

*AVERAGING EFFECTS IN THE STUDY OF
FIXED-RATIO RESPONSE PATTERNS*

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Three rats were exposed to multiple fixed-ratio schedules in which large and small ratios alternated in an irregular order. Over a series of training phases, one ratio was held constant as the second ratio was increased to higher values. On average, postreinforcement pauses increased in duration as the ratio size was increased. Pausing was controlled by the size of the upcoming ratio; the previous ratio had smaller and less consistent effects. However, more detailed consideration of the aggregated data indicated that the pause distributions were positively skewed and that changes in average performances were more a consequence of increased skew rather than shifts of the entire distributions. Moreover, the distributions of pauses from condition to condition overlapped, and brief pauses were common even at the highest ratios. These results demonstrated that depictions of pausing based on aggregated data can be misleading without corresponding information about variations in the distribution on which the averages are based.

Key words: fixed-ratio schedules, postreinforcement pause, averaging, molar versus molecular analysis, lever press, rats

Analyses of behavioral data inevitably involve some form of aggregation. An extreme case occurs when values from different subjects are grouped and conclusions are based on the performance of the average group member. But even when the focus is on the individual organism, results usually are reported in the form of averages. There are no clear rules about this. Examples can be found in the literature in which the data were averaged across segments of individual sessions, across entire sessions, and across blocks of sessions.

Interpretations of average values are simplest when variation within the underlying distributions are relatively small and nonsystematic, in other words, when the average faithfully represents the individual scores. When this is not the case, essential conclusions about the data may be laid open to question. Some of the interpretative issues are illustrated by the finding that response rates drawn from different parts of an experimental session may differ systematically

(McSweeney, Roll, & Weatherly, 1994). Consequently, conclusions about a variable may differ depending on whether they are based on data aggregated over the entire session or data from a selected part (e.g., the beginning or the end).

Even when performances are more or less constant throughout a session or block of sessions, local variations can produce overall distributions of different shapes. When the distribution is symmetrical, the average value, although at the center of the distribution, may be a poor representative of values at the tails. When the distribution is skewed, interpretative problems are compounded because the average may be distorted by extreme values at one tail but not the other.

The study of fixed-ratio (FR) response patterns constitutes one area in which distribution form may play a critical role (for reviews of FR performance, see Lattal, 1991; Mazur, 1998). Well-known features of such performances are the pauses that follow delivery of the reinforcers and the systematic increases in pause durations that accompany increases in ratio size (e.g., Felton & Lyon, 1966; Mazur, 1983; Powell, 1968). However, these conclusions are largely based on aggregations of data from individual ratios that are summarized as mean values. This procedure can create special problems because latency distributions usually contain a positive skew and because the statistical properties of the mean

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make it particularly susceptible to distortion by extreme values. Our review of the literature on FR pausing suggested that some researchers have not given sufficient recognition to this possibility. Some have been silent about the variation underlying the mean values (e.g., Felton & Lyon, 1966). Others have presented data on the distribution forms, but still have relied on means to describe essential relationships (e.g., Mazur, 1983; Powell, 1968).

These data-analytic issues extend to research on variables that may control FR pausing. As discussed by Mazur (1998), one hypothesis is that pausing is controlled by the size of the previous ratio because of aftereffects of the just-completed series of responses. Alternatively, pausing may be influenced by the size of the upcoming ratio because larger ratios increase the separation of initial responses from the reinforcer at the end of the series. To differentiate these effects, researchers have employed schedules containing two ratios, each correlated with a stimulus that signals the size of the upcoming FR (multiple FR FR). For example, the ratios of a two-component schedule can be arranged in terms of the four possible sequences of large and small ratios: small-small, large-large, small-large, large-small. If the upcoming ratio is critical, then longer pauses should accompany the small-large and large-large sequences, whereas influences of preceding ratios would be indicated by longer pauses under the large-small and large-large conditions.

Experiments with multiple FR FR schedules have suggested that pausing is influenced more by the upcoming ratio than by the preceding one (e.g., Crossman, 1968; Inman & Cheney, 1974; Mintz, Mourer, & Gofseyeff, 1967). This conclusion may be questioned, however, because the data analyses focused on the means of what presumably were skewed distributions of pauses. Another reason to question the conclusions is that the large and small ratios were arranged in predictable sequences, either single alternation (Crossman; Inman & Cheney) or double alternation (Mintz et al.). Inman and Cheney examined an irregular sequence at the end of their experiment, but exposure was limited.

Of the research in this area, the procedures of an experiment by Griffith and Thompson

(1973) come closest to meeting our concerns. They arranged irregular (rather than fixed) sequences of ratios, and they based their conclusions on evaluations of distributions of pauses rather than means of the distributions. However, their main finding—that prolonged pauses occurred almost exclusively when the upcoming ratio was large—involved data that were presented and discussed in abbreviated form. (The researchers referred to their study as an “illustrative experiment.”)

The present experiment was designed to reexamine pause-ratio relations through analyses that give fuller account to variations in performance from ratio to ratio. To extend the generality of previous research, we exposed rats to several multiple FR FR schedules, and we arranged the ratios in an irregular sequence so that only the immediately preceding and upcoming ratios could have systematic effects.

METHOD

Subjects

Experimentally naive Sprague-Dawley rats were 8 months old at the start of the experiment. They were individually housed with free access to water, and their weights were maintained at 75% to 80% of free-feeding weights by scheduling 1-hr feeding periods approximately 30 min after the experimental sessions (Hurwitz & Davis, 1983). Illumination within the vivarium followed a 16:8 hr light/dark cycle. Results from 3 animals are reported; data collected from 3 additional animals were discarded either because they became ill or because of procedural errors.

Apparatus

Single-lever rodent chambers (Grason-Stadler, E3123; 29 cm by 24 cm by 19 cm) were enclosed within sound-attenuating ventilated chests. Extraneous sounds were masked by white noise and the sound of the ventilating fan (background level of approximately 80 dB). The lever, which required a minimum force of about 40 g (0.40 N) to operate, was centered on the front wall, 9.5 cm above the grid floor. Each response was accompanied by momentary interruption of the background white noise. Food reinforcement (45-mg Noyes pellets) was delivered to a recessed cup positioned at floor level di-

rectly below the lever; the cup was reached through an opening in the wall. Illumination was provided by two shielded 3-W lamps mounted outside the Plexiglas walls of the chamber, one at the front of the right wall and the other at the rear of the left wall. Programming and recording equipment was controlled by microcomputers located in an adjacent room.

Procedure

The components of a multiple FR FR schedule contained either a small or a large ratio, each correlated with a different visual stimulus. For 2 animals, the larger FR was correlated with continuous illumination of both lights, and the smaller FR was correlated with blinking of the front light (1 s on, 1 s off). These correlations were reversed for the 3rd animal. Daily sessions employed one of four irregular sequences of the small and large ratios, with the restriction that the same ratio size could not appear more than three times in a row. Each sequence included an equal number of transitions between adjacent ratios: small preceded by small (S-S), small preceded by large (L-S), large preceded by large (L-L), and large preceded by small (S-L).

When the required number of responses was completed, a tone replaced the white noise and a food pellet was delivered. The pellet was delayed 1 s from the onset of the tone, and each response during the delay period extended the delay for 1 s. The purpose of the delay was to reduce the likelihood that responding would continue through the reinforcement cycle and run over into the next ratio. Direct observations of the animals indicated that the procedure was successful: When the tone came on, they characteristically left the lever and approached the food cup. Following delivery of the pellet, the tone went off, the white noise was reactivated, and the visual stimulus correlated with the next ratio was presented.

During a preliminary phase, the lever-press response was shaped by the method of reinforcing successive approximations, and the multiple FR FR schedule was introduced in a series of increasing ratio sizes. After several sessions with FR 20 FR 20, the first of the pair of ratios was held constant at FR 20 (small ratio) as the second ratio (large ratio) was increased from session to session. The rate of

Table 1

Sequence of schedules (multiple FR FR) and number of sessions in each.

Condition	Subject		
	R18	R19	R23
FR 20/50	19	14	22
FR 20/80			20
FR 20/100	15	35	13
FR 20/150	24	18	
FR 20/30	12	12	12
Total	107	125	104

Note. The values include the eight sessions required to attain the stability criterion. The total includes, in addition, transitional sessions that intervened between the main schedule conditions.

increase depended on individual performances. However, animals were exposed to at least two sessions at each level, and the schedule was advanced only when the cumulative records showed no discernible breaks in the ratio runs for at least 80% of the ratio runs (cf. Powell, 1968).

The data described in this report came from a more extensive series of observations that were conducted at four combinations of small and large ratios, ranging from FR 20 FR 30 to FR 20 FR 150. Table 1 shows the specific values for each animal and the sequence; note that in all cases, the FR 20 FR 30 combination was the last condition. Training continued for at least 12 sessions at each combination and until the daily medians of the pause distributions were stable over eight sessions. Specifically, the stability criteria required that the difference between the medians for two consecutive four-session blocks did not exceed 10% of the median for all eight sessions. This criterion was applied separately to the data classified in terms of both the upcoming and the preceding ratios.

At the start of a session, the test chamber was dark and silent except for the sound of the ventilating fan, and the lever was inoperative. After a 1-min delay, the session began. Initiation of the schedule was accompanied by activation of the lever, illumination according to the stimulus condition, and continuous white masking noise. When the session ended, the lever was deactivated and the chamber light and white noise were turned off.

Although sessions were scheduled for a maximum of 41 ratios, they were ended ear-

Table 2

Number of sessions classified in terms of whether all scheduled reinforcers were received (all) or whether the session was terminated early because a pause exceeded the 10-min criterion (early). When sessions were terminated early, the size of the current ratio, either small (S) or large (L), is also indicated.

Condition	R18			R19			R23		
	All	Early		All	Early		All	Early	
		S	L		S	L		S	L
FR 20/50	19	0	0	13	0	1	18	1	3
FR 20/80							1	0	19
FR 20/100	15	0	0	13	0	22	0	0	13
FR 20/150	24	0	0	0	0	18			
FR 20/30	12	0	0	12	0	0	12	0	0
Total	70	0	0	38	0	41	31	1	35

lier if 10 min elapsed without a response. Only sessions that included at least 21 completed ratios were used in the final data analyses. Also, the first pause value for the session was discarded (this value did not follow a reinforcer); thus, a complete session provided data for a minimum of 20 pauses. Table 1 shows the numbers of sessions at each of the four conditions as well as the total number of sessions including transition sessions for the entire data-collection period. Sessions were conducted six to seven times each week.

RESULTS

Postreinforcement pauses were recorded to the nearest second. Pauses were measured from the offset of the tone that defined the reinforcement period to the first response of the upcoming ratio. For purposes of the analyses, pause values were then classified into the four possible sequences of small and large ratios.

It will be recalled that sessions were terminated if 10 min elapsed without a response (this criterion had been successfully used in previous research; see Baron, Mikorski, & Schlund, 1992). Although 1 animal (R18) always completed all 41 ratios, an unexpected finding was that the other 2 (R19 and R23) sometimes exceeded the time limit, with the consequence that the session ended early. These 10-min pauses typically occurred before any responses toward the ratio had been made; that is, they constituted a prolonged postreinforcement pause. Relevant data are summarized in Table 2: the number of completed sessions at each FR FR level, and, for

those sessions that ended early, whether the current ratio was small or large. Two findings are apparent. First, pauses longer than 10 min occurred with increasing frequency with increasing ratio size (for both R19 and R23, this was the exclusive pattern at the highest ratio). Second, when animals quit, they usually did so when the larger of the two response requirements was in effect.

Relative frequency distributions of postreinforcement pauses for the four terminal sessions under each condition are presented in Figures 1, 2, and 3. To facilitate display of effects of the upcoming ratio, the figure plots pairs of conditions with similar preceding ratios and different upcoming ratios: S-S and S-L in the upper panels and L-S and L-L in the lower panels. To accommodate the wide range of latency values (1 s to 300 s), pauses have been plotted on a logarithmic scale. Table 3 presents summary statistics for the data in the figures.

Overall, the distributions were positively skewed, with the extent of the skew depending on the particular condition. Under the two conditions in which the upcoming ratio was small (S-S and L-S), pauses were relatively short (<10 s) and did not change much during the experiment. By comparison, the pause distributions when the ratio was large (S-L and L-L) included longer pauses, and the distributions became increasingly skewed as the ratio size was increased. Consequently, even at the largest ratio sizes, a significant proportion of the pauses remained relatively short. Although the size of the upcoming ratio played the major role in these changes,

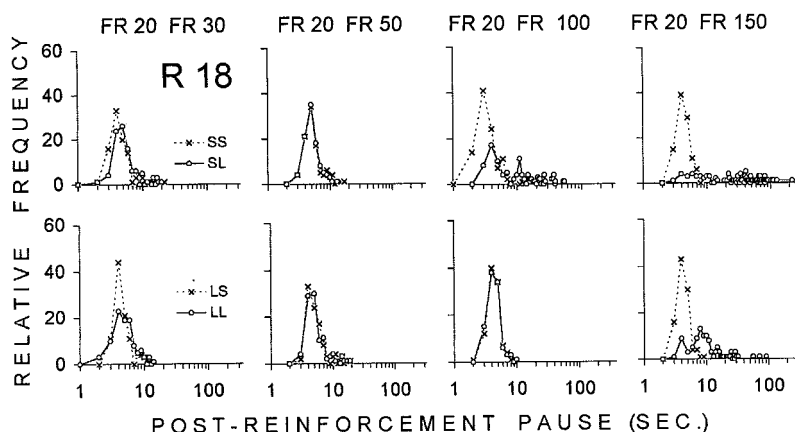


Fig. 1. Relative frequency distributions of pauses in 1-s intervals for R18. Pauses following short ratios (S-S and S-L) are presented in the top panels, and pauses following long ratios (L-L and L-S) are presented in the bottom panels. Note that the abscissa is a logarithmic scale.

influences of the preceding ratio can be seen for 2 animals (R18 and R19): Long pauses were more frequent when the preceding ratio was small (S-L condition) than when both preceding and upcoming ratios were large (L-L).

Comparisons of the summary statistics in Table 3 with the distributions in Figures 1 through 3 show parallel variations in the means and medians of the distributions. However, effects of ratio size are more apparent when the mean serves as the measure of central tendency, and, as might be expected for positively skewed distributions, the difference between the mean and median increased as a function of the extent of the skew. The increased skewing under the S-L

and L-L conditions also may be seen in the increasing differences between the lower and upper ranges of the distribution (calculated from the 10th, 50th, and 90th percentiles). By comparison, the distributions from the S-S and L-S conditions remained more or less symmetrical, regardless of the size of the larger ratio.

DISCUSSION

Data from early studies of FR performances (Ferster & Skinner, 1957; Skinner, 1938) were in the form of cumulative records, and analyses focused on response patterns within the individual ratios of the schedule. Subsequent investigations adopted more quantitative ap-

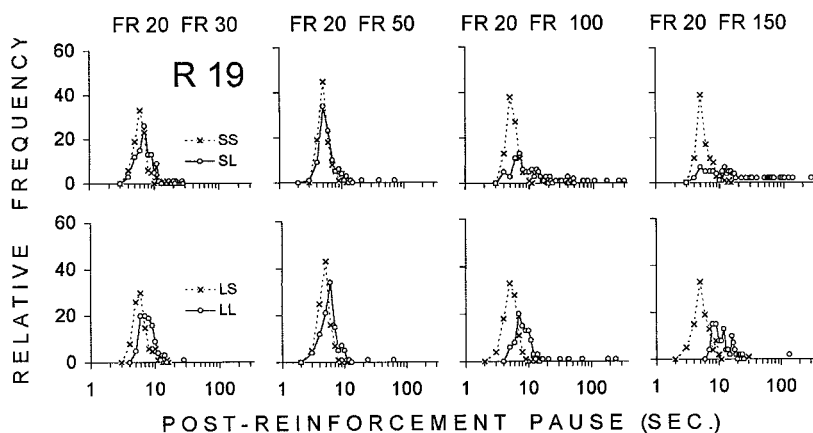


Fig. 2. Relative frequency distributions of pauses in 1-s intervals for R19. See Figure 1 for further details.

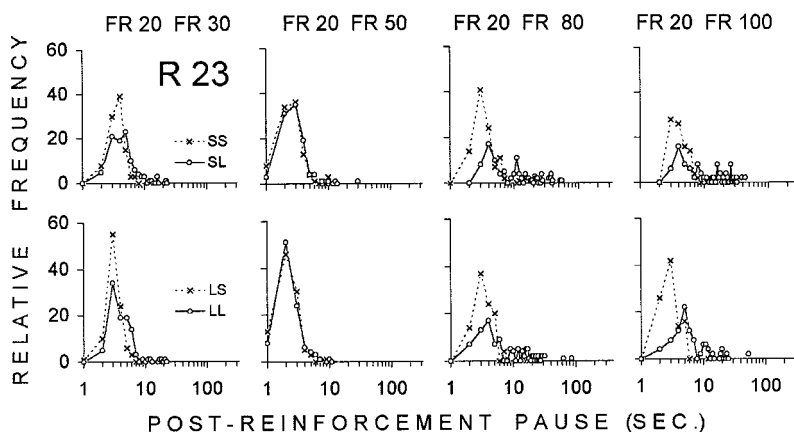


Fig. 3. Relative frequency distributions of pauses in 1-s intervals for R23. See Figure 1 for further details.

proaches. To evaluate changes, pause durations are usually grouped into a single average value, such as the mean of the distribution. The present study brings to light the ways in which this practice may generate a less than accurate interpretation of the patterns evidenced within the individual ratios.

When we analyzed our results using average values as the unit of analysis, outcomes were not unlike those already reported in the literature. The mean pause increased as a function of ratio size (cf. Felton & Lyon, 1966; Mazur 1983; Powell, 1968), and the duration was influenced more by the size of the

Table 3

Descriptive statistics based on data depicted in Figures 1 through 3. Values shown are the mean, the median (mdn), the lower range (LR; 50th minus 10th percentile), the upper range (UR; 90th minus 50th percentile), and the difference between the two ranges (diff).

	R18				R19				R23			
	SS	SL	LS	LL	SS	SL	LS	LL	SS	SL	LS	LL
	20/30				20/30				20/30			
Mean	5.4	6.4	5.0	5.7	6.9	7.3	6.4	8.3	3.8	5.5	3.4	4.8
Mdn	4.6	5.3	4.5	5.2	6.3	7.3	6.0	7.8	3.7	4.7	3.3	4.1
LR	1.6	1.8	1.4	2.1	1.7	2.3	1.7	2.2	1.4	2.1	1.2	1.7
UR	4.3	5.9	3.6	3.8	2.9	3.4	3.3	3.2	1.6	4.5	1.5	2.6
Diff	2.7	4.1	2.2	1.7	1.2	1.1	1.6	1.0	0.2	2.4	0.3	0.9
	20/50				20/50				20/50			
Mean	5.9	5.7	6.0	6.0	5.6	7.4	5.1	7.9	3.0	3.5	2.5	2.7
Mdn	5.3	5.3	5.2	8.2	5.3	5.8	4.9	6.0	2.7	2.9	2.4	2.4
LR	1.7	1.6	1.6	1.6	1.3	1.6	1.4	2.0	1.4	1.4	1.3	1.2
UR	4.1	3.1	5.3	4.6	2.5	4.2	1.7	3.6	1.9	2.0	1.5	2.0
Diff	2.4	1.5	3.7	3.0	1.2	2.6	0.3	1.6	0.5	0.6	0.2	0.8
	20/100				20/100				20/80			
Mean	4.9	11.3	4.5	4.6	5.8	23.4	5.5	11.5	3.7	13.5	3.8	10.8
Mdn	4.8	5.1	4.4	4.5	5.6	10.7	5.4	8.6	3.5	10.3	3.6	6.4
LR	1.5	1.7	1.3	1.3	1.4	5.2	1.6	2.6	1.4	6.8	1.5	4.0
UR	2.0	23.4	1.5	1.7	2.2	35.4	1.8	5.9	2.3	24.7	2.3	17.4
Diff	0.5	21.7	0.1	0.4	0.8	30.2	0.2	3.3	0.9	17.9	0.8	13.4
	20/150				20/150				20/100			
Mean	4.5	44.4	4.6	13.5	1.3	35.4	5.7	15.4	5.9	13.3	3.4	8.4
Mdn	4.5	35.5	4.3	9.5	2.3	14.5	5.4	12.3	4.4	8.8	3.1	5.8
LR	1.4	29.5	1.3	5.0	1.0	9.4	1.7	3.8	2.3	5.3	1.5	2.6
UR	1.7	50.0	1.6	16.0	3.2	80.3	2.6	6.5	4.6	18.7	1.9	11.7
Diff	0.3	20.5	0.3	11.0	0.1	70.9	1.1	2.7	2.3	13.4	0.4	9.1

Note. Differences between the upper and lower ranges of 5 s or more appear in italic type.

upcoming ratio than by the size of the preceding one (cf. Crossman, 1968; Griffith & Thompson, 1973; Inman & Cheney, 1974; Mintz et al., 1967). The latter findings are noteworthy because they were observed with unpredictable sequences rather than with the alternations used in previous research.

A new finding concerned interactive effects of the preceding and upcoming ratios. For 2 animals, the longer pauses that preceded the larger upcoming ratios were prolonged when the previous ratio was small; in other words, the small-large sequence produced longer pausing than the large-large one. Perone and Courtney (1992) observed a parallel contrast effect when reinforcer magnitude was varied from ratio to ratio (FR size was held constant). They found that the longer pauses that preceded smaller upcoming magnitudes were prolonged when the previous magnitude was large rather than small; that is, large-small exceeded small-small.

Despite these correspondences with the literature, our reservations about averaging were confirmed when we considered the distributions from which the averages were derived. Increased ratio size was accompanied by increased positive skewing, with the consequence that the means (and, to a lesser extent, the medians) deviated increasingly from the modal value. Nevertheless, in many reports of FR pausing, the mean has been the unit of analysis.

The present finding of positively skewed pause distributions is hardly new. What is surprising is the extent to which this feature has been overlooked in discussions of FR pausing. Consider, for example, Powell's (1968) experiment, which provided detailed information about changes in postreinforcement pausing as a function of ratio size. For all 3 pigeons, mean pauses increased systematically as the ratio size was increased (see his Figure 1), and this is the prominent feature of the results. However, the pause distributions included in the report reveal that these changes were accompanied by marked increases in the positive skew of the distributions (his Figure 2). Although the report noted this second feature, it failed to acknowledge that the size-duration functions overestimated the extent of changes.

Also instructive are comparisons of the present results with those of studies in which

measures of dispersion were not reported at all. Data presented by Felton and Lyon (1966) show a linear relation between the size of the ratio and the logarithm of the mean pause (see their Figure 1). At the largest ratio studied (FR 150), mean pauses ranged from 30 s to 2 min per ratio (note that the values on the ordinate of Figure 1 must be divided by 50 to get the mean per ratio). To judge from the present results as well as Powell's, most of the pauses must have been considerably shorter, in which case the reported means reflected the influence of a minority of long pauses.

In this discussion, we have focused on the analytic problems created by skewed distributions of FR pauses. However, these problems are an outgrowth of a more general issue: how best to deal with the variation that results from multiple observations of the same phenomenon. The questions raised by the specifics of our findings are clarified by considering them within this broader context.

A fundamental distinction concerns whether the variation has been created by aggregating performances of different individuals or by aggregating repeated observations of the same individual. Behavior analysts have viewed the first type (i.e., between-subject aggregation) with suspicion because the average from a group of individuals may not provide a satisfactory picture of any particular member of that group (Sidman, 1960). By comparison, methods that characterize an individual's performance through an average of data from *that* individual (i.e., within-subject aggregation) are commonly regarded as quite acceptable. The possibility raised here—that the average may provide a less than ideal representation of the array of individual responses—is met with the argument that the validity of an analysis rests on the orderliness of the relationships among the averages, as might be found, for example, in the matching function in the case of choice and in pause-ratio relations in the case of the postreinforcement pause.

Whatever the extent of regularities on the level of average performance, it is difficult to avoid the implication that variation on the individual level represents a failure of experimental control. Nevertheless, the dominant view within the behavioral sciences is that var-

iation need not be a source of concern. To the contrary, variation is regarded as an inherent aspect of behavioral phenomena, and is, therefore, something to be accepted as an expected feature of behavioral research. This view of variation may be seen in the treatment of between-subject variation with inferential statistics. Variation among the subjects within an experimental condition is considered to be quite acceptable as long as the between-subject variation is sufficiently outweighed by the average difference between experimental conditions.

Statistical solutions to the problem of within-subject variation are also available. With regard to varied distributions of latencies obtained from the same individual, Luce (1986) proposed regarding the values as a random variable, in which case the mathematics of stochastic (probabilistic) processes can be used to identify regularities. The goal of such analyses is a kind of statistical order, as would be reflected in the finding that response probabilities (e.g., the response that defines the latency) are constant across the range of values represented in the latency distributions. In the context of the present discussion, such an analysis is a way of identifying a single probability value that will represent all of the individual cases within the varied distributions of latencies.

Shull (1991) has described the use of stochastic methods for the analysis of behavioral data. Applications to the analysis of FR pausing are straightforward. Frequency distributions of the sort we have presented are replotted so that the logarithm of the opportunity to respond is expressed as a function of elapsed time (such plots are called log survivor functions; for details, see Shull, 1991, pp. 266–271). The slopes of these functions reveal the conditional probability of a response at a given point in time, and the linearity of the functions reveals the constancy of the probability over the possible times.

Although we attempted such analyses of our data, we decided that not much would be gained by presenting the results in this report. One reason is empirical. The analysis made it clear that for the present data, at least, probabilistic analyses would not provide the desired simplification; in other words, clear evidence that responses were emitted with a constant probability across the range

of pauses. Instead, we found that probability of pause termination varied in an irregular fashion; if any pattern could be discerned, it was that the probabilities tended to increase with increases in the duration of the pause (the functions were roughly analogous to those shown in Shull, 1991, Figure 6, column 3).

The other reason is more conceptual and certainly more controversial. In our view, the assumption that variability is an inherent aspect of behavior is at serious odds with an important behavior-analytic tradition: the conviction that researchers should approach irregularities in experimental findings through improved experimental analysis, not through statistical manipulations. Behavior-analytic objections to statistical control are most often expressed with regard to between-subject research designs. For example, this is the message conveyed by Skinner's (1959) observation that "no one goes to the circus to see the average dog jump through a hoop significantly more often than untrained dogs" (p. 370), and the same theme reappears at length in Sidman's (1960) influential book, *Tactics of Scientific Research*. Both Skinner and Sidman went on to emphasize the value of careful experimental control to preclude the need for statistical analyses. At issue, then, is whether similar concerns and prescriptions are in order when the variation appears in the behavior of the same individual.

The role of probability within the experimental analysis of behavior is a matter that remains to be resolved. Marr (1982), for example, argued that adoption of a probabilistic approach (and abandonment of a deterministic one) will help to bring behavior analysis more in line with modern scientific developments. By comparison, Johnston and Pennypacker (1993) emphasized the ambiguous and sometimes contradictory features of the concept, as witnessed by the blurred distinction between statistical and experimental control in Skinner's writings (see also Moxley, 1998). On the one hand, Skinner advocated probabilistic descriptions as a way of expressing the strength of responding, as well as a way of avoiding the limitations of all-or-none statements about behavior. However, he and others also view the concept as an expression of confidence in a particular outcome (or,

conversely, ignorance of that outcome). From this latter standpoint, probabilistic statements about behavior may not do much more than point to the need for better specification of the controlling variables, in other words, the need for experimental analysis of the conditions that have given rise to the unexplained variation.

Returning to the specifics of the present results, we are left with the question of which approach to FR pausing is appropriate: a more molecular analysis that attempts to preserve the characteristics of performances within individual ratios versus a more molar analysis that aggregates local performances into a single value. Some writers on the question of "levels of analysis" (e.g., Iversen, 1991) have argued that findings at a particular behavioral level should be judged only within the domain of the analytic method, and it follows that a principle established at one level need not hold at other levels. We are reluctant to criticize this effort to resolve what Iversen referred to as a controversy "rooted in difference in underlying philosophy regarding what constitutes an explanation of behavior" (p. 235). Nevertheless, the present analysis of FR pausing suggests that molar depictions of the phenomenon (average data) may have to be qualified in the light of information from more molecular levels (performances within the individual ratios).

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