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BEHAVIORAL CONTRAST IN A TWO-OPTION ANALOGUE TASK OF FINANCIAL DECISION MAKING

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The effects of an alternative course of action on sustained escalation and persistence in the face of failure was investigated using a computerized stock investment task. Subjects invested in "stock" in two "markets" that yielded returns according to two-component multiple variable-interval schedules. Both markets yielded equal but intermittent return rates during the first phase. In the second phase, one market ceased to yield returns, while the return rate for the other market was unchanged. During the second phase, behavioral contrast effects were evident. Investing in the market that ceased to yield returns dropped precipitously, and investing in the unchanged market increased significantly. Although the behavior may be economically "irrational," it is predictable from the matching law and shows that interactions among a history of intermittent returns in a course of action, current return rate, and currently available alternative courses of action are important determinants of persisting in, or withdrawing from, a failing course of action.

DESCRIPTORS: behavioral contrast, financial decision making, multiple schedule, financial investment, matching theory

In the classic study of behavioral contrast by Reynolds (1961), subjects responding under variable-interval (VI) schedules with equal reinforcement rates in a two-component multiple schedule allocated responding equally to each component. However, when one of the components ceased to provide reinforcement and the reinforcement rate in the other component remained unchanged, responding in the component under extinction decreased precipitously, while responding escalated sharply in the unchanged component. This marked change in responding in opposite directions in the changed and unchanged components defines behavioral contrast.

Most research on behavioral contrast has employed nonhuman subjects responding under various arrangements of multiple schedules, or sometimes concurrent schedules (see Schwartz & Gamzu, 1977, and Williams, 1983, for reviews, and Rachlin, 1973, for a theoretical account). However, laboratory studies of behavioral contrast in humans by O'Brien (1968) with developmentally delayed adolescent females, Waite and Osborne (1972) with elementary school children, and Fagan (1979) and Rovee-Collier and Capatides (1979) with infants have yielded results similar to those found in studies of nonhuman animals.

Behavioral contrast has also been demonstrated in applied research. Koegel, Egel, and Williams (1980) studied autistic and handicapped children during therapy sessions in two different settings at home or school. When a target behavior (e.g., compliance) was reinforced in one setting but not in the other setting, responses increased in the setting in which reinforcement was available, but decreased in the setting in which reinforcement was not available. In a field study similar to that of Koegel et al. (1980), but involving elementary school children with "behavior problems," John-

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son, Bolstad, and Lobitz (1976) found comparable, although not as reliable, effects. In light of these findings, Gross and Drabman (1981) and Redmon and Ferris (1987) have suggested that behavioral contrast should be more thoroughly investigated by applied behavior analysts.

Although the behavioral contrast literature is substantial, theoretical accounts of the phenomenon vary. For example, some investigators argue that behavioral contrast results from matching and schedule interaction (Herrnstein, 1970), interactions of biology and economics (Rachlin, 1973), additive effects of Pavlovian conditioning (Schwartz & Gamzu, 1977), primacy effects in short-term memory (Grossberg, 1978), anticipatory responding (Williams, 1983; Williams & Wixted, 1986), or reallocation of extraneous responding (McLean, 1992, but see also Williams & Wixted, 1994). These explanations are not necessarily mutually exclusive, nor are they necessarily mutually inclusive of one another, yet all seem to agree that the primary variable in behavioral contrast is interaction of the reinforcement rates paired with schedules that are signaled by highly distinctive discriminative stimuli (Herrnstein, 1970; Williams, 1983).

The most intriguing feature of behavioral contrast is that when one component is subject to extinction, there is a marked and sustained increase in responding in the unchanged component, although the rate of reinforcement in that component remains unchanged. The vast majority of behavioral contrast studies have used interval schedules. Although there is a linear relationship between rate of responding and rate of reinforcement in ratio schedules, rate of responding and rate of reinforcement are largely uncorrelated in interval schedules (Ferster & Skinner, 1957). This phenomenon of escalation and persistence in responding in the unchanged component is not only counterintuitive but also violates prescriptions and norms of economic rationality (see Herrnstein, 1990; Rachlin, 1989). Thus, behavioral contrast may be another instance of behavior that is "irrational" from the perspective of economics and rational choice theory, but is entirely consistent with data and theory in behavior analysis.

According to Herrnstein (1990), behavior analysis is uniquely suited to investigate and explain such deviations from economic rationality. A case in point is the recent behavior-analytic research in escalation and persistence of commitment (Goltz, 1992, 1993; Hantula & Crowell, 1994). In many cases of managerial and financial decision making, commitment of resources to a course of action or investment is continued, or even increased past the point of economic advisability, despite mounting losses or failure (see Brockner, 1992; Brockner & Rubin, 1985; Staw & Ross, 1987, 1989, for reviews). Examples of such "decision fiascoes," commonly known as "escalation of commitment" in the literature, are the United States' escalation in the Viet Nam war (Staw & Ross, 1978) and British Columbia's continuation of EXPO 86 (Staw & Ross, 1989) (see also Goltz, 1992, and Hantula & Crowell, 1994, for additional examples).

Goltz (1992) presented a behavioral analysis of escalation and persistence of commitment of organizational resources in a failing course of action based on the sequential hypothesis (Capaldi, 1966) and the partial reinforcement extinction effect (PREE) (Amsel, 1967). Using a stock investment task, Goltz (1992) provided subjects with either a continuous (CRF) schedule of returns on investments, a fixed-ratio (FR) 2, or a variable-ratio (VR) 2 schedule of returns for the first half of the experiment. In the second half of the experiment, all subjects ceased to earn returns on their investments. Consistent with the sequential hypothesis and the PREE, subjects who experienced a CRF or FR 2 schedule of returns did not escalate amounts invested or persist in investing when returns were no longer forthcoming; however, subjects who experienced a VR 2 schedule escalated amounts invested and persisted in investing in the face of no returns. These results were replicated and extended in the second experiment of Goltz (1992) to include stimulus generalization effects (see also Ferguson, 1989) and by Goltz (1993) and Hantula and Crowell (1994) with different subject populations, demonstrating that a history of unpredictable, partial reinforcement is an important independent variable in escalation and persistence.

Most of the previous experimental studies of escalation and persistence of commitment have used a task with a single course of action, as have behavior-analytic experiments (Goltz, 1992, 1993; Hantula & Crowell, 1994) and conceptual analyses (Capaldi, 1992; Ferguson, 1989; O'Flaherty & Komaki, 1992; Platt, 1973). Staw and Ross (1987) suggested that a single course of action may not be representative of all escalation and persistence dilemmas; however, the effects of an alternative, nonfailing course of action are unclear. Staw (1976) and Staw and Fox (1977) showed that providing an alternative course of action does not reduce escalation, yet McCain (1986) demonstrated the opposite.

None of these previous studies measured or discussed investments or allocations made to the alternative course of action; rather, the studies focused only on the effect such an alternative had on allocations to the failing course of action. Thus, whereas the effects of a nonfailing alternative on allocations made to a failing alternative are disputed, the effects on allocations made to the nonfailing alternative are unknown in this literature.

However, if providing two courses of action in an investment situation is conceptualized as a multiple schedule (Ferster & Skinner, 1957), the effect of placing one course of action on an extinction schedule while leaving the return rate from the other course of action unchanged should resemble behavioral contrast. The present study sought to advance a behavior-analytic account of escalation and persistence of commitment to include a two-option environment and an analysis of possible behavioral contrast effects.

McCain's (1986) study showed that during extinction, investing in the alternative placed on extinction decreases with each investment. That is, escalation and persistence of investing are not expected to occur in this alternative. However, although the literature in behavioral contrast is consistent with McCain's study, it also suggests that investing in the unchanged alternative should increase over time, then plateau until another change in reinforcement schedules or return rates occurs.

METHOD

Subjects

Six senior business and engineering students enrolled in a computer-based personalized system of instruction (PSI) introductory psychology class (see Hantula, Crowell, & Boyd, 1989, for further description) at the University of Notre Dame volunteered to participate in exchange for extra course credit. All subjects had experience working with computers.

Apparatus and Task

An IBM-PC/XT® microcomputer equipped with a hard disk drive, two floppy disk drives, keyboard, and monochrome monitor delivered instructions, controlled experimental events, and collected the data.

The task was the same one used in previous behavior-analytic research on financial decision making (Goltz, 1992; Hantula & Crowell, 1994), with the exception that the present task presented two investment alternatives rather than one investment alternative. Subjects engaged in a dynamic investment task in which they managed money for an investment group with the goal to make as much money as possible. Numerous opportunities were presented in which subjects could invest between \$100 and \$10,000 in \$100 units in a "stock." Investments could either gain or lose money, and any money not invested remained in a non-interest-bearing "money market account." A subject could choose not to invest in any opportunity by entering \$0.

The allocation of money for each investment, feedback on gain or loss, and amount of gain or loss were identical to those used in prior research (Goltz, 1992; Hantula & Crowell, 1994). Each investment opportunity began with a new allocation of \$10,000. For each investment opportunity, subjects entered the dollar amount they chose to invest on the keyboard or number pad and pressed the return or enter key. Feedback from each investment decision was immediate. Investments that earned money resulted in a return of \$30 per \$100 invested, investments that lost money resulted in a

loss of $10 per $100 invested, and investments of $0 did not result in a gain or loss, nor did they provide information about the scheduled consequence. Instead, the computer displayed a message confirming that no money was gained or lost. There was no limit to the number of investments a subject could make. Therefore, subjects had repeated opportunities in which they could choose to invest a sum of money or not invest at all.

Subjects were presented with a free-operant, two-component (or "market"), single-alternation multiple-schedule environment (Ferster & Skinner, 1957), hereafter referred to as "Market A" and "Market B." Market A was signified by a reverse video presentation (white screen background with dark gray characters), and Market B was indicated by a "normal" monochrome video presentation (dark gray screen background with white characters); pairing of each market with the light or dark screen background was balanced across subjects. Following each component there was a 1-s time-out, during which data from the previous component were saved and the computer displayed the message, "switching to the other market." Any key presses during this time-out were not recorded and did not result in any feedback or consequences.

The schedule of return was intermittent and unpredictable. Returns on investments occurred according to multiple VI VI schedules (Ferster & Skinner, 1957). Interval values were calculated according to a 25-step Fleshler and Hoffman (1962) equation with the algorithm and program of Hantula (1991). When investing under these VI schedules, the first investment made after the interval elapsed resulted in a gain of $30 per $100 invested, and all other investments resulted in losses of $10 per $100 invested. Substantial pilot work showed that under these VI schedules, subjects quickly acquired and maintained a steady rate of investment.

Procedure

Each subject worked individually in a small office equipped with a filing cabinet, coat rack, desk, chairs, and microcomputer. After the subject read instructions displayed on the computer screen, a trained experimenter repeated the instructions to the subject. The subject then participated in a sample investment that neither gained nor lost money. The experimenter answered any questions by referring the subject to the appropriate section of the instructions. Before leaving the office, the experimenter reminded the subject that the goal was to make as much money as possible for the investment group and that the subject would be asked to complete a questionnaire following the experiment asking for justification of investment decisions. The computer informed the subject when the experiment ended.

The experiment was divided into two phases. In Phase 1, subjects invested under a multiple VI VI schedule in which both Market A and Market B (components) yielded overall equal return rates. In Phase 2, subjects invested under a multiple VI extinction (EXT) schedule, in which the return rate for Market A remained constant while Market B ceased to yield returns and every investment in this market resulted in a loss of $10 per $100 invested. Aside from the changes in return rate, all other procedures remained constant when phase changes were programmed. Subjects were not informed that any changes in return rate were programmed. Component durations and schedule values for each subject were as follows: Lewie: 30-s components, VI 10 s; John: 36-s components, VI 5 s; Howie: 20-s components, VI 10 s; Dash: 30-s components, VI 10 s; Ivan: 20-s components, VI 5 s; Mike: 30-s components, VI 5 s.

RESULTS

Mean dollars invested were blocked by three or four components to facilitate visual display and analysis. Table 1 shows mean amount invested in Phases 1 and 2 in each component for each subject. Figure 1 shows mean dollars invested by trial blocks in Phases 1 and 2 for Lewie, Dash, and Mike, and Figure 2 shows mean dollars invested in Phases and 2 by trial blocks for John, Howie, and Ivan. All subjects invested similar amounts of money in each market during Phase 1. During Phase 2, amount invested in the market during extinction (yielding

no returns) dropped quickly and precipitously for Lewie, John, Dash, Ivan, and Mike, but decreased slowly for Howie. All subjects except John responded in a manner consistent with a clear contrast effect by increasing investing in the unchanged (VI) component; however, John did show a small ($300) overall increase in amount invested in this component.

Table 1
Mean Amounts Invested in Phases 1 and 2

Subject	Component	Amount invested in Phase 1 (VI VI)	Amount invested in Phase 2 (VI EXT)
Lewie	A	$ 545.55	$ 232.23
	B*	436.00	951.11
John	A	4,630.46	184.21
	B*	5,515.91	5,811.41
Howie	A*	4,596.25	5,795.80
	B	3,414.55	2,158.05
Dash	A	3,031.84	1,031.59
	B*	4,233.79	5,433.79
Ivan	A*	2,850.00	9,034.17
	B	2,054.58	839.06
Mike	A	5,406.70	18.90
	B*	5,328.90	6,860.00

* Unchanged component.

DISCUSSION

Consistent with previous research in behavioral contrast (Reynolds, 1961; Schwartz & Gamzu, 1977; Williams, 1983), when the return rate changed from a multiple VI VI schedule to a multiple VI EXT schedule, subjects decreased their rates of investment in the component placed on extinction while investment rates in the unchanged component increased. This study contributes to the literatures on escalation and persistence of commitment, behavioral contrast, and the behavioral analysis of economics and decision making.

Escalation and Persistence of Commitment

Goltz (1992, 1993) and Hantula and Crowell (1994) showed that a history of intermittent reinforcement in a course of action leads to escalation and persistence during a period of failure. However, the deescalation of investment in the stock placed on extinction demonstrates that an alternative investment limits escalation in that stock. These data are consistent with those of McCain (1986), but not with others who included an alternative opportunity and reported large escalation effects in dollar allocations (Staw, 1976; Staw & Fox, 1977). Although all of these studies used the same materials (Staw's, 1976, "A & S Financial Decision Case"), there appear to be some important differences in their procedures that may have contributed to the disparate results.

The alternative opportunity provided by Staw (1976) was also a failing opportunity. The alternative opportunity provided by Staw and Fox (1977) was stated as "reserved for other uses" (p. 439), and provided no information about its success or failure. Conversely, in the study by McCain (1986), subjects in one group were told that money not allocated would be returned to the company (similar to Staw & Fox, 1977), but subjects in another group were given three nonfailing alternative investment opportunities and were shown the performance of these alternatives over time. McCain found that subjects who were shown the performance of the investment alternatives reported feeling that they had alternatives, whereas those who were merely told of the alternative's existence reported feeling that they had no alternatives. McCain's results showed that subjects who were merely told of the existence of an alternative investment showed escalation effects (similar to Staw, 1976, and Staw & Fox, 1977) but that those who were actually exposed to the alternatives did not escalate, consistent with the results of the present study.

Like other suggested prescriptions derived from the research literature for managing persistence and escalation behaviors, such as removal of responsibility (see Barton, Duchon, & Dunegan, 1989; Simonson & Staw, 1992), modeling (Brockner et al., 1984), and training (Goltz, 1992), providing an alternative course of action also may not work as expected. Inadvertent and unintended behavioral

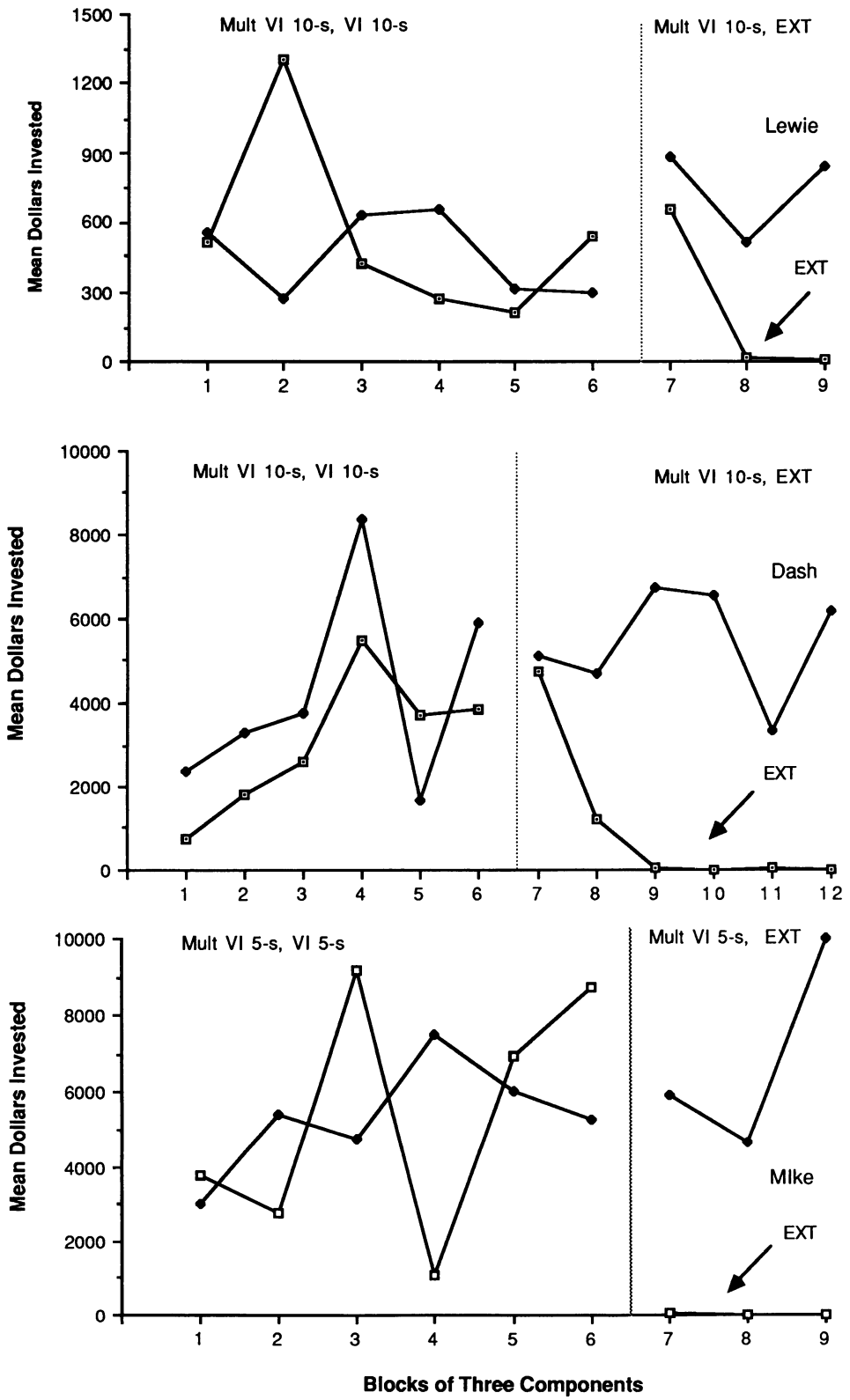

Figure 1. Mean dollars invested by trial blocks during Phase 1 (VI VI) and Phase 2 (VI EXT) for Lewie (note the *y*-axis ranges from \$0 to \$1500; top), Dash (middle), and Mike (bottom).

contrast effects may occur, in that persistence or escalation in a failing course of action may be attenuated, yet escalation in a substandard alternative may be the price paid.

Escalation of Commitment and Behavioral Contrast

Experiencing an identifiable, successful alternative can limit escalation if only allocations to the failing alternative are considered. In the present study, if both Market A and Market B are viewed as single, independent courses of action, an increase in investing in the unchanged market when the other market is placed on extinction may not be an instance of escalating in the face of failure, because the unchanged market is not by itself a failing course of action, although the return schedule in the unchanged market does not increase. Although the precipitous decline in investing in the failing market is consistent with prescriptions of economic "rationality," the increase in investing in the unchanged market may not be "rational," and may be an instance of escalation of investment beyond economic advisability. That is, although returns are available in the unchanged market, the return schedule itself has not increased. Investing additional amounts in this market in the absence of any additional returns or increase in return rate may be a case of escalation.

If Market A and Market B together are viewed as an economic whole or a *behavior situation* (Baum, 1973), a simple derivation of the matching law describes subjects' allocations of their investments in both phases (Herrnstein, 1970; Rachlin, 1973). Investments in Market A (I_A) and in Market B (I_B) earned returns of (R_A) and (R_B); (R_O) represents returns from "other" sources, or in the present study, the money market account.[1] Thus, with k as a constant accounting for bias and m as the degree of interaction between the two schedules, the relative investment in Market A would be

$$I_A = \frac{kR_A}{R_A + mR_B + R_O}. \quad (1)$$

Likewise, relative investing in Market B would be

$$I_B = \frac{kR_B}{R_B + mR_A + R_O}. \quad (2)$$

In multiple schedules, m ranges from 0 to 1, and as m approaches 1, more interaction exists between the two schedules. Rapid alternation of components (as in the present study) increases schedule interaction and the value of m (Herrnstein, 1970), which can lead to matching in multiple schedules (Rachlin, 1973). Thus if it is assumed that $R_A = R_B$, Equations 1 and 2 predict the equivalent investment observed in Phase 1. With $R_A > R_B$ in Phase 2, the contrast effects seen in terms of escalation of investing in the unchanged component are also predicted. Because in Phase 2 $R_A > 0$ and was unchanged (R_A in Phase 1 = R_A in Phase 2) and R_B in Phase 2 = 0, the numerator in Equation 1 remains the same while the denominator reduces by the value of R_B; therefore, I_A increases. Likewise, the value of I_B reduces to 0. Thus, the increase in investment seen in Market A and the concomitant decrease in Market B are consistent with the matching law.

Behavioral contrast in these circumstances may be understood in the context of matching theory. The returns obtained from a given course of action, relative to the returns obtained from all other courses of action, emerge as the controlling variable. In terms of Baum's (1973) correlation-based law of effect, the unchanged market becomes overvalued as the returns from both markets are averaged across time and the feedback functions begin to differ. It is this dynamic unfolding across time of repeated cycles of investment and return or loss that reveals relative stability (Phase 1), disruption (beginning of Phase 2), and adjustment (later Phase 2). Redmon and Lockwood (1987) presented a descriptive analysis of the matching law and organizational behavior in terms of concurrent schedules of rein-

[1] Although the current study used multiple schedules, subjects exposed to the single VR schedules in past studies (Goltz, 1992; Hantula & Crowell, 1994) allocated approximately the same overall mean amount of money while earning returns as did the present subjects; thus, it appears that R_O was approximately equal in each of these studies.

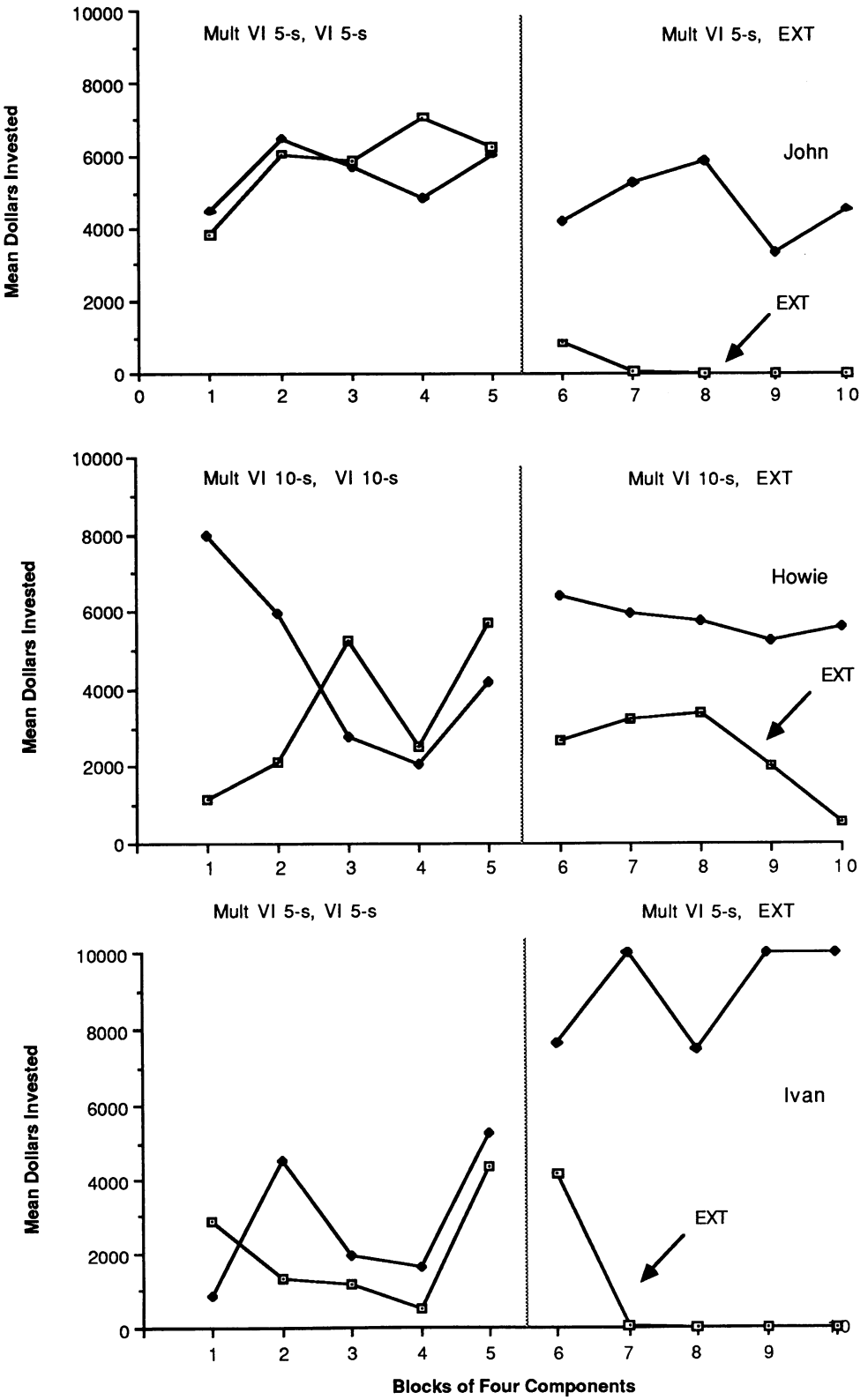

Figure 2. Mean dollars invested by trial blocks during Phase 1 (VI VI) and Phase 2 (VI EXT) for John (top), Howie (middle), and Ivan (bottom).

forcement; the present study provides impetus to extend their analysis to include multiple schedules.

This contextual account of behavioral contrast and escalation is consistent with O'Flaherty and Komaki's (1992) Bayesian analysis of Goltz's (1992) escalation studies. It also suggests that behavioral contrast may be more common than has been assumed (Gross & Drabman, 1981; Redmon & Ferris, 1987). The present study shows that behavioral contrast can occur in sequential decision tasks in simulated organizations. Although further research is necessary, it is not implausible for such effects to occur in other types of organizational settings or situations. For example, behavioral contrast-like phenomena have been documented in the performance appraisal literature. When managers are asked to make sequential ratings of the performance of a number of subordinates, these ratings have shown contrast-like effects in that a "neutral" performer is given a higher rating when rated subsequent to a "poor" performer and is given a lower rating when rated subsequent to a "superior" performer (Ivancevich, 1983; Wexley, Yukl, Kovacks, & Sanders, 1972). Apparently, sequential rating or valuation of an equivocally performing resource, whether a stock or a subordinate, may be prone to contrast effects. Indeed, escalation has been demonstrated in a performance appraisal task (Bazerman, Beekun, & Schoorman, 1982). Perhaps behavioral contrast is an important, but as yet unexplored, determinant of escalation in a variety of dynamic contexts.

Two significant limitations to this study remain. First, the generality of these results to daily management and financial decisions is open to question. Strictly programmed reinforcement schedules do not normally occur in the workplace or in the marketplace; however, metaphorical extensions of these results to naturally occurring complex phenomena may be less difficult to conceptualize (see, e.g., Rao & Mawhinney, 1991, for a schedule-based simulation and analysis of leadership). Although resource allocation decisions by professional managers and investors are often assumed to be rational, a good deal of evidence suggests the opposite (see Lewis, 1989, for examples). Also, considering that the subjects in the current study had substantial education in the "decision sciences" and were weeks away from graduation, these results may be more generalizable than first appears. Second, because of the ethical and practical limitations of using human subjects, experimental phases were not of sufficient length to capture the full effect of the contingencies in either phase. Longer phases may have engendered even more stabilized investing in Phase 1, as well as allowing investment during Phase 2 to plateau in Market A at its zenith and in Market B at its nadir. Perhaps when investing in Market B ceased, investing in Market A may have increased more; or, investing in Market A may be attenuated as Market B becomes functionally a noncomponent of the situation. These speculations await further study.

This study affords a methodology for moving research on escalation and persistence beyond a single-alternative environment and provides further evidence for the generality of behavioral contrast effects. In its most fundamental sense, the current study is an extension of previous work that has explored economic decisions from a basic behavior-analytic viewpoint (Allison, 1981; Herrnstein, 1990; Herrnstein, Loewenstein, Prelec, & Vaughan, 1993; Hursh, 1984; Kagel & Winkler, 1972; Rachlin, 1989; Rachlin, Green, Kagel, & Battalio, 1976; Raineri & Rachlin, 1993; Skinner, 1953) and provides further impetus to forge interdisciplinary analyses of dynamic decision-making processes. In particular, using a behavior-analytic framework to investigate seemingly "irrational" decision-making processes (Akerlof, 1991; Ferguson, 1989) may prove to be especially fruitful (Herrnstein, 1990). Thus far, a behavioral analysis of such "irrational" processes has yielded replicable data showing that intermittent schedules (Goltz, 1992, Experiment 1; Hantula & Crowell, 1994), stimulus generalization (Goltz, 1992, Experiment 2), and behavioral contrast are important factors, and that such cognitive/motivational variables as "responsibility" are amenable to a behavioral analysis (Goltz, 1993). This line of research is essentially contextual because of the recognition that previous history, especially previous schedules of reinforce-

ment in similar situations, is an important determinant of future behavior in a given situation. However the basic point of this line of research may be that "most escalation situations involve intermittent reinforcement schedules" (Staw & Ross, 1988, p. 32).

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