cues from other patients, encouragement from staff, and the wide variety of materials about the room which were

potential cues for responses if the subjects were perceptive enough to utilize this "deus ex machina". Also, for each quiz session, the seating in the dayroom was physically altered, and for those subjects participating in the quiz their proximity and social interaction with other patients differed from normal. Bandura (1969) points out that in social situations some people serve as models which others imitate, the model normally being either a prestigeful, distinguished, or conspicuous person; thus, the changes in reinforcement contingency may have modified the behavior of the conspicuous patient models and other patients may have copied their behavior independently of token rewards.

Finally, one variable that is typically a covariant of token reinforcement studies, and may therefore also have functional control over the response, is the instruction given to the subjects at the onset of each phase. As mentioned earlier, this is one of the criticisms of the Ayllon and Azrin (1965) study, where the dramatic changes noted in performance may have been partially due to the different instructions preceding each experimental phase. The effect of instructions in the absence of reinforcement has been shown to be transient (Packard, 1970), but instructions are effective in initiating behavior change (Hopkins, 1968) and can augment the effectiveness of reinforcement contingencies (Herman and Tramontana, 1971; Frazier, 1973); however, there are exceptions

to this (Kazdin, 1973b). In the present study, a different set of instructions preceded each experimental phase, but any potential effects regarding their functional control over the subjects' verbal response rate was not controlled for. Whether or not instructions do precede each phase, there are other factors such as the incentive function and the informational function of the reinforcement procedure, which are inherent in a reinforcement program. Zimmerman et al. (1969) showed that feedback alone can improve performance, but that token reinforcement increases performance even further.

It appears a common phenomenon with token programs that a certain percentage of the patient sample remain unaffected by the reinforcement procedure. Ayllon and Azrin (1965) reported that 18% (n = 8) of their chronic schizophrenic patients failed to be affected by the token procedure, and Atthowe and Krasner (1968) reported 10% (n = 6) of their patients not responding to the program. Throughout the present study, 20% (n = 6) of the patients made no verbal response at all, thus negating, in the case of this sample, Barton's (1972) suggestion of decreasing nonresponsiveness by including 'high', 'medium', and 'low', or nonresponders, within one group. Allen and Magaro (1971) suggest separating types of patients in accord with how they respond to token reinforcement. They reported that patients either responded independently of token reinforcement (46% of their sample), or responded

directly to the reinforcement contingencies (13%), or did not respond at all (41%). It could be deduced, therefore, that since only 13% responded uniquely to the token contingency, the use of token as reinforcers may be most appropriate for some intermediate group of patients.

Ayllon and Azrin found no differences between responders and nonresponders with regard to age, IQ, length of hospitalization, and diagnosis. Similarly, Allen and Magaro found that age and length of hospitalization were not related to improvement, or to responsiveness to the contingencies. However, Panek (1969)[1] reported improvements for separate diagnostic groups in a token program, with the chronic schizophrenics showing the greatest improvement and the mentally retarded the least. Atthowe and Krasner describe their nonresponders as those "who had previously been 'catatonically' withdrawn and isolated"; interestingly, in the current study, four of the six nonresponders had diagnoses of schizophrenia with catatonic tendencies. There are, however, more compelling reasons as to why there was such a high percentage of nonresponders: (1) the mixing of 'high' and 'low' responders could have had the effect of suppressing the emittance of any response from a typically low responder; (2) the backup reinforcers, cigarettes and chocolate, may have been not only insufficiently motivating, and even

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[1] Reported in Kazdin (1973).

inappropriate, for some patients, but also satiating, due to the lack of variation of reinforcers; (3) one or two subjects, possibly, did not understand the relationship between performance and reinforcement. Related to this last factor is the question of IQ and its influence upon the overall response behavior of the subjects. A significantly positive correlation was established between verbal response rate and scores on the Mill Hill Vocabulary Scale for this group of patients, and thus one could conclude that response rate was relative to the IQ of each individual subject. However, as indicated above, other researchers have concluded that IQ is not related to performance in token programs. Questions of an open-ended type were employed in the quiz sessions, thus partially overcoming the problem of IQ, and varying educational, environmental and cultural backgrounds.

Kazdin (1973c) lists other possible reasons for nonresponsiveness - e.g., the required behavior not being in the behavioral repertoire of some subjects, or the delay between token reinforcement and backup exchange being too long to enhance performance - and then suggests various means of ameliorating such situations. Relevant to this study would be the altering of the backup value of the tokens, response priming to increase responsiveness to token reinforcement, and individualized contingencies.

A small percentage of subjects made responses during the quiz session but seemed unaware that either

the same response had already been recorded or that they were using an incorrect stimulus letter. A separate recording of these responses was required, and as a consequence, these low or nonresponders could be seen as active participants in the program. One patient, a nonresponder, finger-traced letters on the floor during several sessions.

In conclusion, it appears that this group of psychiatric patients approximated the pattern of responding to token programs, as described by Allen and Magáro. In order to seek out the true effects of these different types of patient responders on the overall results obtained, and to gain information on the response characteristics of individual patients, group statistics such as means and averages need to be shelved and, following Allen and Magaro's suggestion, be replaced by a system of homogenous groupings of patients, using cumulative or noncumulative curves to observe what does occur in a token program as related to the different types of patient responders.

CHAPTER FIVE

C O N C L U S I O N.

Outside the laboratory setting, it is extremely unlikely that a CRF schedule ever naturally occurs. With token reinforcement programs, therefore, it is highly desirable that such contingencies be utilized as to replicate the outside community. The schedule probably most suited to this end is the VR schedule of reinforcement, for not only does it accurately reflect the contingencies that generally exist in the community, but also, it is an extremely powerful schedule for generating and maintaining behavior.

This investigation, although carried out in the "field" and not in a controlled laboratory setting, does show some indication that the VR schedule of reinforcement is a potent technique in maintaining a target behavior with a group of chronic psychiatric patients. Despite the potential influence of a number of extraneous variables, and lack of control groups, discussed above, these findings do lend support to the contention that intermittent reinforcement and in particular, VR reinforcement, is to be preferred to CRF within the context of token reinforcement programs.

That token programs be regarded as prosthetic

rather than therapeutic depends, undoubtedly, upon the type of contingencies that are employed by researchers, or ward staff, etc., in the token program. As Baer, Wolf and Risley (1968) state, "generalization should be programmed, rather than expected or lamented". One method of ensuring facilitation of generalization is the use of appropriate reinforcement schedules. This investigation, although not a complete token economy, does substantiate this point, and one might conclude, along with Paul (1969), that the token economy ward program is one of the few treatment programs which holds promise for counteracting the effects of institutionalisation and the rehabilitation of the chronic psychotic patient.

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APPENDIX 1.

NAME	AGE	DIAGNOSIS	SCORES ON : PROGRESSIVE MATRICES	MILL HILL	TOTAL RESPONSES
P.B.	59	MR	0	0	43
F.J.B.	57	RS	11	25	0
W.E.B.	55	RS	2	0	0
R.B.	43	E	10	13	108
G.B.	57	RS	16	13	26
P.B.	51	CS	10	13	1
J.C.	61	CS	16	0	0
W.G.C.	40	CS	0	0	0
G.C.	45	MR/E	24	19	333
S.D.	60	CS	0	0	0
C.V.D.	59	S	11	31	827
E.F.E.	52	MR	12	35	581
J.P.E.	42	CS	5	46	323
F.E.	62	RS	0	0	0
B.T.F.	59	RS	9	40	803
W.C.H.	45	MR	25	32	1744
L.M.H.	50	KP	9	38	1531
N.H.	52	PS	16	0	1216
A.C.H.	62	E	0	0	0
G.C.J.	63	RS	5	32	1152
E.V.J.	63	MR/SS	0	0	0
C.V.K.	57	E/MR	15	24	41
A.J.M.	62	CS	14	40	1201
D.A.M.	51	RS	14	20	0
D.M.	35	CS	8	11	128
G.W.M.	31	CS	20	60	377

Appendix 1, continued.

NAME	AGE	DIAGNOSIS	SCORES ON : PROGRESSIVE MATRICES	MILL HILL	TOTAL RESPONSES
F.M.O.	67	RS	15	32	739
W.A.R.	58	PS	7	54	864
J.A.S.	61	E/P	18	31	1442
R.M.S.	40	MR/AP	29	18	828
C.R.T.	44	CS	11	32	1434
B.G.W.	53	RS	29	0	0
A.W.	58	PS	11	19	1083
J.F.W.	79	IP	16	29	307
J.H.W.	46	MR	5	0	5
S.Y.	57	KP	17	0	1463

Key to Abbreviations:

AP - Anti-social personality

CS - Chronic schizophrenia

E - Epilepsy

IP - Involutional paraphrenia

KP - Korsakoffs psychosis

MR - Mental retardation

P - Psychosis

PS - Paranoid schizophrenia

RS - Residual schizophrenia

S - Schizophrenia

SS - Simple schizophrenia

APPENDIX 2.

SESSIONS

VARIABLE RATIO SCHEDULES

1.	GP.1(80%);GP.4(66%)	17.	GP.2(33%);GP.3(20%)
2.	GP.3(33%);GP.2(20%)	18.	GP.4(80%);GP.1(66%)
3.	GP.4;GP.3	19.	GP.2;GP.4
4.	GP.2;GP.1	20.	GP.3;GP.1
5.	GP.4;GP.3	21.	GP.4;GP.1
6.	GP.2;GP.1	22.	GP.2;GP.3
7.	GP.2;GP.3	23.	GP.1;GP.2
8.	GP.1;GP.4	24.	GP.3;GP.4
9.	GP.4(33%);GP.2(80%)	25.	GP.2(66%);GP.4(20%)
10.	GP.1(20%);GP.3(66%)	26.	GP.1(33%);GP.3(80%)
11.	GP.4;GP.2	27.	GP.1;GP.2
12.	GP.3;GP.1	28.	GP.3;GP.4
13.	GP.1;GP.4	29.	GP.3;GP.2
14.	GP.2;GP.3	30.	GP.4;GP.1
15.	GP.2;GP.3	31.	GP.3;GP.1
16.	GP.4;GP.1	32.	GP.2;GP.4

SESSIONS

EXTINCTION (NCR)

1.	GP.3;GP.4	7.	GP.2;GP.1
2.	GP.4;GP.2	8.	GP.4;GP.3
3.	GP.1;GP.4	9.	GP.2;GP.4
4.	GP.2;GP.3	10.	GP.1;GP.3
5.	GP.4;GP.1	11.	GP.4;GP.3
6.	GP.2;GP.3	12.	GP.1;GP.2