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# DEVIATIONS FROM ANIMAL STANDARDS IN HUMAN SCHEDULE PERFORMANCES THROUGH SELF-GENERATED VERBAL BEHAVIOR

## DESVIACIONES HUMANAS RESPECTO A ESTANDARES ANIMALES BAJO PROGRAMAS DE REFORZAMIENTO MEDIANTE LA AUTOGENERACION DE CONDUCTA VERBAL

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## RESUMEN

Se examinó la ejecución de personas y animales bajo programas múltiples de reforzamiento para probar su sensibilidad a las contingencias en cuatro diferentes programas múltiples de tres componentes . Con las personas además se examinó su ejecución cuando se les permitió generar sus propias reglas, cuando se les dió una regla o cuando no se les dió ninguna instrucción. Los resultados mostraron que la ejecución de personas y animales no difirió dramáticamente cuando se les permitió una breve exposición a las contingencias en cada programa. Aparentemente la habilidad de las personas para derivar reglas precisas, más que el tener un repertorio verbal, es la responsable de los resultados tradicionalmente diferentes entre las ejecuciones de personas y de animales en los programas de reforzamiento.

Palabras Clave: programas múltiples, autogeneración de reglas, control por reglas, presión de palanca, jalón de palanca, animales, humanos.

## ABSTRACT

Human and animal multiple schedule performances were examined for sensitivity to contingencies on four different three component multiple schedules. Human performances were additionally examined by either allowing subjects' concurrent self-generation of rules, the delivery of a rule, or left uninstructed.

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Results illustrated that human and animal performances did not differ dramatically when only brief exposure to contingencies were allowed on each schedule. Rather than simply a verbal repertoire, it appears that human subjects' ability to derive accurate self-rules more appropriately account for the traditional differing results between animal and human performances on schedules of reinforcement.

Key Words: multiple schedules, self-rules, rule governance, lever press, plunger pull, animal, human

Response patterns on fixed-interval (FI) schedules has been studied extensively in animals. Results show a pattern of a post-reinforcement pause with durations systematically related to the values of the fixed-interval, along with a higher number of responses during the later part of the inter-reinforcement interval (Ferster & Skinner, 1957). Studies with humans, on the other hand, have shown response patterns to be either a high steady rate, or a very low rate, with only one or two response per inter-reinforcement interval (Weiner, 1969; Baron, Kaufman, & Stauber, 1969).

Attempts to explain such differences between human and animal responding have centered on humans' verbal ability. Since human language is acquired over time, research using preverbal human children's performances on differing schedules has produced results that resemble animal performances, while older verbal children's performance under the same programmed contingencies has produced results resembling adult humans (Lowe, Beasty, Bentall, 1983; Bentall, Lowe, & Beasty, 1985, Bentall & Lowe, 1987).

The verbal activity of humans that may account for schedule atypical patterns has been argued to be their proclivity toward describing contingencies controlling their behavior, or their responding to contingency descriptions provided by others, that is , their rule generation or rule following repertoires, respectively (Matthews, Shimoff, Catania, & Sagvolden, 1977; Shimoff, Catania, & Matthews, 1981; Matthews, Catania, & Shimoff, 1985; Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986; Hayes, Brownstein, Haas, & Greenway, 1986). The performance of subjects under such cases is said to be insensitive to programmed contingencies.

This insensitivity is likely to be a disadvantage to the organism under conditions which contingencies are changing. Rule following behavior may be restricted in variability when such variability is necessary to contact programmed contingencies (Joyce & Chase, 1990). Although poor performance is often a product of experimenter given rules, the same is not true for self-generated rules. Subjects who generate self-rules that describe important aspects of the experimental situation often perform more successful than those who do not (Dixon and Hayes, 1996; Wulfert, Dougher, & Greenway, 1991).

The present study examined the correspondence of human to animal response patterns and sensitivity to changing contingencies on a variety of multiple schedules. Three groups of human subjects were compared to animal responding of rats with the same amount of exposure on the same schedules. The comparison between animal and human subjects' responding on identical schedules of reinforcement may allow for a clearer examination of the interaction of a verbal repertoire on responding, than simply comparing human performance to animal standards that have developed over thousands of trials in different experiments.

## METHOD

*Subjects*

Three male Sprague Dawley albino rats, maintained at 85% of their free-feeding weights, and 15 human undergraduate psychology students served as subjects. Of the 15 human subjects, 3 were randomly assigned to group one, 9 to group two, and 3 to group three.

*Apparatus*

*Human.* The experimental room contained a rear screen slide projector, a response console, headphones that delivered white noise, and a panel affixed to the wall above the console containing cards for rule generating, rule receiving, or irrelevant verbal responding. The subjects' console was a trapezoidal box containing two rows of lights, below which was a counter labeled "points earned" with a yellow signal light, and below that, a Lindsley plunger pull manipulandum set at 1 kg tension. The top row of lights consisted of 3 white stimulus lights.

Stimuli in the form of light presentations, reinforcement counts, and instructional slides were presented from an adjacent control room where responses were monitored by response counter and cumulative recorder. Subjects were also visually monitored by a one-directional mirror that separated the two rooms.

*Animal.* Subjects were run in a modified operant conditioning chamber containing 3 stimulus lights, 1 lever, and a food magazine.

*General Procedure: Human Subjects*

All subjects were required to participate in 5 sessions on successive days. Each subject was exposed to a pretraining session followed by 4 experimental sessions. In each of the experimental sessions, a different three component multiple schedule (A-D) was in effect. Schedules were as follows: (A) fixed interval (FI)30"-fixed ratio (FR)30 -FR30 with a 30" limited hold (LH); (B) FR30-FI30"-FR30(30" LH); (C) variable interval (VI) 20"- variable ratio (VR) 20-VR20(LH20"); and (D) VR20-VI20-VR20(20" LH).

*Pretraining.* Subjects were informed that they would receive bonus course credit as well as monetary reinforcement contingent upon their performance during all sessions. Subjects were then told to earn as many points as possible when the green light above the experimental apparatus was illuminated. Point earnings were indicated by a flashing of a yellow signal light and were displayed on a counter. Following these minimal instructions, successive approximations toward the target response of pulling the plunger were shaped. Pulls were initially reinforced on a CRF, and gradually increased to a FR40.

*Training.* Each session began with the presentation of three instructional slides indicating that points were available when the green light was on, not available when the red light was on, and to try to earn as many points as possible. Following these instructions, the green light was illuminated and each group of subjects followed their specific group procedures.

*Specific Procedures for Group 1.* In addition to the green light being illuminated, a white stimulus light (Sd1) was turned on, indicating the beginning of the first component of the multiple schedule. The first component was in effect until 3 reinforcers were delivered. Following this , the green light was turned off, the red light was turned on, and an instructional slide that asked the subject to remove a card from the panel above the console was presented. The card instructed the subjects to report in writing on the card what they had to do to earn points. Subjects were given 30 seconds to respond.

At this time another instructional slide asked the subject to return the card to the panel, and the screen went blank. The same sequence of events took place during the second and third components of the multiple schedule, yet differed only in that the second of the three white lights were illuminated during component two, and the third during component three. The entire schedule was presented 5 times. During subsequent component presentations, the report card from the previous reporting appeared again, and reports were allowed to be revised.

*Specific procedure for Group 2.* The same general procedure was in effect for Group 2 except instead of generating rules, these subjects were given access to the rules one at a time that generated by a yoked Group 1 subject in the same order in which they were generated. Three Group 2 subjects were yoked to each Group 1 subject.

*Specific procedure for Group 3.* The same general procedure was in effect for Group 3 except instead of generating rules or being yoked to a rule generator, when the report cards were presented it instructed these subjects to answer task-irrelevant questions, such as "what is art?".

*Procedure for Animal Subjects (Group 4).* The 3 animal subjects were exposed to comparable multiple schedules over four sessions, following a pretraining session. The verbal tasks of the human subjects were replaced by 30" time-outs from the opportunity to earn reinforcement.

## RESULTS

The data obtained from both animal and human subjects during the five presentations of each multiple schedule were averaged to illustrate overall response patterns.

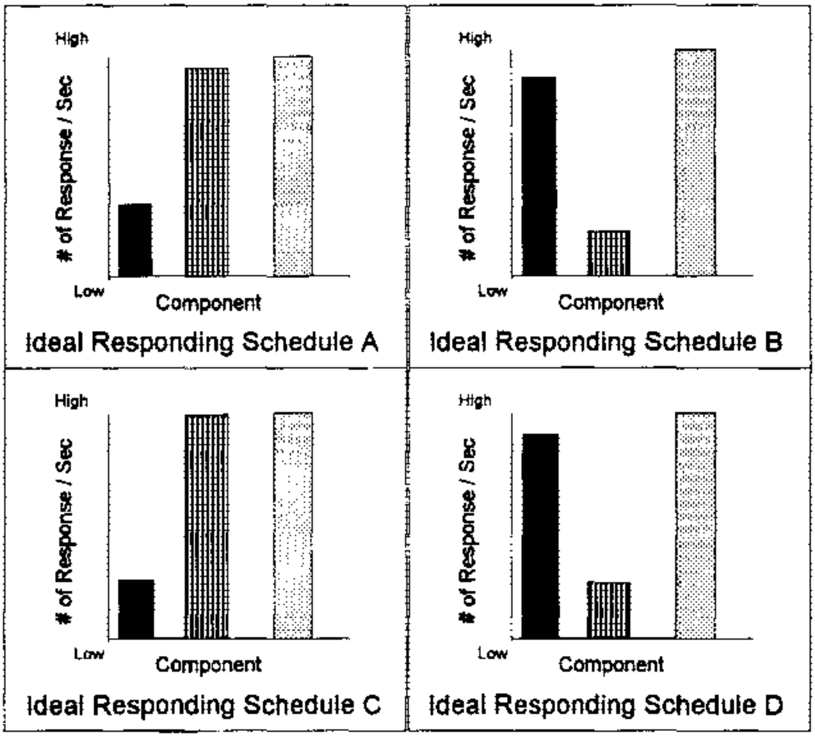


Figure 1. Ideal average response rates across the three components for each of the four multiple schedule used in the present study

Comparisons between the average animal standard and human schedule performance were based on the pattern of responding and the relative variability of response rates across the three components of each multiple schedule. Figure 1 displays schedule sensitive, or ideal response rates for each of the four multiple schedules.

Figure 2 indicates that sensitivity to programmed contingencies was found in one subject in Group 1, and the three Group 2(A) subjects that were yoked to that subject.

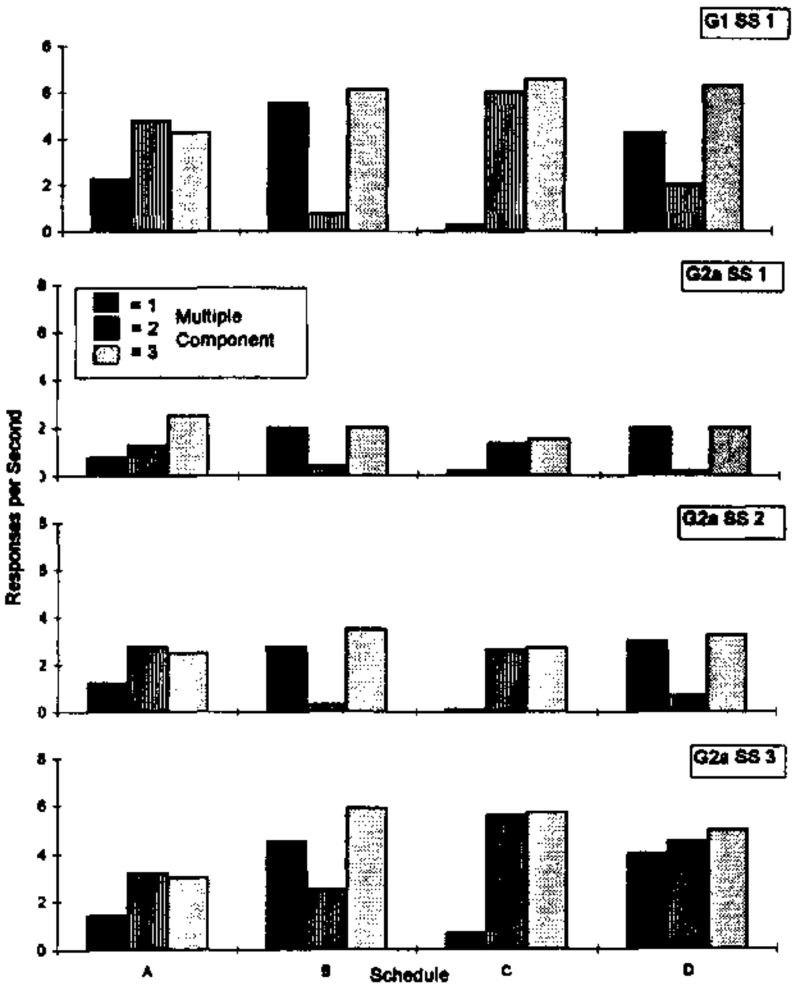


Figure 2. Averaged response rates across the three components of each of the four multiple schedules for human subject 1 in group 1 (rule generator), as well as the three human subjects in group 2 that were yoked to that subject (rule receivers)

All other human, and all animal subjects did not display schedule typical response rates. Their data can be found in Figures 3-6. For subjects in Groups 2(B) and 2(C), responding closely resembled that of their yoked rule-generator of Group 1. This indicates that although performances were not contingency sensitive, they were in fact rule-governed by the yoked instructions of their corresponding rule-giver

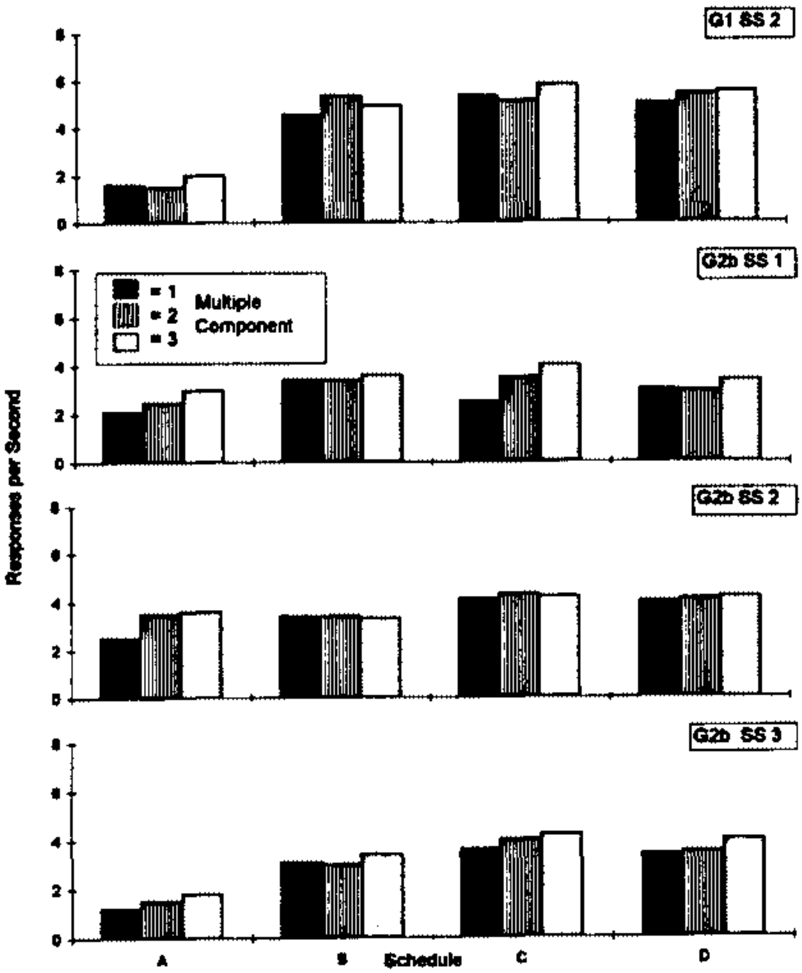


Figure 3. Averaged response rates across the three components of each of the four multiple schedules for human subject 2 in group 1 (rule generator), as well as the three human subjects in group 2 that were yoked to that subject (rule receivers)

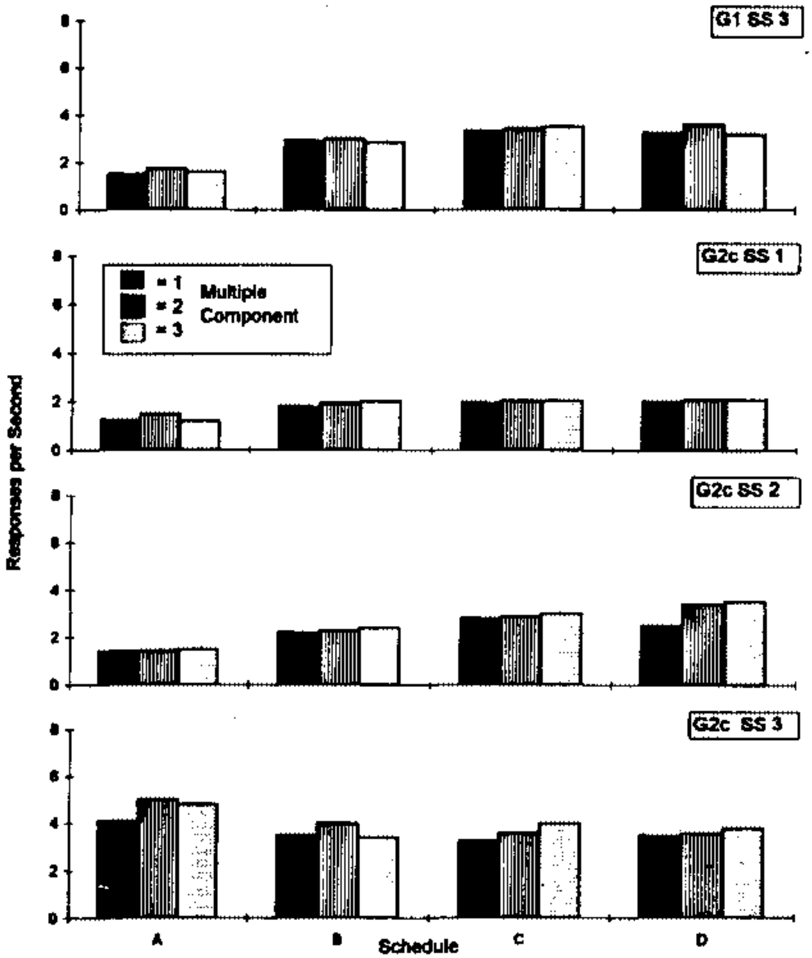


Figure 4. Averaged response rates across the three components of each of the four multiple schedule for human subject 2 in group 1 (rule generator), as well as the three human subjects in group 2 that were yoked to that subject (rule receivers)

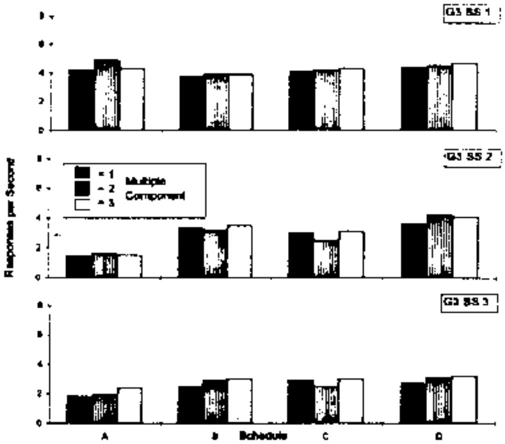


Figure 5. Averaged response rates across the three components of each of the four multiple schedules for the three human subjects in the uninstructed group

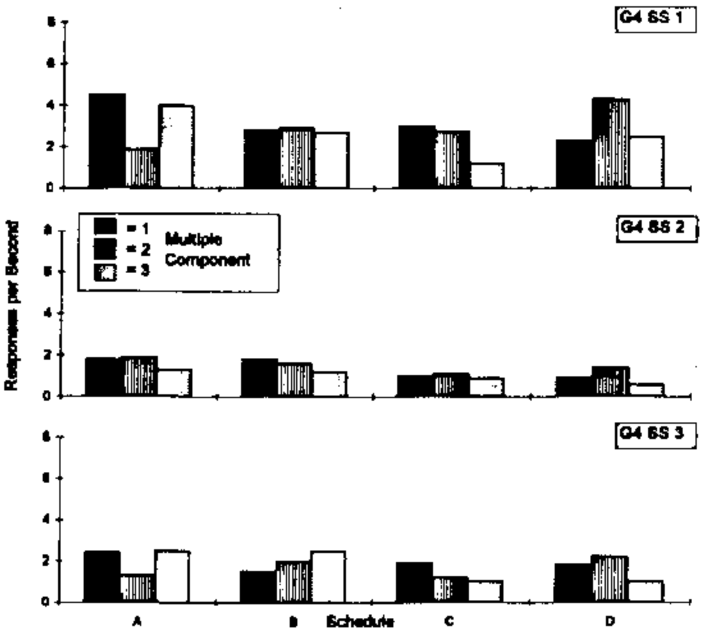


Figure 6. Averaged response rates across the three components of each of the four multiple schedules for the three animal subjects

Results also show that SS 1 generated accurate rules for all components of the multiple schedules, while SS 2 did not generate any accurate rules for any components, and SS 3 generated accurate rules for only the ratio components of the schedules. Although all Group 2 subjects had the opportunity to revise their self-rules, only SS1 consistently revised any initially inaccurate rules. Subject 2 did not revise any rule, while SS3 occasionally revised rules. Table 1 provides a summary of rule accuracy and revision for all three subjects.

Table 1. Accuracy and revision of group 1 self-generated rules.

| | Multiples Schedules | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Accuracy of Rules | | | | Revision of Rules | | | |
| Subject | A | B | C | D | A | B | C | D |
| 1 | y/y/y | y/y/y | y/y/y | y/y/y | y/y/y | y/y/y | y/y/y | y/y/y |
| 2 | n/n/n | n/n/n | n/n/n | n/n/n | n/n/n | n/n/n | n/n/n | n/n/n |
| 3 | n/y/y | y/n/n | n/y/y | y/y/y | y/y/y | y/y/y | n/n/n | y/y/y |

## DISCUSSION

In previous research, human schedule performances have deviated from the classical "scallop pattern" of fixed interval schedules and the "break and run" pattern of fixed ratio schedules found in nonhumans. These deviations have been the basis for considerable theorizing concerning the influence of human language on nonverbal behavior and the ways in which it may override or compete with contingency control over nonverbal behavior. Although most studies have compared human performance with a previously established animal standard obtained under different durations of schedule presentation, the present study employed the use of animal standards obtained under exact conditions of reinforcement that were made available to its' human subjects.

Neither the animals nor the humans demonstrated the "classical patterns" characteristic of animals reported in the literature. Moreover, human rates of responding were quite similar to that of the rats. The failure of animal subjects to show schedule sensitivity in the present experiment is likely due to their brief exposure to these schedules relative to exposures supported in the literature. The text by Ferster and Skinner, (1957) is often used to compare schedule appropriate and inappropriate response rates, as well as differences between human and nonhumans performances on these schedules of reinforcement (Lowe, et. al, 1983; Matthews, Shimoff, & Catania, 1977; Shimoff, Catania, & Matthews, 1981). Such comparisons may be problematic since the responses patterns summarized in that text are based on "approximately 70,000 recorded hours, during which the experimental organisms (pigeons) emitted approximately one-quarter of a billion responses" (pg.38), while human subject studies are run on these schedules for very much shorter periods of time. Torgrud and Holborn (1990) have suggested that extended exposure to programmed contingencies may result in human subjects' behavior coming under control of programmed contingencies. If the present study was carried out for many more sessions, animal, as well as human performances, may have been brought under schedule control.

Rule-governed behavior has been found to interfere with human's contact with programmed contingencies (Skinner, 1969; Baron, et. al, 1969) The rule-following which occurred in Group 2 subjects was demonstrated by the fact that only subjects given accurate yoked rules became schedule sensitive. In other words, everyone followed the yoked rules, and if those rules were accurate, schedule appropriate behavior was emitted. Such findings are consistent with Hayes, Brownstein, Zettle, Rosenfarb, & Korn, (1986) that when subjects are given specific instructions as to how to solve a problem their behavior often coincided with that rule regardless of its' accuracy.

Requiring human subjects to perform a concurrent activity has been found to interfere with schedule sensitivity (Barnes & Keenan, 1993). Therefore the task of asking irrelevant questions given to Group 3 subjects of the present experiment, appeared to have produced a similar effect. It is suggested by the present findings that such tasks may actually interfere with subjects' self-rule generation, and it is this behavior that is responsible for schedule sensitivity.

It appears that assumptions regarding human "insensitivity" to programmed contingencies can not be based strictly on possessing a verbal repertoire . Rather, the absence of overt emission of certain responses within that repertoire during the experimental situation may account for this insensitivity. Group 1 SS1's responding was "schedule sensitive", as a result of consistently editing his overtly emitted self-rules as to how to solve the problem. The other two subjects in this group did not consistently edit their self-rules, and subsequently did not respond sensitively to the contingencies. This leads us to conclude that the consistent revision of self-instructions is an important variable in human schedule performances.

In summary, classical response patterns on schedules of reinforcement are not characteristics of animal responding when schedule exposure is brief. Rather, they may be the result of extended exposure to contingencies. Results of the present experiment indicate that during brief exposure to the same contingencies, response rates are quite similar between verbal and nonverbal organisms. Differences in these rates may not be due to the mere possession of verbal abilities. Instead, it appears that the verbal responses actually emitted within that verbal repertoire during the experimental situation effect performance. Human subjects who consistently generate and revise self-instructions, contact programmed contingencies more readily than those who do not.

## REFERENCES

Baron, A., Kaufman, A., & Stauber, K. (1969). Effects of instructions and reinforcement - feedback on human operant behavior maintained by fixed-interval reinforcement. *Journal of the Experimental Analysis of Behavior, 12,* 701-712.

Bentall, R.P., Lowe, C.F., & Beasty, A. (1985). The role of verbal behavior in human learning: II. Developmental differences. *Journal of the Experimental Analysis of Behavior, 43,* 165-181.

Bentall, R.P., & Lowe, C.F. (1987). The role of verbal behavior in human learning: III. Instructional effects in children. *Journal of the Experimental Analysis of Behavior, 47,* 177-190.

Dixon, M. R., & Hayes, L. J. (1996). The effects of different instructional histories on response variability and the resurgence of rule-following during extinction. Unpublished master's thesis.

Ferster, C., Skinner, B.F. (1957). *Schedules of reinforcement.* Appleton-Century-Crofts: New York.

Hayes, S.C., Brownstein, A.J., Haas, J.R., & Greenway, D.E. (1986). Instructions, multiple schedules, and extinction: Distinguishing rule-governed from schedule-controlled behavior. *Journal of the Experimental Analysis of Behavior, 46,* 137-148.

Hayes, S.C., Brownstein, A.J. Zettle, R.D., Rosenfarb, I., Korn, Z. (1986). Rule-governed behavior and sensitivity to changing consequences of responding. *Journal of the Experimental Analysis of Behavior, 45,* 237-256.

Joyce, J.H., & Chase, P.N. (1990). Effects of response variability on the sensitivity of rule-governed behavior. *Journal of the Experimental Analysis of Behavior, 54,* 251-262.

Lowe, C.F., Beasty, A., Bentall, R.P. (1983). The role of verbal behavior in human learning: Infant performance on schedules of reinforcement. *Journal of the Experimental Analysis of Behavior,39,* 157-164.

Matthews, B.A., Catania, A.C., & Shimoff, E. (1985). Effects of uninstructed verbal behavior on nonverbal responding: Contingency descriptions versus performance descriptions. *Journal of the Experimental Analysis of Behavior, 43,* 155-164.

Matthews, B.A., Shimoff, E., Catania, A.C., & Sagvolden (1977). Uninstructed human responding: Sensitivity to ratio and interval contingencies. *Journal of the Experimental Analysis of Behavior, 27,* 453-467.

Shimoff, Catania, Matthews (1981). Uninstructed human responding: Sensitivity of low-rate performance to schedule contingencies. *Journal of the Experimental Analysis of Behavior, 36,* 207-220.

Torgrud, L.J. & Holborn, S.W. (1990). The effects of verbal performance descriptions on nonverbal operant responding. *Journal of the Experimental Analysis of Behavior, 54,* 273-292.

Weiner, H. (1969). Controlling human fixed-interval performance. Journal of the Experimental Analysis of Behavior, 12, 349-373.

Wulfert, E., Dougher, M.J., & Greenway, D.E. (1991). Protocol analysis of the correspondence of verbal behavior and equivalence class formation. *Journal of the Experimental Analysis of Behavior, 56,* 489-504.