The Psychological Record, 2004, 54, 405-422

HUMAN SCHEDULE PERFORMANCE, PROTOCOL ANALYSIS, AND THE "SILENT DOG" METHODOLOGY

FRANCISCO CABELLO
Universidad de La Rioja (Spain)

CARMEN LUCIANO and
INMACULADA GOMEZ
Universidad de Almeria (Spain)

DERMOT BARNES-HOLMES
National University of Ireland, Maynooth

The purpose of the current experiment was to investigate the role of private verbal behavior on the operant performances of human adults, using a protocol analysis procedure with additional methodological controls (the "silent dog" method). Twelve subjects were exposed to fixed ratio 8 and differential reinforcement of low rate 3-s schedules. For 6 subjects, verbal self-reports were recorded concurrently during exposure to the reinforcement schedules. Results showed a significant relationship between certain types of rules and task performances, and especially between counting and schedule-sensitive performance. A detailed analysis also suggested that counting facilitated the discrimination of programmed contingencies in the current task. Suggestions are offered for further research involving the use of the protocol analysis methodology.

Since the 1960s, a significant number of studies have analyzed the impact of verbal behavior on the performance of human subjects. Some research has focused on the role played by instructions in facilitating schedule-sensitive performances (Baron, Kaufman, & Stauber, 1969; Gomez & Luciano, 2000; Harzem, Lowe, & Bagshaw, 1978; Leander, Lippman, & Meyer, 1968; Lowe, Harzem, & Hughes, 1978; Shimoff, Catania, & Matthews, 1981; Weiner, 1970). Other investigators have shown that the operant performances of nonverbal children are similar to animal performances, but as children begin to acquire verbal abilities, they respond like human adults (Bentall & Lowe, 1987; Bentall, Lowe, & Beasty, 1985; Lowe, 1979). Furthermore, research has shown that when verbal behavior is disrupted (i.e., with a concurrent task) the performances of human subjects are most likely to resemble those of animals (Laties & Weiss, 1963; Lowe et al., 1978). This type of research

This research was conducted in partial fulfillment of a doctoral program by Francisco Cabello at Universidad de Almeria, under the supervision of Carmen Luciano. We thank Sonsoles Valdivia for helping with the experiment, and the members of the RFT Lab at NUI Maynooth for reading and commenting on an earlier draft of the manuscript. Please address all correspondence to Francisco Cabello, Unidad de Ciencias Sociales del Trabajo, Universidad de La Rioja, Spain 26004. (E-mail: f.cabelloluque@terra.es).

has been used to support the argument that a distinction should be drawn between verbal and nonverbal behavior, and that for humans, verbal behavior may in certain contexts override the effect of consequences produced by nonverbal behavior, thus producing an apparent lack of adjustment to direct contingencies (Galizio, 1979; Skinner, 1957, 1969).

Some studies have attempted to explore the relationship between verbal and nonverbal behavior, focusing on the effects of different instructions, or rules stated by others (for a review, see Chase & Danforth, 1991; Hayes, Zettle, & Rosenfarb, 1989). For example, Hayes, Brownstein, Haas, and Greenway (1986) showed that when the instructions were specific and corresponded to scheduled contingencies, the nonverbal performances were less sensitive to changes in contingencies. However, when instructions described no contingencies or inaccurate contingencies, they produced more behavioral variability and greater schedule-sensitivity. Although similar relationships between instructions and nonverbal responding were obtained by several researchers, thus demonstrating the relevance of the content of instructions on the control of human behavior (Matthews, Catania, & Shimoff, 1985; Ribes & Sanchez, 1992), other investigators have focused on the analysis of the interaction between verbal behavior that subjects produce about their own nonverbal behavior, and experimental performances. This analysis is typically based on the use of verbal reports, which often refer to some form of verbal regulation during experiments, such as describing, giving reasons, explaining, counting, and so on (e.g., Barnes & Keenan, 1989, 1993; Holland, 1958; Leander et al., 1968; Molina & Luciano, 2002).

In obtaining verbal reports, some investigators have used postsession questionnaires that attempt to tap into the types of verbal regulation that subjects exhibit during task performance (see Lowe, 1983). However, some caution is required when verbal reports are obtained post hoc, because they are based on the assumption that the verbal behavior that occurs during the experiment corresponds with the verbal reports obtained after the experiment (Ericsson & Simon, 1984; Shimoff, 1986). In response to this problem, Rosenfarb, Newland, Brannon, and Howey (1992) conducted a study that involved obtaining multiple verbal reports at various points throughout the experiment, rather than obtaining a single report at the very end. Subjects were exposed to differential reinforcement of low rate 5-s (DRL5-s) and fixed ratio 8 (FR8) schedules, using an experimental task that involved moving a circle through a grid by pressing several buttons. Subjects were assigned to one of three conditions: self-generated rules, yoked rules, and no rules. Results showed that, in general, the behavior of subjects corresponded to the rules they stated. Furthermore, formulating rules, or being exposed to them, initially led to better control by complex contingencies, but the rules also produced less sensitivity when a change in the contingencies occurred, and when subjects were exposed to extinction.

The present study is also focused on the issue of verbal regulation,

and particularly on the role of verbal behavior in facilitating or hindering contact with programmed contingencies. As in the Rosenfarb et al. (1992) study, subjects were exposed to a computerized task involving the movement of a circle through a grid under different reinforcement schedules (FR8 and DRL3-s) that alternated during sessions. Moreover, the current experiment aims to solve problems related to the collection of self-reports. In the Rosenfarb et al. (1992) study, self-reports were obtained within each session but *after* each schedule, whereas in the current study they were obtained concurrently during task performance using the protocol analysis technique (Ericsson & Simon, 1984).

In addition to this technique, the "silent dog" controls proposed by Hayes (1986) were also used. This method consists of several controls to ensure correspondence between verbal self-reports and private verbal behavior, and to isolate the function of self-reports in relation to the experimental performances. The first control states that requiring subjects to think aloud should not affect their performance on task, which may be accomplished with a comparison between experimental conditions required to think aloud and not required to do so. The second control suggests that disrupting self-talk should alter subjects' performances, and thus the verbal stream has to be disrupted through experimental manipulations. Finally, the third control in the "silent dog" method uses verbal behavior from subjects in think-aloud conditions to alter task performance for other subjects in a consistent manner. If results show the expected pattern across the three controls, it can be concluded that the verbal behavior is task-relevant and, therefore, that private self-talk in the silent condition and the overt verbalizations in the think-aloud condition, are functionally the same (Barnes-Holmes, Hayes, & Dymond, 2001; Cabello & O' Hora, 2002; Hayes, White, & Bissett, 1998).

In accordance with the "silent dog" method, several experimental conditions were employed in which some subjects were instructed to think aloud during the task whereas others remained silent (Control 1). Furthermore, some of the subjects were exposed to simultaneous activities to disrupt self-talk, whereas others were not (Control 2). Public self-talk was recorded for subjects in the think-aloud conditions, and a protocol analysis was performed using different categories. A detailed analysis was performed to determine how these categories of verbal utterances related, on a moment-to-moment basis, to performances on the schedules.

Method

Subjects

Participants were 12 undergraduate volunteers (9 male, 3 female). None of them had previous experience with psychology experiments nor were they psychology majors.

Apparatus

All sessions were conducted in a room equipped with a PC

microcomputer (Intel Pentium 166, 32 MB RAM) with a keyboard, a 14" color monitor, 60-W stereo speakers, and a tabletop microphone connected to a hidden tape recorder (Sony TCM-S68V). All sessions were controlled by software programmed in Visual Basic, which also recorded task performances (for further information on the use of Visual Basic for experimental psychology, see Cabello, Barnes-Holmes, Stewart, & O´Hora, 2002).

Experimental Task

During the experimental task, subjects were seated in front of the computer, and the screen presented a 6 x 6 square grid (see Figure 1). Subjects had to move a black circle from the upper-left corner, to reach a symbol placed randomly in the grid (the symbol varied in shape in a random sequence including a cross, a triangle, a pentagon, or a star). Movement of the circle was under the control of one of two different schedules: FR8 and DRL3-s. This is an experimental preparation similar to that employed by Hayes et al. (1986), because the requirements of the two schedules are very different, and thus they permit a clear analysis of the adjustment to the change in the programmed contingencies, and of the effect of verbal behavior. Unlike the study by Hayes et al., however, no distinct stimulus was correlated with each schedule in the current experiment (e.g., a green light with the FR8 schedule or a red light with the DRL3-s schedule). Instead, the movement of the circle itself provided feedback for the task performances (i.e., if subjects responded in accordance with the schedule contingencies the circle would move reliably—if they did not the circle would remain stationary).

To emit a response on either schedule, subjects were required to press the space bar on the computer keyboard (e.g., FR8 required eight bar presses, whereas DRL3-s required only one bar press after 3 or more

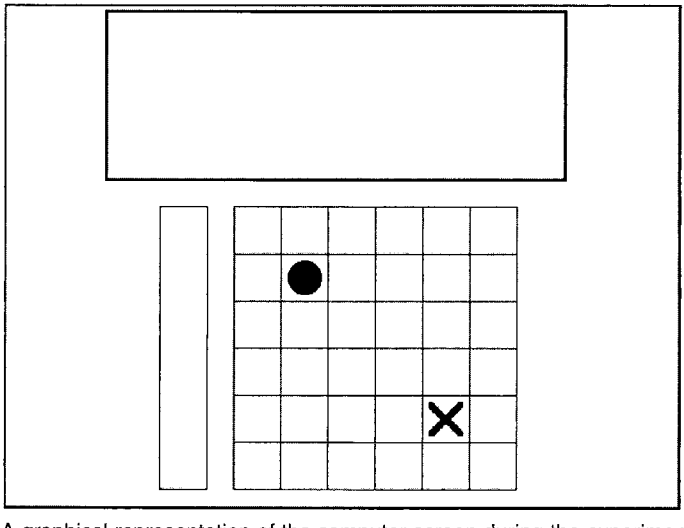

Figure 1. A graphical representation of the computer screen during the experimental task.

sec without responding). Once the schedule criterion had been reached, subjects had to press one of the arrow keys on the keyboard to move the circle into the next square in the grid, in the direction marked by the pressed key (e.g., pressing the down arrow to move the circle into the next square below). If subjects pressed the arrow key before the schedule criterion was met, the number of bar presses recorded on the FR8 schedule was set to 0, or the time since the last response on the DRL3-s schedule was set to 0. Pressing the arrow keys thus served as a consummatory response (see Harzem et al., 1978; Matthews, Shimoff, Catania, & Sagvolden, 1977).

When the circle reached the symbol, a computer-generated "beep" was presented and one point was added to a counter at left of the grid. The circle appeared again in the upper-left corner of the grid, while the symbol appeared in a random position, and with a new shape.

Procedure

Subjects were recruited through in-class announcements. They were told that the Department of Psychology was conducting an experiment to examine learning processes, and the results could be used to help individuals with learning disabilities. All participants volunteered for the study and received no money or academic credits (only a token that could be exchanged for beverages in the student bar on the campus).

Four experimental conditions were employed: public self-reports and simultaneous activities (Condition 1); public self-reports without simultaneous activities (Condition 2); no public self-reports with simultaneous activities (Condition 3); and no public self-reports without simultaneous activities (Condition 4). These conditions were designed to check for the "silent dog" Controls 1 (think-aloud versus silent conditions) and 2 (disrupted versus no-disrupted conditions).

Subjects were randomly assigned to one of four conditions, with 3 subjects in each condition. For all conditions, the experiment was divided into two sessions of about 1 hr each, taking place on the same day. Figure 2 shows a diagram representing the experimental sequence.

Session 1

Subjects were first given a "personal identification number" (PIN) for identification on the computer. They were then brought to the experimental room, where the experimenter provided general instructions about the task, such as the response sequence and the schedules. Subjects in Conditions 1 and 2 were also told that they must think aloud during the task, while subjects in Conditions 1 and 3 were told about the simultaneous activities. After addressing any points raised by the subjects, the experimenter left the experimental room.

Once the subjects had entered their PIN in the computer, they were provided with detailed instructions about the task through screen messages (see Appendix). Pressing the space bar presented the next message. Subsequently, all subjects completed a preexperimental test,

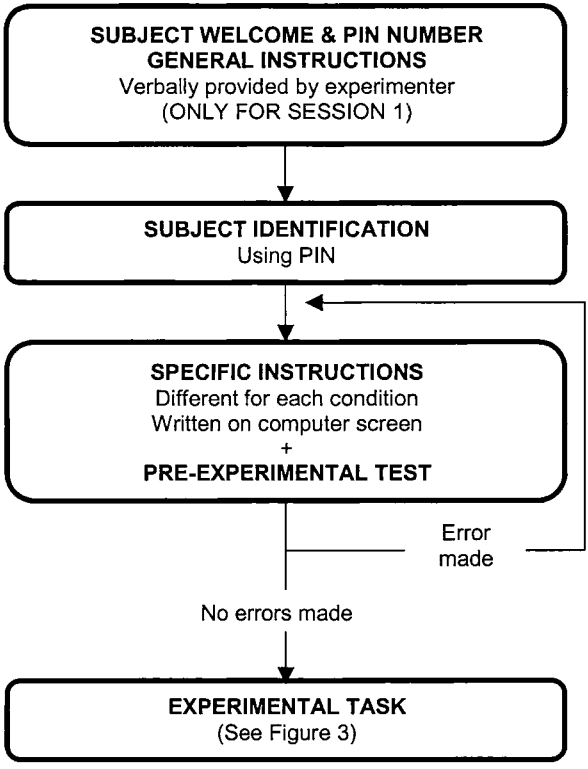

Figure 2. The sequence for experimental sessions.

involving several questions, in order to check that they had understood the instructions. Each question was presented at the top of the screen followed by three answers, only one of which was correct. The subjects used the cursor and spacebar to select the answer to each question. If an answer was incorrect, the screen showed the following message: "YOUR ANSWER IS NOT CORRECT. THE COMPUTER WILL SHOW THE INSTRUCTIONS AGAIN, PLEASE READ CAREFULLY." This was followed by the instructions and the test. If an answer was correct, the next question was presented. When no errors were made, a message indicated the task was about to begin ("YOU DEMONSTRATED THAT YOU KNOW WHAT TO DO. LET'S BEGIN.")

Each of the two sessions was divided into halves. Subjects in the four experimental conditions were exposed to the same sequence of schedules (see Figure 3). The first half of the session started with FR8, which lasted for a maximum of 15 min. Making three correct consecutive responses was defined as adjustment to the schedule (a correct response was defined as pressing the space bar exactly eight times, and then pressing the arrow key to move the circle). If subjects' behavior adjusted to the schedule in this way, the subjects were exposed to the

schedule for an additional 4 min. If the 15-min limit elapsed without a subject showing adjustment to the FR8 schedule, the subject was not exposed to the DRL3-s schedule.

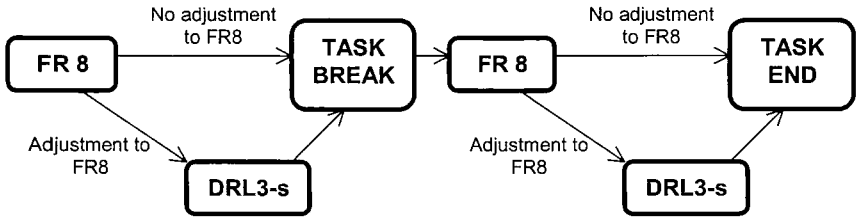

Figure 3. The schedule sequence during the experimental task.

Subjects who did show adjustment to FR8 were exposed to DRL3-s for a maximum of 5 min, or until a subject emitted three consecutively correct responses (i.e., pressing the space bar once, and once only, after an interval of 3 or more sec without responding). If subjects adjusted to the schedule in this way, they were exposed to the schedule for an additional 4 min. If adjustment did not occur during the 5-min interval, exposure to that particular schedule was terminated.

All subjects were permitted a short break between halves of the session. The length of the break was determined by the subject, but lasted no longer than 1 min. In the second half of the session, subjects were exposed to the same sequence of schedules as in the first half (i.e., starting with FR8, and if adjustment was shown, followed by DRL3-s). After exposure to the schedules, the session was finished, and a message appeared on the computer screen stating, "SESSION FINISHED."

A message box was placed on the top of the screen to provide written messages to subjects while the task was ongoing. In the think-aloud conditions, the experimenter monitored silence from another room, and if subjects were silent for more than 30 sec, a written reminder appeared in the message box: "REMEMBER TO THINK ALOUD." For subjects in the simultaneous activities conditions, two activities were presented in the message box for each schedule during 30-s intervals; the first activity was presented after 1 min from the beginning of the schedule, and the second activity was presented after 2 min. In the first half of the session, the message prompted subjects to count forwards and backwards during exposure to the FR8 schedule, and to add three numbers and multiply two numbers during the DRL3-s schedule. In the second half of the session, during the FR8 schedule, the activities involved forming a word using syllables (e.g., COMPUTER using TER-COM-PU), and forming words using the last syllable of a previous word to begin a subsequent word (e.g., given PIG*LET*, a correct response would be *LET*TER). During the DRL3-s schedule, activities involved spelling backwards (e.g., E-L-B-A-T for table) and repeating a word (e.g., repeating RED ROSE many times).

Session 2

This session was the same as Session 1, except that the experimenter did not provide the general instructions pertaining to the task at the beginning of the session. After completing the second session, subjects were debriefed and were given a beverage token.

Results

Operant Performances

Overall performances produced by the subjects were described by the adjustment index employed by previous researchers (Hayes et al., 1986; Rosenfarb et al., 1992). An index was calculated for each subject, by dividing the response rate in the FR8 schedule by the combined response rates for the FR8 and DRL3-s schedules. The closer the index value to 1, the better adjustment to the reinforcement contingencies, whereas values closer to 0 indicate worse adjustment. Table 1 shows index values for all subjects. The data indicate that for all conditions, the subjects produced similar overall performances. Two subjects in each of Conditions 1, 2, and 4 obtained an index approaching 0.7 or above (showing adjustment to both schedules), whereas the remaining subject in each of these three conditions obtained a lower index (showing adjustment only to the FR8 schedule). Subjects from Condition 3 showed lower indices relative to the other conditions, but the differences are relatively small, and as in the other three conditions, 2 of the subjects showed adjustment to both schedules and the 3rd subject adjustment to the FR schedule alone.

Table 1

Adjustment Index

	Subject	Index	Adjustment		Subject	Index	Adjustment
Cond. 1 Reports & Activities	1	0.485	FR only	Cond. 3 No Reports & Activities	7	0.482	FR only
	2	0.692	FR+DRL		8	0.675	FR+DRL
	3	0.869	FR+DRL		9	0.580	FR+DRL
Cond. 2 Reports & No Activities	4	0.808	FR+DRL	Cond. 4 No Reports & No Activities	10	0.821	FR+DRL
	5	0.533	FR only		11	0.802	FR+DRL
	6	0.831	FR+DRL		12	0.473	FR only

Silent Dog Controls

Although the primary purpose of the study was to examine the relationship between on task verbal behavior and schedule performance at the level of the individual subject (not groups), the "silent dog" controls require that comparisons first be made between experimental conditions. Control 1 (self-reports should not affect task performance) involved two

comparisons: one between Condition 1 and Condition 3 (think-aloud versus silent conditions with simultaneous activities), and one between Condition 2 and Condition 4 (think-aloud versus silent conditions without simultaneous activities). These comparisons showed no obvious performance differences between think-aloud and silent conditions, as indicated in Table 1.

Control 2 (disrupting self-talk must alter task performance) involved a single comparison between data from Conditions 1 and 3 (with simultaneous activities) versus data from Conditions 2 and 4 (without simultaneous activities). As expected, disrupting the verbal stream through simultaneous activities proved to be difficult (as indicated in Figure 4).[1]

Figure 4 shows a cumulative record using data from Subject 2 in Session 2, who had demonstrated adjustment to both schedules in the previous session. The data demonstrate that, when reexposed to the FR8 schedule, the subject showed good performance (as demonstrated by the constant increase in number of correct trials achieved). However, when simultaneous activities were presented, performance was significantly worse and no correct trials were achieved.

Although differences between conditions with and without simultaneous activities emerged during the exposures to the simultaneous activities, the impact of such activities apparently

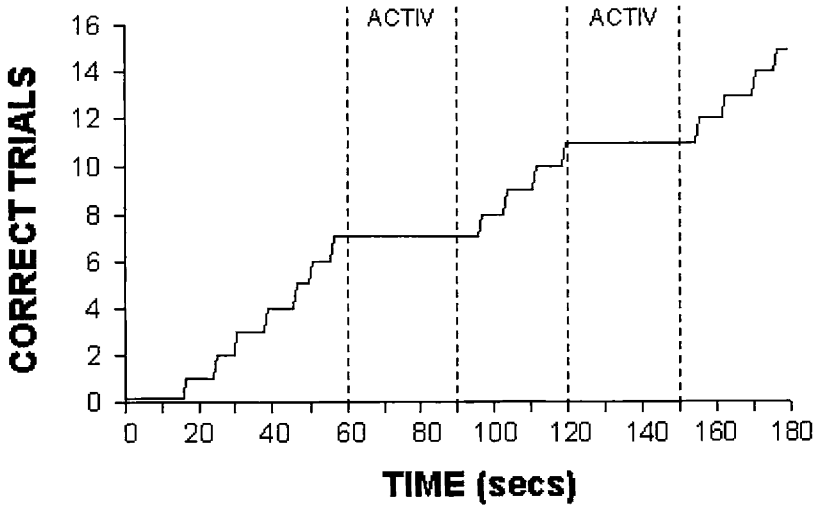

Figure 4. Effect of simultaneous activities on the responding of Subject 2. The *x* axis indicates time (in sec), whereas the *y* axis represents the cumulative number of correct trials. "ACTIV" indicates the time interval in which activities were presented.

[1]Given the large amount of data related to the impact of simultaneous activities, only a limited set of data is included here; the full set of data is available upon request from Francisco Cabello.

decreased during the experiment and they were not apparent by the end of the study. Therefore, the overall performances of subjects in all conditions were similar (see Table 1).

Protocol Analysis and Coding

Given that the experiment produced (as indicated above) the conditions for assuming a functional correspondence between public verbal reports and private self-rules, the results presented below are for the verbal reports and their relationship with the operant performances.

A protocol analysis was performed for subjects in the two conditions that involved public self-reports. The contents of the tapes were transcribed and then coded by two independent coders using five categories (agreement between coders was 90% across all transcripts). The categories were developed after data inspection, and were termed:

1. Counting (CNT), either number of key presses or time, or both; for example, "One, two, three."
2. Planning (PLN), which referred to subjects describing what they were going to do; such as "I am going to push seven times."
3. Describing (DSC), including contingency descriptions ("I must push eight times to move the circle"), performance descriptions (like "I am pushing faster than before"), or task elements ("A message has appeared").
4. Complaints (CMP), related to a subject being bored or tired; for example, "I am very tired."
5. Other (OTH), including responses not related to task ("I will go to the beach tomorrow"), or that could not be coded into one of the other categories.

The data in Table 2 show the total number of verbalizations in each category during the entire experiment, for all subjects who received instructions to think aloud. The data show considerable variability, although in general counting (CNT) appeared to be the most common verbal report across both conditions (specially for those subjects who showed adjustment to both schedules).

Table 2

Total Number of Verbalizations for Each Category During the Experiment

	Subject	Counting	Planning	Describing	Complaint	Other
Cond. 1	1	4%	1%	27%	41%	25%
Reports &	2	79%	13%	4%	2%	1%
Activities	3	84%	1%	1%	14%	0%
Cond. 2	4	41%	48%	7%	3%	1%
Reports &	5	41%	14%	39%	1%	3%
No Activities	6	70%	14%	8%	2%	4%

Schedule Performances and Verbal Reports

In order to determine if there was a significant relationship between performances and verbal reports, Pearson correlation indices were calculated between the number of verbalizations and the adjustment index. Results showed two significant correlations ($p < .05$), one between counting and the adjustment index with a value of 0.757, and the second between describing and the adjustment index with a value of -0.866. In other words, subjects who counted during task tended to demonstrate clear adjustment, whereas subjects who engaged in describing tended to demonstrate poor adjustment.

This type of statistical analysis indicates a relationship between two variables, but given the main aim of the current study a molecular analysis of the moment-to-moment relations between verbal reports and task performances is also called for. Accordingly, a more detailed analysis was performed that related counting (versus other verbal utterances) and schedule performances across the entire experiment. Given that this analysis includes a large amount of data and that the relationship between task performance and verbal behavior was replicated across subjects and experimental conditions, only data for some subjects is shown in Figures 5, 6 and 7.[2]

Figure 5 shows data from Subject 4. During the first session, the subject did not achieve adjustment to any schedule and produced no counting reports except for some trials. During the first half of Session 2, the subject started counting during FR8 and achieved adjustment to this schedule. When the subject was exposed to the DRL3-s schedule, performance was initially poor and no counting reports were emitted. However, after some time the subject started counting again and the performance improved considerably. During the second half of Session 2, counting reports were produced during all trials, and the subject showed adjustment to both schedules (FR8 and DRL 3-s).

Figure 6 shows data from Subject 2 (only for Session 1). During this session, the subject produced counting reports almost exclusively and showed adjustment to both schedules. In contrast, Subject 5 (see Figure 7) did not adjust to either reinforcement schedule, and this subject failed to produce any counting report during the session; instead, describing was the most frequent type of report.

In general, these data indicate a relationship between reports of counting and adjustment to the schedules. When counting reports were produced adjustment to both schedules was also observed, whereas other verbal content was not correlated with schedule adjustment and subjects adjusted to only the FR8 schedule, or to neither schedule.

Discussion

The current study aimed to examine the role of particular types of

[2]The full set of data (including schedule performance and verbal reports for all subjects) is available upon request from Francisco Cabello.

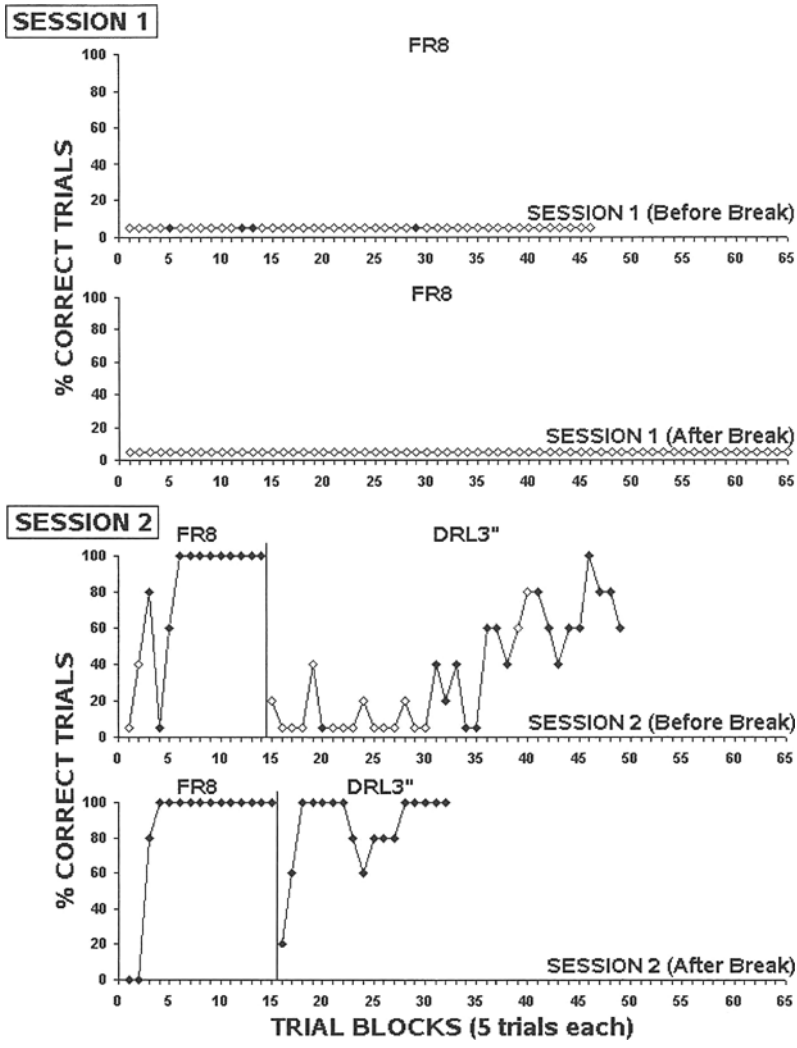

Figure 5. Schedule performance and verbal reports for Subject 4. The *x* axis represents blocks of five trials and the *y* axis indicates the percentage of correct trials for each block. A black circle indicates that the subject was counting during these trials, whereas a white circle indicates that other verbal utterances (e.g., describing or complaining) were produced. The two graphs at the top indicate data from Session 1; the two graphs at the bottom indicate data from Session 2.

verbal behavior in human operant responding. Results showed significant correlations between specific types of self-reports (i.e., counting and describing) and task performances. The fact that significant correlations were obtained between schedule performances and verbal reports during

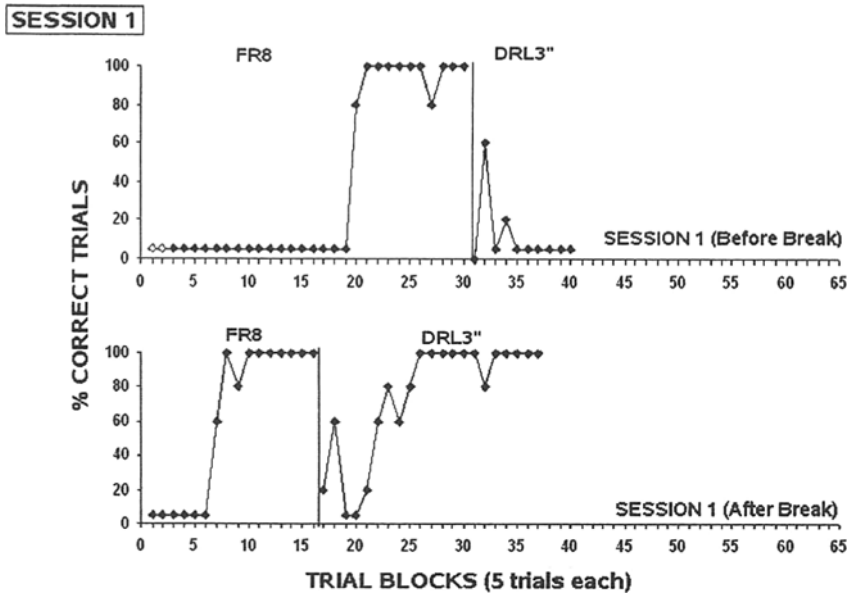

Figure 6. Schedule performance and verbal reports for Subject 2. The *x* axis represents blocks of five trials and the *y* axis indicates the percentage of correct trials for each block. A black circle indicates that the subject was counting during these trials, whereas a white circle indicates that other verbal utterances (e.g., describing or complaining) were produced.

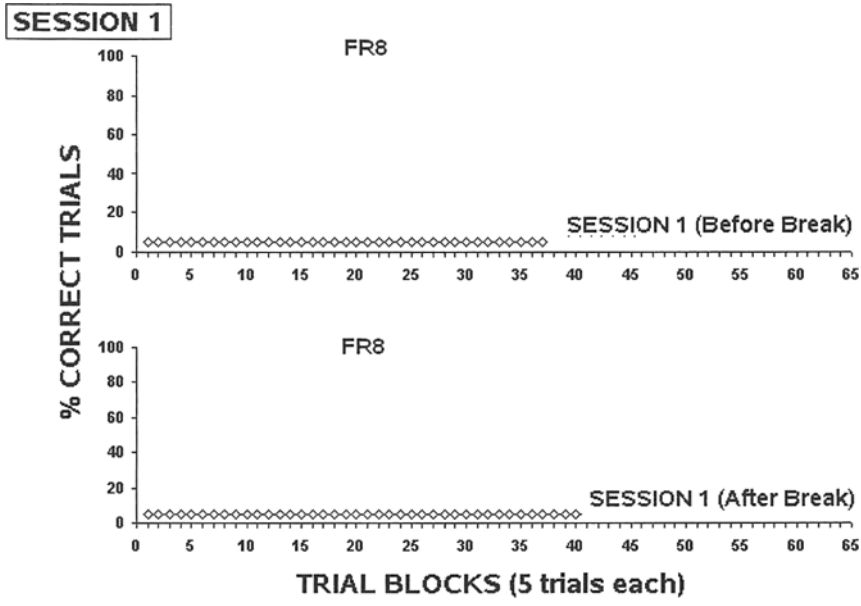

Figure 7. Schedule performance and verbal reports for Subject 5. See caption for Figure 5 for details.

relatively brief exposures to the programmed contingencies serves as testimony to the power of the think-aloud procedure and protocol analysis as a method for examining complex relations between verbal reports and other behaviors (for an additional discussion of this issue, see Cabello & O´Hora, 2002). Furthermore, a trial-by-trial analysis of the relationship between schedule adjustment and type of verbal report, as seen in Figures 5, 6, and 7, lends further support to the statistical analyses.

Although the relationship between self-reports and schedule performance is merely correlational at this point, and thus any inferences should be made with caution (Barnes, 1989), the trial-by-trial analyses do suggest a causal relationship from verbal reports to schedule performances. More specifically, the current data show that adjustment to the schedule was usually achieved sometime after the production of counting (CNT) reports (see Figures 5 & 6), and not at all if counting did not occur (see Figure 7). This indicates that counting was facilitating adjustment because it was present before; if adjustment had generated counting, then it should have occurred before the counting reports appeared.

The current study provides an example of the protocol analysis method and its utility as a tool for the study of verbal behavior. Although some empirical work has reported its use (Dixon & Hayes, 1998; Potter, Huber, & Michael, 1997; Rehfeldt & Dixon, 2000; Rehfeldt, Dixon, Hayes, & Steele, 1998; Rehfeldt & Hayes, 2000; Wulfert, Dougher, & Greenway, 1991; Wulfert, Greenway, & Dougher, 1994), the current research constitutes the first explicit application of the "silent dog" methodological controls to the analysis of task-concurrent verbal behavior. The present findings, however, are limited by the partial application of these controls, in that the full set of controls were not implemented in the current study. However, the control that was not used would involve using the counting reports to consistently alter the performance of new subjects. Such an effect has already been documented in the operant literature. More specifically, subjects who are encouraged to count during interval schedules tend to demonstrate consistent adaptation to the reinforcement contingencies (see Lowe, 1979, 1983, for a review).

Nevertheless, the successful use of Controls 1 and 2 demonstrated here indicates that this research methodology is worth pursuing in the human operant laboratory as an assessment method of verbal behavior. Insofar as functional correspondence between the public reports and the private rules is demonstrated, the experimental analysis of the former stands as a model for the latter. Thus the methodology bears promise in terms of providing systematic and useful analyses of rule generation, of rule following, and of human cognition more generally (Barnes-Holmes, Hayes et al., 2001; Hayes et al., 1989). The application of the methodological procedures, especially the "silent dog" controls, increases the complexity of the research and the resources needed and may not be suitable to all areas (Austin & Delaney, 1998; Critchfield & Epting, 1998). But such analyses may provide important evidence that could serve either as primary data or as supplementary information, in that "silent dog" controls allow us to obtain reliable self-reports (Hayes, 1986; Hayes et al., 1998).

There are some other issues that emerged during the current study that should be taken into consideration, especially in future protocol analysis research. First, the importance of using a procedure that minimizes social control as much as possible has been highlighted by different authors (Critchfield, Tucker, & Vuchinich, 1998; Gomez & Luciano, 2000; Zettle & Young, 1987) and is supported by data indicating that social contingencies have a real impact on the performances of subjects and on verbal statements (Barrett, Deitz, Gaydos, & Quinn, 1987; Williams, 1985). The use of a PIN for subjects, hiding the tape recorder and cables, and subjects working alone on the task, were some of the measures taken for that purpose. Second (although not systematically measured), verbal reports tended to change over time during the current task, from frequent and elaborated to less frequent and shorter, an effect also reported by Potter et al. (1997) and Wulfert et al. (1991) using a stimulus equivalence task. Given that this trend has been found using tasks that differ, at least formally, it may indicate that when experimenters expose subjects to multiple exemplars, verbal regulation (or rule governance) is not a static phenomenon, but a dynamic one. Moreover, these changes should be understood as changes in the functions of verbal behavior (see Luciano, 1993). This has certainly been shown in the cognitive literature within the context of what researchers call automatic processes (e.g., Shiffrin & Schneider, 1977). Third, perhaps protocol analysis may require alternative and novel methods of measurement to track the ongoing and dynamic interaction between verbal behavior and schedule performances. Future work that employs the types of methodology developed in the current study may help to provide the kinds of empirical data that will be necessary to assess this approach to rule-governed behavior, and may demonstrate the dynamic nature of behavior-behavior relations across tasks (Barnes-Holmes, O´Hora, et al., 2001).

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Appendix

The following three screens appeared for subjects in all conditions (*translated into English*):
(1) Welcome. During this experiment, the computer screen will show a grid, with a black circle and a symbol placed within. Your objective is to move the circle to reach the symbol as many times as you can. For that purpose, use the space bar and the arrow keys.
(2) In order to move the circle first press the space bar until reaching a certain criterion, and then one of the arrow keys, the one corresponding to the direction in which you want to move the circle. Pressing the arrow keys more than once will not move the circle.
(3) The criterion for pressing the space bar may change over the experiment, involving greater or fewer bar presses, and more or less time between pushes. There will always be a correct sequence for moving the circle.

Subjects in Conditions 1 and 2 (think-aloud) were also instructed:
(4) Remember that while you are working on the task, you will have to think aloud, saying everything that comes to your mind, even if it's strange for you. If not, the computer will remind you with a message.

Finally, subjects in Conditions 1 and 3 (simultaneous activities) were shown the following screen:
(5) Two red signals may appear at the top of screen. While they are present, you will be prompted to engage in an activity that you should complete while working on the task. This activity will involve saying something while also moving the circle.