JOURNAL OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOR 1998, **70,** 1–21 NUMBER 1 (JULY)

EFFECTS OF CONSEQUENCES OF ADVICE ON PATTERNS OF RULE CONTROL AND RULE CHOICE

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Rules in the form of advice can inaccurately state the effects of recommended responses by overstating or understating size of the consequences. Three experiments investigated the effects of such inaccuracies on patterns of rule control and rule choice with female college students. In Experiment 1, signaled accurate, overstated, or understated rules specified that a given number of points would be earned by pressing a designated key. For some subjects, rules specified a number of points to be gained; for other subjects, rules specified a number of points to be lost from an amount given earlier. Point totals stated in the inaccurate rules averaged 25% more (overstated) or 25% less (understated) than those received. When subjects could choose either the response specified in the rule or an alternative response that produced an unpredictable number of points, they showed greater sensitivity to the inaccuracy of overstated rules than understated rules. In trials at the end of the experiment in which subjects could choose which rule to see, subjects did not always choose accurate rules and often chose inaccurate rules for which they had shown less sensitivity earlier. Experiment 2 replicated this pattern in which subjects could choose which type of rule to see on a greater number of trials. Some evidence suggested that subjects prefer an improvement from the outcomes promised to those later received. In Experiment 3, rules misstated by averages of 25% and 50% were compared. Evidence suggested that increasing the size of the misstatement reduced the discrimination of inaccurate rules from accurate ones.

Key words: rule-governed behavior, rule following, rule control, rule choice, advice, button press, college students

Control of behavior by verbal statements is at the foundation of the coordination of activities throughout everyday human activity—in education, child rearing, personal relations, and industry. Statements may range from several words that describe a proscribed act (e.g., ''no smoking'') to more elaborate instructions that describe complex actions, the occasions for making them, and their consequences (e.g., rules of a game, work regulations, battle plans). Statements that prescribe (or proscribe) behavior through either implied or explicitly stated consequences include instructions, rules, advice, commands, orders, directives, adages, and proverbs. The generic term *rule* is most widely used for such statements (e.g., Hayes, 1989; Skinner, 1969). Rules necessarily derive from some source, for example, a person, organization, or publication. For many of these sources, rules are offered over a period of time, and thus complex histories of receiving and following rules develop.

Given that people are able to make the prescribed responses, the rule's or instruction's effect depends in large part on consequences that are delivered for rule following (cf. Cerutti, 1989; Hayes, Zettle, & Rosenfarb, 1989; Skinner, 1969). Consequences can derive from two types of sources. Much attention has been paid to consequences arranged by the source, for example, the speaker who states the rule. When the speaker's personally arranged consequences are contingent on rule following, a rule is characterized in everyday language as an order or command (Skinner, 1969). The consequences may be explicit in the order; for example, ''Do X and I will give you Y'' or ''Do X or I will take away Z,'' or implied based on past experience with the speaker. Because personally delivered consequences are varied, salient, and often sizable, their description and manifold effects have usually set the agenda in the study of rule control in the social sciences, under the heading of social power. In the study of interper-

Some of these data were reported at the 20th annual convention of the Association for Behavior Analysis, Atlanta, May 1994. Thanks to Robert Duniway, Kari Cassidy, Heidi Eriksen, Yvette Gaston, and Julie Hinterberger for their assistance in collecting the data and the Department of Sociology for subject money.

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sonal relations, for example, a major variable is relative power based on personal resources and the dependence of others on those resources (e.g., Blau, 1964; Emerson, 1981; Homans, 1974; Kelley & Thibaut, 1978).

Following rules from a source can also occur because of environmentally arranged or natural consequences—ones not under the control of the rule giver. When natural consequences determine rule following, a rule can be characterized in everyday language as advice; for example, ''Do A to get B'' or ''Do A to avoid C'' (Skinner, 1969). Hayes et al. (1989) use the terms *ply* and *track* to distinguish between rules based on personally arranged and natural consequences, respectively. In social psychology, Homans (1974) uses the terms *power* and *authority,* respectively, to make a similar distinction. In many instances, of course, rules entail both types of consequences.

Although rules in the form of advice are ubiquitous in matters of health, finance, safety, education, and the like, outside of behavior analysis less attention has been paid to conditions that determine their effectiveness compared to issues related to power. The ability of advice to engender compliance is obviously consequential for the formal control required in organizations, as well as for informal control and trust in everyday activities. This study focuses on how rule control and rule choice are affected by some of the characteristics of natural consequences.

Rules describing the relation between behavior and natural consequences have been studied in the form of experimenter-provided instructions that accompany reinforced responding on a laboratory task. Interest has focused on how the presence and accuracy of instructions affect responding (for reviews, see Chase & Danforth, 1991; Hayes et al., 1989; Vaughn, 1989). Results show that instructions often produce patterns of responding that differ (sometimes markedly) from conditions in which instructions are absent, and that the effects of inaccurate instructions are often resistant to change (e.g., Baron & Galizio, 1983; Catania, Matthews, & Shimoff, 1982; Catania, Shimoff, & Matthews, 1989; Cerutti, 1989; Hayes, Brownstein, Haas, & Greenway, 1986; Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986; Matthews, Catania, & Shimoff, 1985; Shimoff, Matthews, & Catania, 1986). These studies suggest that instruction following is a strong, generalized response class in novel situations even when explicit consequences for complying with the rule are absent. Although such instructions are intended as advice, they might also imply experimenter-based consequences, which could enhance effects.

What variables affect the likelihood that rules are followed when the only consequences are natural? Despite evidence cited above that inaccurate rules are followed under certain circumstances, rule accuracy (whether the consequences described by a source are actually those received) should be important in most instances. If a positive outcome is described by a source but rarely follows the behavior, rule control by that source should eventually decline (Galizio, 1979). But rule control could also be affected by other conditions, even when the rule is accurate in specifying natural consequences. One of these is consequence type—whether rule following produces positive effects or avoids aversive ones. Evidence suggests that in some situations aversive consequences may produce effects of greater magnitude than do positive ones. In reviewing a number of topics in psychology, Taylor (1991) concluded that aversive events elicit more physiological, affective, cognitive, and behavioral activity than positive ones do. For example in studies of choice, Kahneman and Tversky (1984) found that a given increase in the aversiveness of an event had a greater effect on preference than did a similar increase in attractiveness. Another element that may play a role in following advice is *how* rules are inaccurate. As a complex stimulus, a rule may inaccurately describe events in a number of ways, determined by the number of elements in the rule. In a common case, the rule describes a three-term contingency—the occasion for a response (discriminative stimulus), a response, and a consequence; for example, ''When W occurs, do X and receive Y.'' Inaccuracies in the rule's description of the actual event can occur with regard to any of these three elements or their combinations. In everyday life, inaccuracies in rule elements appear to be widespread and, in cases such as advertising, are clearly intentional. A common instance seems to be the intentional overstatement or understatement of consequences in the di-

rection that makes them appear more favorable. For example, when encouraging children to engage in desirable activities such as studying or eating healthful foods, parents and authorities may overemphasize benefits by claiming immediate large effects on grades or health. When encouraging necessary aversive activities such as hard work or painful treatments, they may underestimate various unpleasant consequences.

The focus of this study is on two variables that could affect the control produced by a source's advice: (a) consequence type (gain or loss of a reinforcer) and (b) direction of rule inaccuracy (overstatement or understatement of consequences). Two general questions are addressed. The first concerns situations in which rule recipients have received previous advice from a given source. How do the consequences of that previous advice affect the likelihood that instances of new advice from the source will be followed? Rule following in this context has been termed *generalized rule control* (Malott, 1989). The second question concerns the situation that arises when more than one rule source is present. Given a choice among sources, which source will be sought for advice? Studies of unavoidable consequences suggest that when ''good news'' and ''bad news'' are both available and equally predictive, only the former is sought (Fantino, 1998; Fantino & Logan, 1979). Thus, when choosing among rule sources, people may tend to select those promising ''favorable'' consequences (e.g., overstated gains or understated losses). In the present study the effects of consequence type and direction of misstatement on both generalized rule control and choice were investigated.

A laboratory procedure was developed in which different rule sources presented rules specifying the consequences of one of several alternative responses on each of a number of trials. This procedure allowed the rapid development of histories of source accuracy or inaccuracy when the response specified by the rule was emitted. Three experiments addressed the following questions: (a) Given several alternative responses, how is choice affected by a rule that is accurate, overstated, or understated regarding the consequences of one of the responses? (b) When only one type of rule can be seen, which is more likely to be chosen? (c) How does an increase in the magnitude of the overstatement or understatement affect rule control and choice? (d) Do the above effects depend on whether the rules specify a gain or a loss?

EXPERIMENT 1

Experiment 1 compared rule control and choice using accurate, overstated, and understated rules in both gain and loss conditions. Rules stated points to be gained or lost, respectively, for making a specified response. The magnitude of overstated and understated gains and losses averaged 25%. A range of misstated values from 15% to 35% was used to prevent subjects from easily calculating the amount of misstatement.

METHOD

Subjects

Twelve female college students were recruited to participate in a laboratory study through notices read in undergraduate classes. The notice stated that the study would consist of three 1-hr sessions, and that subjects typically would earn $7.00 to $8.00 per hour working on a simple laboratory task. Subjects signed consent forms agreeing to be available for the required sessions. Earnings were paid after each session. Six subjects worked under the gain condition, and 6 worked under the loss condition.

Apparatus

Subjects worked in a small room with a table containing a monochrome video monitor, a numeric keypad, and a box (16 cm by 9 cm by 5 cm). Three lights of different colors were mounted in a row on top of the box, each with an adjacent button. Instructions, rules, and point amounts were displayed on the monitor. When a light on the box was illuminated at the beginning of a trial, pressing the adjacent button displayed a rule on the monitor. At times, pressing one of the numbers on the keypad (1 through 9) registered points on the monitor. A computer in an adjacent room programmed contingencies and recorded the data.

Experiment Overview

The procedure included three parts. In the first part subjects pressed one of nine alter-

native response keys on each of a series of trials. For subjects who received point gains, each of the responses earned an unpredictable number of points from trial to trial, although the range of point values and the total number earned were similar across sets of trials. For subjects who received point losses, responses resulted in an unpredictable number of points being subtracted from a sum given prior to the series. In the second part of the procedure, each trial was accompanied by a rule that provided information regarding the consequences of one of the responses. In this context of unpredictable consequences, rules should be useful for maximizing points when choosing among alternatives. That is, if the consequence stated in the rule was an above-average gain (or a below-average loss), the specified response could be made on that trial. If the stated rule consequence was a below-average gain (or above-average loss), one of the alternative responses could be made. The rule given before each trial either accurately stated, overstated, or understated the number of points to be gained (or lost) by one of the nine responses. The number of points specified in the rule varied from trial to trial, so that choosing the response in the rule varied in profitability. In this part of the procedure, the type of rule seen on each trial (accurate, overstated, or understated) was programmed. In the third part, subjects chose which type of rule to see on each trial.

Procedure

Table 1 shows the sequence of conditions for the three sessions. At the beginning of the first session, the experimenter read the following instructions:

> You will be making choices with information given to you on the screen. You will be asked to enter numbers, and you use these numbers on the keypad [experimenter pointed to the numbers 1 through 9 on the keypad]. You will also be asked to press RETURN. Later one of these lights will go on [experimenter pointed to lights on the box] and you will be asked to press one of these buttons [experimenter pointed to adjacent buttons]. You will earn points and your pay will depend on how many points you earn. You will earn $1 for every 1,550 points. You will receive further instructions on the screen.

Table 1

Sequence of conditions.

Session	Period	Condition	Trials
1	1	No rules	18
	2	Accurate rule (forced)	9
	3–5	Accurate rule	27
	6	Overstated rule (forced)	9
	7–9	Overstated rule	27
	10	Understated rule (forced)	9
	11	Understated rule	9
2	12–13	Understated rule	18
	14	Accurate rule	9
	15	Overstated rule	9
	16	Understated rule	9
	17	Accurate rule	9
	18	Understated rule	9
	19	Overstated rule	9
	20	Accurate rule	9
	21	Overstated rule	9
	22	Understated rule	9
	23	Accurate rule	9
3	24	Understated rule	9
	25	Overstated rule	9
	26	Accurate rule	9
	27	Overstated rule	9
	28	Understated rule	9
	29	Accurate rule	9
	30	Understated rule	9
	31	Overstated rule	9
	32–33	Rule choice (accurate, overstated, understated)	18
	34–35	Rule choice (overstated, understated)	18

Gain condition. In Period 1 subjects could earn points on each trial by pressing one of the nine numbered keys on the keypad, but no rules were available. The points earned on each trial were derived from one of nine base values: 60, 70, 80, 90, 100, 110, 120, 130, 140. An amount ranging from −4 to +5 was added randomly to each value to create the nine values that subjects actually received. Points received thus ranged from 56 to 145. Two sets of nine values derived in this way were used in a predetermined, random order over the 18 trials. Thus, earnings for any single response were unpredictable, regardless of which keypad number was chosen. Pressing the same key on each trial produced the same order of point values as pressing different keys.

At the beginning of the first period, a message on the screen stated:

> You will be able to earn points (worth money) for the next few trials. On each trial the amount you can earn depends on the number

(from 1 to 9) you press on the keypad. Press RETURN to continue.

Then a message stated ''Trial beginning. Press a number, then RETURN.'' When the subject pressed a key (e.g., 3) and RETURN, a message followed stating the response (e.g., ''Number 3 has been pressed''). After 3 s, it was replaced by a message stating the number of points earned (e.g., ''Number 3 pays 106 points''). A message then told the subject to type the number of points earned and to press RETURN to continue. The message was repeated if the number typed was incorrect. Typing the correct number initiated the next trial and a new point amount. At the conclusion of the 18 trials, earnings were shown on the screen (1,800 points), followed by a pause of approximately 1 min before Period 2 began. During that pause, the monitor screen was blank. Each of the subsequent periods was separated by a 1-min pause as well.

In Periods 2 through 13, the accurate, overstated, and understated rules were introduced in turn. These and all subsequent periods consisted of nine trials, and a rule with a different point value was shown at the beginning of each trial. Each rule specified a key number and the points that could be earned by pressing that key. The accurate rules were introduced in Periods 2 through 5. The nine amounts used for the accurate rules were derived in the same manner as the amounts for the nine keys, with points ranging from 56 to 145. Each amount was used once in a predetermined random order during each nine-trial period, thus providing subjects with the complete range of rules. A subject who pressed the key specified by the rule on all nine trials earned 900 points. The key specified in the rule varied from trial to trial in a predetermined random order.

To ensure that subjects contacted rule accuracy over a range of point values, the first exposure to the accurate rules (Period 2) required that the response specified in the rule be chosen on each trial. A message before the first trial stated ''When a button is lighted, pressing it will give you advice. On each trial you must follow the advice.'' A message then stated ''Trial beginning,'' followed by ''Press a lighted button for advice.'' The red light on the left side of the box was illuminated. Pressing the adjacent button produced a message stating a rule (e.g., ''Press 3 and you will get 127 points''). After a delay of 8 s, a message instructed the subject to type the point amount that could be earned (e.g., 127) and to press RETURN to continue. Then, as in Period 1, the subject was instructed to type a number on the keypad. In Period 2 this number had to be the one shown in the advice in order for the trial to continue. The prompt was repeated until the correct number was entered. Following the nine trials, earnings were displayed (900 points), and a message told the subject to wait for further instructions.

In Periods 3 through 5, subjects on each trial could select either the key specified in the rule or one of the other keys. Selecting a key other than that specified in the rule earned points ranging from 56 to 145 with a mean of 100, as in Period 1. These amounts totaled 1,800 points every 18 trials—an average of 900 points per nine-trial period. The instructions from Period 2 were repeated, except that the subject now received a message at the start of each period stating ''On each trial you can decide whether or not to follow the advice.'' Thus, after receiving the advice, the subject could select the number shown in the rule and receive the specified number of points or select another number and receive from 56 to 145 points. Choosing the response specified in the rule on all or none of the trials produced approximately equal earnings (averaging 100 points per trial or 900 points per period). Earnings could be maximized by pressing the key specified by the rule when stated point values were above 100 (the case for four of the nine rules), choosing another number when the rules gave point values below 100 (the case for four of the nine rules), and making either choice for a rule specifying approximately 100 points (the case for one of the nine rules). The result from nine trials with this pattern would be earnings of approximately 1,000 points, 100 more than choosing randomly or as specified by the rule on every trial.

In Periods 6 through 9, the overstated rules were presented using the same instructions described for the accurate rules. In these periods the blue light in the center of the box was illuminated, and pressing the adjacent button produced an overstated rule amount. Overstated amounts were derived in the same

manner as the accurate amounts, but were then increased by a percentage between 15% and 35% (equally distributed with a mean of 25%). Points actually received when the specified key was pressed did not include the markup, and therefore were similar to those received with accurate rules. As with the accurate rules, selecting a number other than the one specified in the rule in Periods 7 through 9 produced from 56 to 145 points.

In Periods 10 through 13, the understated rules were presented using the procedure described for the accurate rules. In these periods the yellow light on the right side of the box was illuminated, and pressing the adjacent button produced an understated rule amount. Understated amounts were derived in the same manner as the accurate amounts, but were then decreased by a percentage between 15% and 35% (equally distributed with a mean of 25%). Points received when the specified key was pressed did not include the markdown, and therefore were similar to those received with accurate rules.

Thus, three rule sources, one accurate and two inaccurate, were signaled by different colored lights. The two types of inaccurate rules were based on the accurate rules, and used the same percentages in either overstating or understating the number of points actually received if the key specified in the rule was chosen.

Periods 14 through 31 provided additional experience with the three types of rules. Each period consisted of nine trials with the same rule type (accurate, overstated, or understated), in which the subject could choose the key specified by the rule or not. Beginning with Period 14, accurate rules were presented every third period. In the intervening periods, the order of the overstated and understated rules was switched back and forth. Each type of rule was thus presented on 54 trials.

In Periods 2 through 31, the rule type shown was experimentally predetermined. In Periods 32 and 33, all three rules were available on each trial, and the subject could choose one of them to see. On each trial, all three lights were illuminated, and an accurate, overstated, or understated rule was displayed depending on which button the subject pressed. A sentence added to the instructions stated that only one button could be pressed. Pressing one of the buttons extinguished all three lights, so that no other rules could be chosen. In Periods 34 and 35, only the overstated and understated rules were available. The red light correlated with the accurate rule was not illuminated. After Period 35, each subject answered written questions. The first asked ''How would you describe the difference between the blue and yellow rules?'' These were the overstated and understated rules, respectively. The next three questions asked how the subject decided whether or not to take the advice for each type of rule (e.g., ''How did you decide to take the advice or not with the *red* light rules?'').

Loss condition. The sequence of conditions shown in Table 1 was also used in the loss condition. Now, however, subjects were given points at the start of each period, and pressing a key (which was required in order to continue) resulted in a loss of points. Subjects were given 3,600 points before the 18 trials in Period 1. Points lost per trial ranged between −56 and −145, with a mean of −100. Net earnings at the end of a given period were thus similar to those in the gain condition. Instructions on the monitor screen stated:

> You will be able to earn points (worth money) for the next few trials. On each trial the amount you can earn depends on the number (from 1 to 9) you press on the keypad. You now have 3,600 points (worth money) to start this period. Press the number of points you have been given, then RETURN to continue. On each trial you will lose some points. The amount you lose depends on the number (from 1 to 9) you press on the keypad.

Then the message ''Trial beginning'' appeared on the screen, and the sequence was identical to that for the gain condition, except that losses instead of gains were registered. At the conclusion of the 18 trials in Period 1, 1,800 points had been lost from the 3,600, leaving 1,800, as in the gain condition.

For Periods 2 through 35, 1,800 points were given at the beginning of each period, and pressing a lighted button produced a message stating a rule (e.g., ''Press 3 and you will lose 127 points''). Except on the trials in which the subject was forced to choose the key specified by the rules, the subject could either lose the amount shown in the rule or

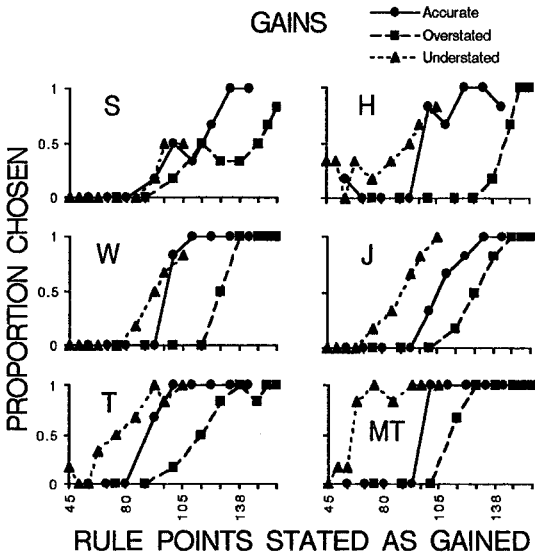

Fig. 1. Proportion of trials on which the specified response was chosen with accurately stated, overstated, and understated gains over the range of point values stated in Experiment 1.

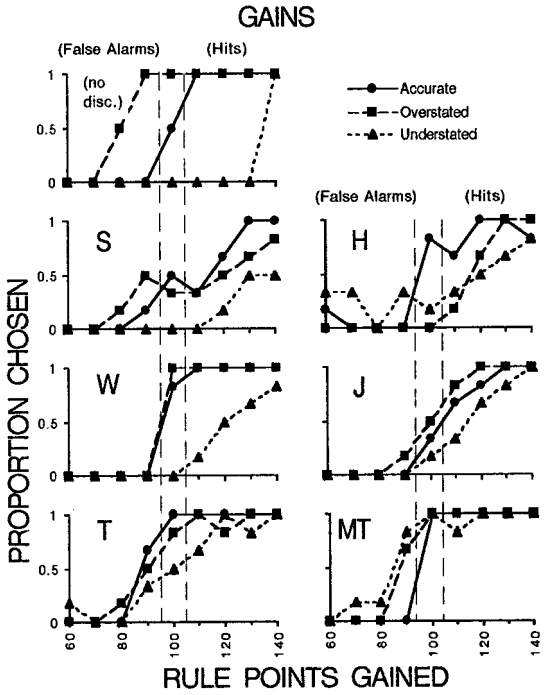

Fig. 2. Proportion of trials on which the specified response was chosen with accurately stated, overstated, and understated gains over the range of point values received in Experiment 1. Upper left figure shows the hypothetical patterns that would result if the responses specified by accurate rules were chosen when they were more profitable than alternatives, and responses specified by overstated and understated rules were chosen as if points stated were accurate (no disc.).

select another number and lose from −56 to −145 points. In the inaccurate-rule periods, earnings could be maximized by choosing the key specified by the rules with point values below −100 and choosing another number when the rules specified point values above −100. The result from nine trials with such a pattern would be a loss of 800 points, 100 points less than following all or none of the nine rules. Subtracting the 800 points from the 1,800 points given at the start of the period yielded earnings of 1,000 points, the same number as in the gain condition. In the inaccurate-rule periods, overstated and understated losses were derived in the same manner as overstated and understated gains.

Results

Gain Condition

How does the presence of accurate or misstated rules affect response patterns? Figure 1 compares proportion of trials on which each subject selected the specified response when rules with accurately stated, overstated, and understated gains were presented, over the range of values stated. These were also the values received for accurate, but not inaccurate, rules. The data are for 54 trials for each rule type. For each type, increasing the number of stated rule points increased the proportion of rule-specified responses chosen, showing that subjects were sensitive to consequence size. Subjects who fail to discriminate among rule types should respond similarly to different rule types having the same or similar stated values (near the midpoint of the range). This was clearly not the case, with the exception of accurate and understated rules for Subject S. Compared to accurate rules with similar stated values, specified responses for overstated rules were chosen less often overall, and specified responses for understated rules were chosen more often. Thus, responding was affected both by point amounts and direction of misstatement.

In Figure 2, the choice proportions displayed in Figure 1 are plotted over the range of rule values actually received if the response given in the rule was chosen. The upper left figure shows three hypothetical choice pat-

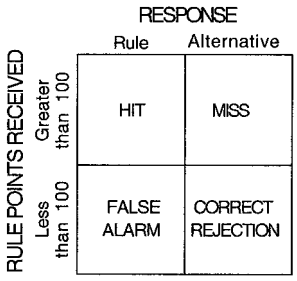

Fig. 3. A signal-detection matrix.

terns. The plot for accurate rules shows the pattern that would result if the responses specified in the rules were chosen only when they were more profitable than the alternatives. The same pattern would also occur for inaccurate rules if both rule inaccuracy and rule profitability were perfectly discriminated. The plots presented for overstated and understated rules show the patterns that would result if the inaccurate rule amounts were treated as if they were accurate (no discrimination of inaccuracy). The actual patterns for accurate rules were broadly consistent with the hypothetical patterns, although they differed in details (see, e.g., the discrepancies in the plot for Subject S relative to the hypothetical function). For Subjects W and MT, discrimination of profitability was perfect with accurate rules. The actual patterns for both misstated rule types show substantial departures from the hypothetical patterns of no discrimination. Subject W perfectly discriminated overstated inaccuracies.

The evidence that subjects discriminated among point values and rule types suggested that signal-detection analyses (e.g., Green & Swets, 1966) could reveal further differences among rule types. The rule setting can be defined as signal plus noise when the rule indicated that the rule-specified response would pay, on average, more than 100 points. The situation can be defined as noise when the rule indicated that the rule-specified response would pay less than 100 points. Figure 3 shows a signal-detection matrix in which these alternatives are used to construct the cells. Choosing the rule-specified response when more than 100 points were received will be a hit, whereas choosing the alternative will be a miss. Choosing the rule-specified response when fewer than 100 points were received will be a false alarm, whereas choosing the alternative will be a correct rejection. The point value of 100 was omitted because hits and false alarms cannot be distinguished—all response patterns produce similar average earnings. In Figure 2, proportions for point values above and below 100 are labeled as hits and false alarms, respectively.

Proportions of hits (H) and false alarms (F) were used to calculate indices of sensitivity (d') and bias (c), based on z-score transformations: $d' = z\mathrm{H} - z\mathrm{F}$, $c = 0.5\ (z\mathrm{H} + z\mathrm{F})$ (Macmillan & Creelman, 1991, Table A5.1). In the present context, the sensitivity score (d') for accurate rules reflects the degree to which choice of the rule-specified response was affected by its profitability. Perfect sensitivity would mean that rule-specified responses were chosen only when more than 100 points were received. For misstated rules, the score reflects the degree to which rule inaccuracies (the difference between stated and received point amounts) were discriminated. Perfect sensitivity would mean that rule-specified responses were chosen only when the received (not stated) amounts exceeded 100 points. Using the convention that defines the highest hit rate (H) as .99 and the lowest false alarm rate (F) as .01 (Macmillan & Creelman, 1991), values of d' range from 4.65 to 0.0, with 0.0 representing chance levels of hits and false alarms and 4.65 representing perfect discrimination of profitability and rule type. Values of the bias index (c) range from −2.33 to 2.33. Negative values indicate disproportionately more false alarms (a bias toward choosing rule-specified responses), and positive values indicate disproportionately fewer hits (a bias toward avoiding the rule-specified responses).

Table 2 shows d' and c values for the 6 subjects. All subjects were sensitive to the consequences of choosing the rule-specified response. For all subjects, sensitivity values for accurate rules equaled or exceeded those for misstated rules. For all subjects except S, values for overstated rules were higher than those for understated rules. With understated rules, 3 subjects (S, W, and J) showed a strong positive bias (hits underrepresented), a pattern evident in Figure 2.

Table 2 also shows the proportions of trials on which each type of rule was chosen when more than one rule was available. Choice among accurate, overstated, and understated

Table 2

Signal-detection indices of sensitivity (d') and bias (c) when only one rule was offered (no choice) and proportion of trials on which each rule was chosen when more than one rule was available (choice). Gain condition: rules accurately stating gains (A), overstating gains by 25% (O25%), and understating gains by 25% (U25%). Loss condition: rules accurately stating losses (A), overstating losses by 25% (O25%), and understating losses by 25% (U25%).

Condition	Subject	No choice (54 trials)						Choice (18 trials per condition)				
		Accurate		O25%		U25%		Three choices			Two choices	
		d'	c	d'	c	d'	c	A	O25%	U25%	O25%	U25%
Gain	S	2.42	0.54	1.16	0.38	1.77	1.43	0.05	0.50	0.44	1.00	0.00
	H	2.93	0.29	2.88	0.89	0.88	0.24	0.56	0.11	0.33	0.61	0.39
	W	4.65	0.00	4.65	0.00	2.43	1.11	0.61	0.39	0.00	1.00	0.00
	J	3.50	0.58	3.50	0.00	2.88	0.89	0.28	0.28	0.44	0.83	0.17
	T	3.28	−0.69	2.70	−0.40	2.35	0.00	0.33	0.33	0.33	1.00	0.00
	MT	4.65	0.00	3.28	−0.69	2.30	−0.60	0.44	0.00	0.56	0.00	1.00
	M	3.57	0.12	3.03	0.03	2.10	0.51	0.38	0.27	0.35	0.74	0.26
Loss	B	4.08	0.29	3.28	0.69	1.61	−0.60	0.78	0.22	0.00	1.00	0.00
	ST	2.70	−0.40	4.08	0.29	2.19	−0.66	0.11	0.61	0.28	0.78	0.22
	K	3.13	0.76	1.80	0.23	2.42	−1.11	0.33	0.67	0.00	1.00	0.00
	J	2.88	0.89	2.53	1.06	2.58	0.12	0.39	0.50	0.11	0.94	0.06
	SH	2.53	−0.14	3.16	0.17	2.56	−0.47	0.17	0.50	0.33	0.39	0.61
	T	4.08	0.29	4.65	0.00	3.28	−0.69	0.22	0.44	0.33	0.50	0.50
	M	3.23	0.28	3.25	0.41	2.44	−0.56	0.33	0.49	0.18	0.77	0.23

rules varied across subjects. Accurate rules were preferred clearly by only 2 subjects (H and W). Understated rules, which often resulted in less sensitive choices in earlier periods, were chosen frequently by 5 of the subjects. When alternatives included the overstated and understated rules only, 5 of the 6 subjects preferred the overstated rules. Eighteen trials distributed across the rule types were too few to compare the likelihood of choosing the rule alternative once the rule was chosen.

The upper half of Table 3 summarizes responses to the postexperiment questions. All subjects correctly described the blue light rules as overstating and the yellow light rules as understating points gained. When asked how they decided to take advice, 4 of the 6

Table 3

Whether or not subjects correctly described difference between overstated and understated rules, and number of points given by subjects when asked "How did you decide to take the advice or not?" for each rule type in Experiment 1.

Condition	Subject	Direction of misstatement described?	Points for rule to be followed		
			Accurate	Overstated	Understated
Gain (minimum points for rule following shown)	S	Yes			
	H	Yes	91	131	81
	W	Yes			
	J	Yes	101	121	96
	T	Yes	90	115	75
	MT	Yes	101	108	81
Loss (maximum points for rule following shown)	B	Yes	−99	−99	−84 to −89
	ST	Yes	−104 to −119		
	K	Yes	−99	−104	−99
	J	Yes			
	SH	Yes	−99	−119	−79
	T	Yes	−99	−119	−79

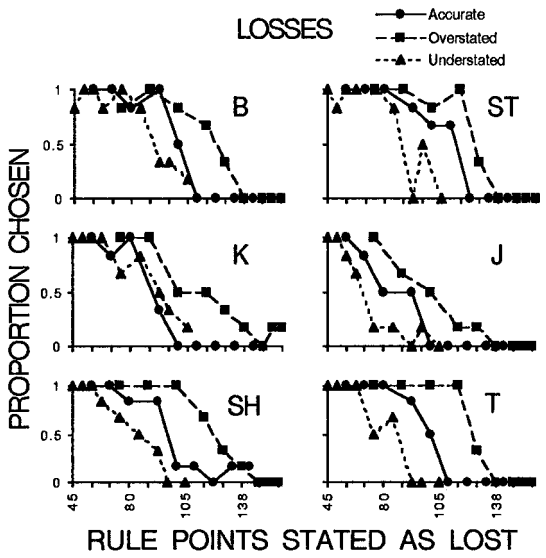

Fig. 4. Proportion of trials on which the specified response was chosen with accurately stated, overstated, and understated losses over the range of point values stated in Experiment 1.

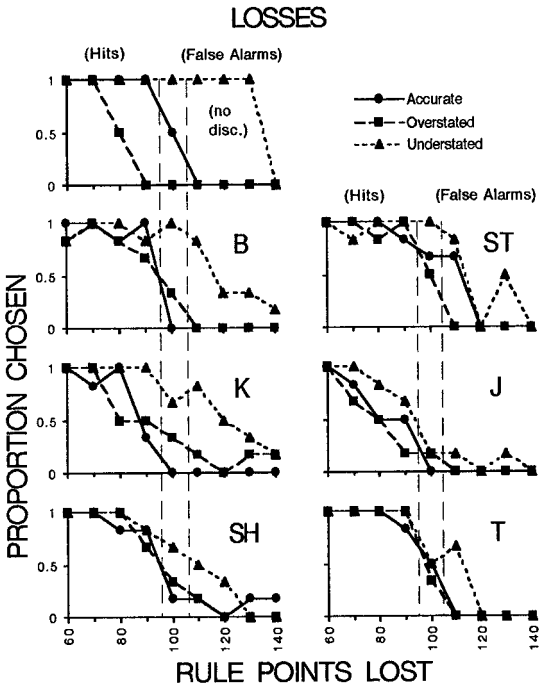

Fig. 5. Proportion of trials on which the specified response was chosen with accurately stated, overstated, and understated losses over the range of point values received in Experiment 1. Upper left figure shows the hypothetical patterns that would result if the responses specified by accurate rules were chosen when they were more profitable than alternatives, and responses specified by overstated and understated rules were chosen as if points stated were accurate (no disc.).

subjects gave explanations that included amounts above which advice from each rule type was taken. For the accurate rules, all four amounts approximated (within .10) the actual point of profitability in selecting the rule-specified response. Three of the overstated amounts and three of the understated amounts approximated that point (125 and 75 points, respectively). Typical responses for the accurate rules included "Whether it is above one hundred or not. Otherwise I will take my chances by guessing," and "I took the advice for the red light when it was 90 or more." For Subjects H and T, response patterns in Figure 1 did not correspond closely to the threshold points described.

Loss Condition

Figure 4 compares proportion of trials on which each subject selected the response specified when rules with accurately stated, overstated, and understated losses were presented, over the range of values stated. The data are for 54 trials for each rule type. Note that an understated (smaller) loss corresponds to an overstated (larger) gain with respect to stating a consequence more profitable than that obtained. For each rule type, increasing the number of rule points decreased the proportion of rule-specified responses selected, showing that subjects were sensitive to consequence size. Comparing rule types, response proportions were dissimilar for similar rule point values, indicating that subjects discriminated accurate from inaccurate rules. Compared to accurate rules with similar stated values, responses specified by overstated rules were chosen more often overall, and responses specified for understated rules were chosen less often. Thus, responding was affected both by point amounts and by direction of misstatement.

Figure 5 compares proportion of trials on which each subject selected the specified response when rules with accurately stated, overstated, and understated losses were presented, over the range of values received if the response stated in the rule was chosen. The upper left figure shows three hypothetical choice patterns. For accurate rules, the function represents specified responses being

chosen only when they were more profitable than the alternatives. The functions presented for overstated and understated rules show the patterns that would result if the inaccurate amounts were treated as if they were accurate. The actual patterns for accurate rules approximated the hypothetical pattern. The actual patterns for both misstated rule types depart from the hypothetical patterns of no discrimination. Subject T perfectly discriminated overstated inaccuracies.

Table 2 shows sensitivity (d') and bias (c) values for each subject. All subjects were at least moderately sensitive to the consequences of rule following. Sensitivity values were not consistently higher for accurate rules. For 4 subjects (B, ST, SH, and T), values were higher for overstated than for understated rules. With understated rules, all subjects except J showed a strong negative bias (false alarms overrepresented), a pattern also evident in Figure 5. In addition, all but 1 subject (T) showed a positive bias (hits underrepresented) with overstated rules.

Table 2 shows the proportions of trials on which each type of rule was chosen when more than one rule was available. Although choice proportions among accurate, overstated, and understated rules varied, an overstated loss was preferred by 5 of the 6 subjects. When alternatives included the overstated and understated rules only, 4 of the 6 subjects preferred overstated losses.

As shown in the lower half of Table 3, all 6 subjects correctly described the blue light rules as overstating and the yellow light rules as understating points lost. When asked how they decided to take advice or not, 4 of the 6 subjects gave explanations for each rule that specified amounts below which advice was taken. For the accurate rules, four amounts (excluding ST) reflected the actual point of profitability in choosing the rule-specified response. Two of the overstated amounts and three of the understated amounts approximated that point. For Subjects B and K, response patterns in Figure 4 did not correspond closely to the threshold points described.

Earnings

Subjects clearly discriminated among responses based on points received. With accurate rules, subjects in the gain condition chose specified responses at stated amounts greater than the average of the nine choices (100 points), and subjects in the loss condition chose specified responses at stated amounts smaller than the average (−100 points). Earnings were set to average 100 points per trial when alternative responses were chosen randomly. All subjects earned more than this minimum during the periods in which response options were not fixed. The amounts gained or lost from trial to trial by selecting the rule-specified response instead of an alternative differed by as much as 80 points (about 5 cents). Across trials, however, the increase in earnings produced when the rule-specified response could be selected or not was much less—approximately 10 additional points per trial. In the gain condition, earnings for the 6 subjects averaged 110 points per trial with accurate rules, 112 points per trial with overstated rules, and 108 points per trial with understated rules. In the loss condition, earnings for the 6 subjects averaged 109 points per trial with accurate rules, 110 points per trial with understated rules, and 109 points per trial with overstated rules. Earnings for each 1-hr session ranged from \$7.15 to \$7.80.

Discussion

Although overstated and understated rules were symmetrical in adding or subtracting an average of 25% to or from the number of points actually received, they often did not have symmetrical effects on response choice. All subjects showed at least some sensitivity to points actually received regardless of rule type, but they frequently failed to adjust their choices to compensate fully for the inaccuracy of understated rules, as reflected in the lower sensitivity values. In the gain condition, there was a disproportionately low number of hits for understated rules (advice not taken in instances in which it was more profitable). In the loss condition, there was a disproportionately high number of false alarms for understated rules (advice taken in instances in which it was less profitable). This is also the bias shown in the hypothetical plots in Figures 2 and 5, in which it was assumed that inaccuracies were not discriminated.

In response to postexperiment questions, however, most subjects gave explanations for their choices that suggested symmetrical sen-

sitivity to overstated and understated rules, although these explanations did not always describe the actual response patterns. Because it is not possible to determine when these descriptions were developed, their effects on behavior during the experiment could not be assessed.

Unexpectedly, when subjects were given a choice of rules, they did not consistently prefer either accurate rules, the consequences of which they had been most sensitive to earlier, or good news (overstated gains, understated losses). In both gain and loss conditions, but particularly with losses, subjects often chose to see rules with bad news (understated gains, overstated losses). Each choice condition lasted only 18 trials, in contrast to the total of 90 trials in which each rule was present singly. Thus, the choice patterns displayed might not represent stable effects. This possibility was investigated in Experiment 2.

EXPERIMENT 2

Experiment 2 focused on the choice conditions used in Experiment 1. The first choice condition included three alternatives (accurate, overstated, and understated rules) and lasted 126 trials. The second choice condition included two alternatives (overstated and understated rules) and lasted 72 trials. The number of choice trials was large enough that selected rules could be compared with regard to whether the rule-specified responses were chosen or not.

METHOD

Subjects and Apparatus

Twelve female college students were recruited to work for three 1-hr sessions. The apparatus from Experiment 1 was used.

Procedure

For both the gain and loss conditions, the training procedure through Period 13 in Table 1 was identical to that in Experiment 1. Then, for 14 nine-trial periods (126 trials), subjects could choose among the accurate, overstated, and understated rules (as in Periods 32 and 33 in Experiment 1). Finally, for eight nine-trial periods (72 trials), subjects could choose between the overstated and understated rules (as in Periods 34 and 35 in Experiment 1). In addition to the postexperiment questions that asked subjects how they decided to take advice, the following question was included: ''Which kind of rule did you prefer, and why?''

RESULTS

Gain Condition

Table 4 shows the proportion of trials on which accurate, overstated, and understated rules were chosen for the first 126 trials, and on which overstated and understated rules were chosen for the last 72 trials. When choices included three rules, 4 of the 6 subjects (M, P, R, and NA) preferred understated rules, 2 strongly. The other 2 (NO and L) preferred accurate rules, 1 strongly. With only inaccurate rules available, all subjects preferred understated rules.

Figures 6 and 7 compare proportion of trials on which each subject selected the responses specified when rules with accurately stated, overstated, and understated gains were presented, over the range of values stated and received, respectively. The data are based on sums from both choice conditions. Where data are omitted for a rule type, the subject made fewer than three contacts with each of the nine point values, a number judged to be too small to obtain representative mean values. Table 4 shows sensitivity (d') and bias (c) values for each subject. No overstated values are shown for Subject NO because fewer than nine contacts occurred with that rule type, a number judged to be too small to obtain representative sensitivity and bias values. Sensitivity values for all subjects were lowest for understated rules. For 3 subjects (M, P, and NO), values were very low, as shown in Figures 6 and 7 by the small changes in proportions over the range of values. Sensitivity values for accurate rules equaled or exceeded those for the other conditions. With understated rules, 3 subjects (P, R, and L) showed a strong positive bias (hits underrepresented), a pattern apparent in Figure 7.

The upper half of Table 5 summarizes the responses to the postexperiment questions. All 6 subjects correctly described the blue light rules as overstating and the yellow light rules as understating points gained. Four subjects (M, R, L, and NA) gave explanations of

Table 4

Proportion of trials on which each rule type was chosen and signal-detection indices of sensitivity (d') and bias (c) for the responses selected when more than one rule was available (choice). Gain condition: rules accurately stating gains (A), overstating gains by 25% (O25%), and understating gains by 25% (U25%). Loss condition: rules accurately stating losses (A), overstating losses by 25% (O25%), and understating losses by 25% (U25%).

Condition	Subject	Proportion chosen: Three choices (126 trials) A	O25%	U25%	Two choices (72 trials) O25%	U25%	Sensitivity and bias (198 trials): A d'	A c	O25% d'	O25% c	U25% d'	U25% c
Gain	M	0.14	0.21	0.64	0.00	1.00	1.11	0.00	0.97	−0.13	0.44	0.22
	P	0.17	0.37	0.46	0.40	0.60	2.25	0.28	2.24	−0.16	0.14	1.41
	NO	0.74	0.05	0.21	0.04	0.96	2.03	−0.63	—[a]	—[a]	0.55	−0.40
	R	0.38	0.20	0.42	0.40	0.60	4.65	0.00	2.52	0.08	2.30	1.18
	L	0.40	0.36	0.25	0.40	0.60	3.97	0.34	3.97	−0.34	2.82	0.92
	NA	0.17	0.11	0.72	0.24	0.76	4.65	0.00	4.65	0.00	3.29	0.24
	M	0.33	0.22	0.45	0.25	0.75	3.11	0.00	2.87	−0.11	1.59	0.60
Loss	JA	0.28	0.60	0.12	0.78	0.22	4.65	0.00	3.16	0.30	2.63	−1.01
	A	0.37	0.54	0.10	0.97	0.03	3.61	0.52	2.67	0.42	4.65	0.00
	O	0.32	0.52	0.17	0.32	0.68	3.03	−0.04	2.20	0.95	1.36	−0.73
	C	0.42	0.31	0.27	0.65	0.35	4.08	0.29	2.69	0.54	2.33	−1.16
	JE	0.25	0.34	0.40	0.31	0.69	2.63	1.01	0.84	0.86	1.59	0.24
	R	0.35	0.52	0.13	0.50	0.50	2.12	0.22	1.89	0.39	1.30	−0.58
	M	0.33	0.47	0.20	0.59	0.41	3.35	0.33	2.24	0.58	2.31	−0.54

[a] Data not shown because rule type was chosen less than nine times.

advice taking that included specific amounts for at least one rule. For Subjects M, R, and L, response patterns in Figure 6 did not correspond closely to the threshold points described. In answer to the question as to which kind of rule they preferred, 3 subjects (NO, R, and L) said they preferred the accurate rule. One of these subjects (R), chose the un-

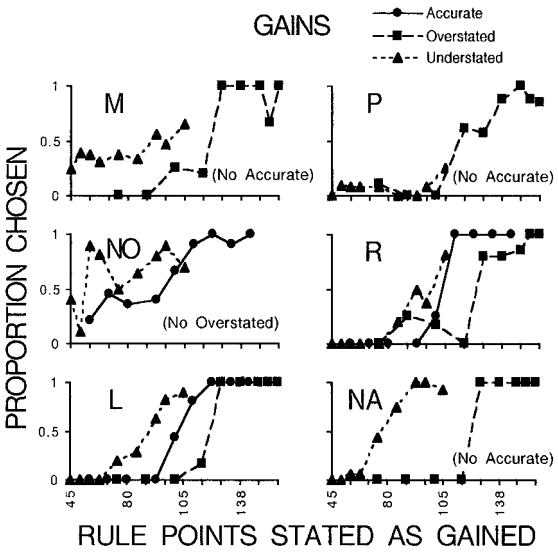

Fig. 6. Proportion of trials on which the specified response was chosen with accurately stated, overstated, and understated gains over the range of point values stated in Experiment 2.

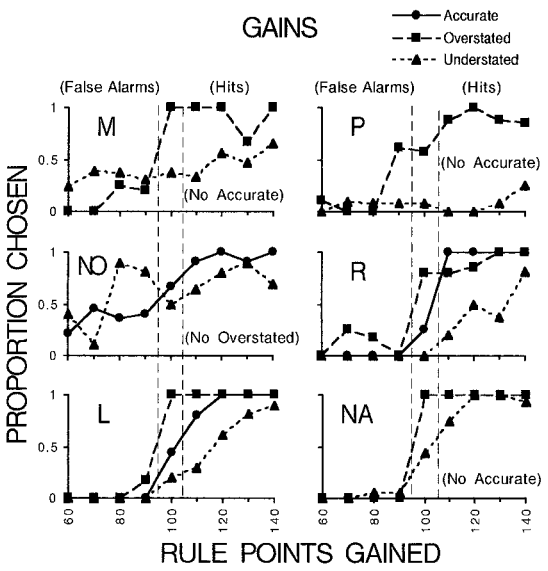

Fig. 7. Proportion of trials on which the specified response was chosen with accurately stated, overstated, and understated gains over the range of point values received in Experiment 2.

Table 5

Whether or not subjects correctly described difference between overstated and understated rules, which type of rule was preferred, and number of points given by subjects when asked "How did you decide to take the advice or not?" for each rule type in Experiment 2.

Condition	Subject	Direction of misstatement described?	Preferred rule	Points for rule to be followed		
				Accurate	Overstated	Understated
Gain (minimum points for rule following shown)	M	Yes	Not answered	75		101
	P	Yes	Overstated			
	NO	Yes	Accurate			
	R	Yes	Accurate			100
	L	Yes	Accurate	101		101
	NA	Yes	Understated	90	120	79
Loss (maximum points for rule following shown)	JA	Yes	Overstated		−119	
	A	Yes	Overstated	−99	−126	
	O	Yes	Overstated		−99	
	C	Yes	None	−99	−109	−69
	JE	No	Accurate			
	R	Yes	Overstated			

derstated rule slightly more often. Typical of the reasons given for preferring accurate rules were "You knew the exact results," and "I had a solid, guaranteed number in front of me." One subject (P) stated a preference for overstated rules, but chose the understated rule most often with both two and three choices. One subject (NA) stated a preference for understated rules and commented on the unattractiveness of an overstated gain, saying it "depressed me when it would give me a lot lower than expected." Subject M's answer could not be interpreted.

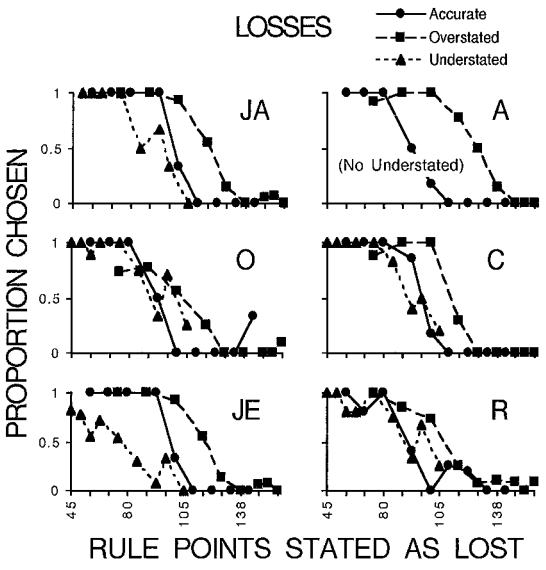

Fig. 8. Proportion of trials on which the specified response was chosen with accurately stated, overstated, and understated losses over the range of point values stated in Experiment 2.

Loss Condition

Table 4 shows the proportion of trials on which accurate, overstated, and understated rules were chosen for the first 126 trials, and on which overstated and understated rules were chosen for the last 72 trials. When choices included three rules, 4 of the 6 subjects (JA, A, O, and R) preferred overstated rules, 1 (C) preferred accurate rules, and 1 (JE) showed a small preference for understated rules. With only inaccurate rules available, the pattern was less clear. Three subjects (JA, A, and C) preferred overstated rules, 2 (O and JE) preferred understated rules, and 1 (R) chose both equally often.

Figures 8 and 9 compare proportion of trials on which each subject selected the response specified when rules with accurately stated, overstated, and understated losses were presented, over the range of values stated and received, respectively. Table 4 shows sensitivity (d') and bias (c) values for the responses selected by each subject. All subjects showed some sensitivity to consequences, which was also shown in Figures 8 and 9 by the decreasing proportions of specified responses that were chosen as the number of points lost increased (either stated or actual). With the exception of Subject A, sensitivity values were highest for accurate rules. For

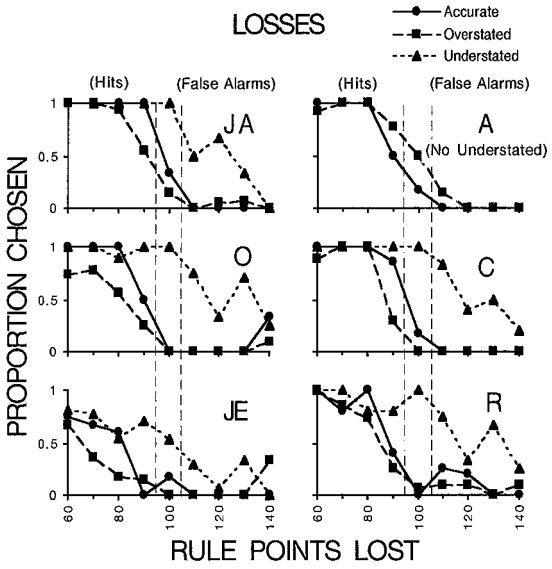

Fig. 9. Proportion of trials on which the specified response was chosen with accurately stated, overstated, and understated losses over the range of point values received in Experiment 2.

overstated and understated rules, sensitivity differences were small, but were lower for understated rules for 4 subjects (JA, O, C, and R). These 4 subjects also showed a strong negative bias (false alarms overrepresented), a pattern that appears clearly in Figure 9. All subjects showed a positive bias (hits underrepresented) with overstated rules.

As shown in the lower half of Table 5, 5 of the subjects correctly described the blue light rules as overstating and the yellow light rules as understating points lost. The 6th subject (JE) described the yellow light (overstated loss) as much more accurate. Four subjects (JA, A, O, and C) gave explanations of advice taking that included specific amounts for at least one rule. For Subjects O and C, response patterns in Figure 8 do not correspond closely to the threshold points described. In answer to the question as to which kind of rule they preferred, 4 subjects (JA, A, O, and R) said they preferred the overstated rules. Reasons referred to the loss of fewer points in comparing the amounts stated and received (e.g., ''Because I knew it would always be less''; ''No matter what, if I took the advice, I'd lose less than the points shown''). For all 4 subjects, explanations and behavior were consistent in the three-choice condition, but statements from 2 (O and R) were not consistent in the two-choice condition. One subject (JE) stated a preference for accurate rules but actually chose the others, and 1 (C) stated no preference but chose accurate rules most often.

Discussion

Increasing the number of choice trials in Experiment 2 produced results that were largely consistent with those from Experiment 1. Choice of which rule to see varied considerably across subjects regardless of number of choices, but subjects did not consistently prefer to see either accurate rules, which they were most sensitive to, or good news. In both gain and loss conditions, subjects often chose to see rules with bad news (understated gains, overstated losses). In comparison with Experiment 1, however, preference for bad news was greater in the gain condition. In citing reasons for their choices, some subjects suggested an added consequence of bad news—an ''improvement'' in outcomes, a case in which the outcome they received was more profitable than the one promised. Improvement apparently constituted better news than promised outcomes favorably misrepresented.

In both experiments subjects tended to compensate less adequately for the inaccuracy of understated than overstated rules. Responses to understated rules showed a pattern of disproportionately fewer hits with gains and disproportionately more false alarms with losses.

EXPERIMENT 3

In the first two experiments, inaccurate rules were overstated or understated by an average of 25%, a number chosen arbitrarily to represent a misstatement of moderate size. What are the effects of misstatements of greater magnitudes? In Experiment 3 the effects of rule amounts misstated by 25% were compared with ones misstated by 50%. The range of overstatement or understatement for the latter was 40% to 60%, and thus did not overlap with the range of 15% to 35% for the 25% rules. As in Experiment 1, one accurate and two inaccurate rules were compared, but inaccurate rules now consisted of 25% and 50% misstatements of either an

overstated or an understated rule. Four three-rule conditions were studied, each using different subjects. In Condition 1, rules stated gains that were accurate, overstated by 25%, or overstated by 50%. In Condition 2, rules stated gains that were accurate, understated by 25%, or understated by 50%. In Condition 3, rules stated losses that were accurate, overstated by 25%, or overstated by 50%. In Condition 4, rules stated losses that were accurate, understated by 25%, or understated by 50%.

Method

Subjects and Apparatus

Twenty-six female college students were recruited to work for three 1-hr sessions. The apparatus from Experiment 1 was used.

Procedure

The procedure shown in Table 1 was used, except that the overstated and understated rules were replaced by 25% and 50% misstatements of the same rule type. The accurate rules remained the same as in Experiment 1.

Results

Increasing the size of the inaccuracy affected sensitivity, bias, and rule control, but variability across subjects was considerable. Table 6 shows sensitivity (d') values and bias (c) values for 24 of 26 subjects—6 subjects in each condition. Data from 2 subjects are not included. One chose the rule-specified response on every trial, and the other never did for two of the three rules. The data are for 54 trials for each rule (Periods 14 through 31 in Table 1).

Figure 10 compares proportion of trials on which each subject selected the specified responses in Condition 1 when rules with accurately stated, 25% overstated, and 50% overstated gains were presented, over the range of values stated. For all subjects, proportions for all three rule types increased with increases in points stated, and proportions for the two overstated rule types were lower than those for accurate rules with similar values, showing sensitivity to both consequences and overstatement. As Table 6 shows, sensitivity to consequences was lower for both overstated rules than for accurate rules for all subjects. The value was very low for Subject F with 50% overstated rules. The bias values show that increasing the degree of overstatement increased false alarms for 5 subjects.

Figure 11 compares proportion of trials on which each subject selected the specified responses in Condition 2 when rules with accurately stated, 25% understated, and 50% understated gains were presented, over the range of values stated. For all subjects except H, proportions for all three rule types increased to some extent with increases in points stated, and proportions for 25% understated rules exceeded those for accurate rules with similar values, showing sensitivity to consequences and understatement. For 50% understated rules, choice proportions were generally low and patterns varied. As Table 6 shows, sensitivity to consequences was lower for both overstated rules than for accurate rules for 4 subjects (H, O, W, and Y). Values for 50% understated rules were very low for all subjects except A, and were substantially lower than those for 25% understated rules for all subjects. The bias values show that increasing the degree of understatement decreased hits for 4 subjects.

Figure 12 compares proportion of trials on which each subject selected the specified responses in Condition 3 when rules with accurately stated, 25% overstated, and 50% overstated losses were presented, over the range of values stated. For all subjects, proportions for all three rule types decreased with increases in stated points lost, and for all subjects except P proportions for both overstated rule types exceeded those for accurate rules with similar values, showing sensitivity to consequences and overstatement. As Table 6 shows, sensitivity to consequences was highest for rules stating 25% overstated losses for 4 subjects (S, CO, N, and R). The bias values show that increasing the degree of overstatement decreased hits for 5 subjects.

Figure 13 compares proportion of trials on which each subject selected the specified responses in Condition 4 when rules with accurately stated, 25% understated, and 50% understated losses were presented, over the range of values stated. For 3 of the 6 subjects (C, B, and M), proportions for all three rule types decreased markedly with increases in stated points lost, and proportions for the two understated rule types were lower than those

Table 6

Signal-detection indices of sensitivity (d') and bias (c) when only one rule was offered (no choice) and proportion of trials on which each rule was chosen when more than one rule was available (choice). Condition 1: rules accurately stating gains (A) and overstating gains by 25% and 50%. Condition 2: rules accurately stating gains (A) and understating gains by 25% and 50%. Condition 3: rules accurately stating losses (A) and overstating losses by 25% and 50%. Condition 4: rules accurately stating losses (A) and understating losses by 25% and 50%.

		No choice (54 trials)						Choice (18 trials per condition)				
		Accurate		25%		50%		Three choices			Two choices	
Condition	Subject	d'	c	d'	c	d'	c	A	25%	50%	25%	50%
Condition 1 (gain overstated)	BA	4.08	0.29	3.73	0.46	2.93	0.29	1.00	0.00	0.00	0.94	0.06
	BL	4.65	0.00	3.16	0.17	2.36	−0.23	0.50	0.28	0.22	0.50	0.50
	V	4.65	0.00	2.21	0.30	2.70	−0.40	0.56	0.28	0.17	0.50	0.50
	A	4.65	0.00	3.50	0.00	3.50	−0.58	0.39	0.28	0.33	0.44	0.56
	F	2.93	−0.29	1.71	0.55	0.67	−0.34	0.56	0.11	0.33	0.33	0.67
	G	2.93	0.29	1.36	−0.13	1.84	−0.48	0.61	0.00	0.39	0.56	0.44
	M	3.98	0.05	2.62	0.23	2.33	−0.29	0.60	0.16	0.24	0.54	0.46
Condition 2 (gain understated)	H	4.08	0.29	1.08	1.21	0.00	2.33	0.33	0.44	0.22	0.72	0.28
	O	3.00	−0.83	1.84	−0.48	0.67	−0.34	0.56	0.22	0.22	0.50	0.50
	W	2.81	0.00	1.48	−0.07	0.45	1.19	0.11	0.50	0.39	1.00	0.00
	A	3.28	0.69	3.28	−0.69	1.77	1.44	0.44	0.28	0.28	0.72	0.28
	Y	2.42	−0.54	1.47	−0.44	0.98	−0.18	0.11	0.28	0.61	0.06	0.94
	S	3.13	0.76	3.16	−0.17	1.08	1.21	0.56	0.11	0.33	0.39	0.61
	M	3.12	−0.19	2.05	−0.11	0.82	0.94	0.35	0.30	0.34	0.56	0.44
Conditions 3 (loss overstated)	P	3.00	−0.83	1.23	0.06	1.52	1.57	0.39	0.33	0.28	0.50	0.50
	S	2.93	0.29	3.16	0.17	3.00	0.83	0.28	0.33	0.39	0.50	0.50
	CO	2.93	−0.29	3.73	0.46	2.63	1.01	0.05	0.11	0.83	0.06	0.94
	N	2.57	0.12	4.08	0.29	1.96	0.43	0.00	0.17	0.93	0.00	1.00
	CH	2.57	−0.12	1.62	−0.37	1.35	0.00	0.72	0.17	0.11	0.11	0.89
	R	1.50	0.65	3.28	0.69	2.12	1.25	0.28	0.28	0.44	0.28	0.72
	M	2.58	−0.03	2.85	0.22	2.10	0.85	0.29	0.23	0.48	0.24	0.76
Condition 4 (loss understated)	C	1.05	0.43	3.00	0.83	1.48	0.07	0.44	0.22	0.33	0.39	0.61
	HU	4.08	−0.29	0.86	−0.12	0.55	−0.28	1.00	0.00	0.00	0.61	0.39
	B	3.50	0.58	3.13	0.76	2.21	−0.30	0.22	0.17	0.61	0.00	1.00
	HA	0.20	0.10	0.24	0.32	0.73	1.04	0.39	0.28	0.33	0.50	0.50
	E	1.63	0.14	0.86	0.12	0.76	−0.18	0.44	0.38	0.17	0.78	0.22
	M	2.93	0.29	2.43	1.11	2.42	−0.54	0.22	0.78	0.00	0.50	0.50
	M	2.23	0.21	1.75	0.50	1.36	−0.03	0.45	0.30	0.24	0.46	0.54

for accurate rules with similar values, showing sensitivity to consequences and understatement. As Table 6 shows, Subject HA showed little sensitivity to consequences of any rule type. Of the remaining subjects, sensitivity values were lower for both understated rules than for accurate rules for all subjects except C. Values for both understated rules were very low for Subjects HU and E. The bias values show that increasing the degree of understatement increased false alarms for 4 subjects.

As Table 6 also shows, misstated rules combined were chosen more often than accurate rules in Conditions 2, 3, and 4. Choice between the two misstated rules showed no consistent pattern.

In answering the postexperiment questions, 21 of 24 subjects gave descriptions indicating that yellow light rules misstated point amounts to a greater degree than did blue light rules. One subject (BA in Condition 1) did not address the question, and 2 (W in Condition 2 and R in Condition 3) indicated no difference. The data were insufficient to compare answers to the question of why advice for each rule was followed. Only 8 of the 24 subjects gave explanations that included specific amounts for each of the three rules. Six of these subjects cited amounts for following the two misstated rules that were identical or differed by 10 points or less, thus suggesting that actual differences between misstated rules were not well discriminated.

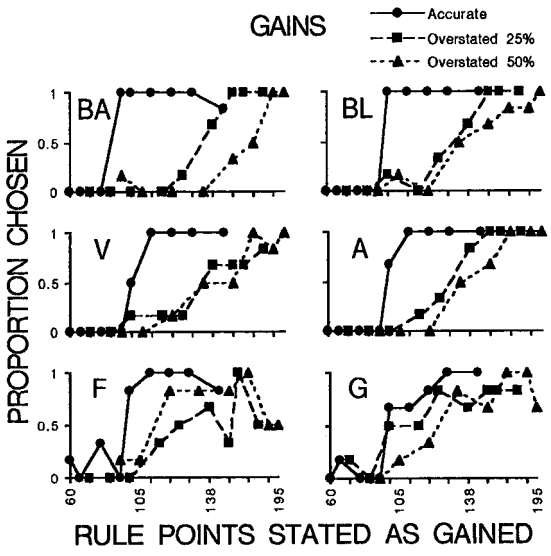

Fig. 10. Proportion of trials on which the specified response was chosen with accurately stated, 25% overstated, and 50% overstated gains over the range of point values stated in Condition 1 of Experiment 3.

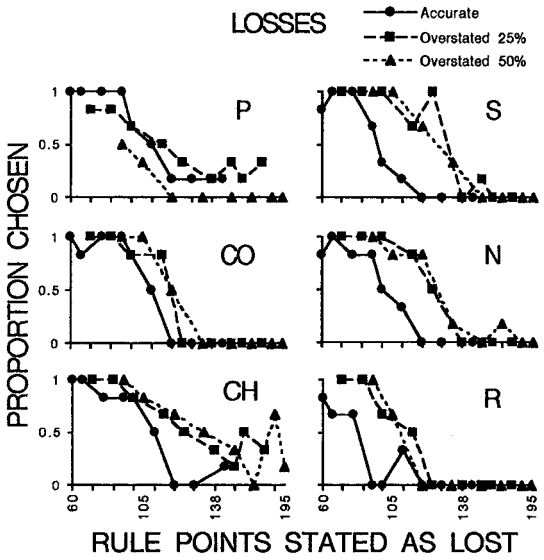

Fig. 12. Proportion of trials on which the specified response was chosen with accurately stated, 25% overstated, and 50% overstated losses over the range of point values stated in Condition 3 of Experiment 3.

Discussion

Overall, an increase in the size of the misstatement tended to reduce the discrimination of misstated rules from accurate ones, with the result that larger misstated amounts were more often treated as if they were accurate (i.e., sensitivity values were generally lower with 50% than 25% misstated rules). Although the correlation between misstated

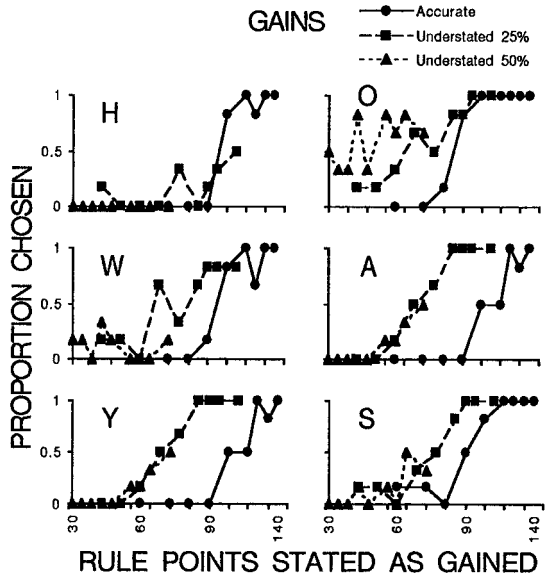

Fig. 11. Proportion of trials on which the specified response was chosen with accurately stated, 25% understated, and 50% understated gains over the range of point values stated in Condition 2 of Experiment 3.

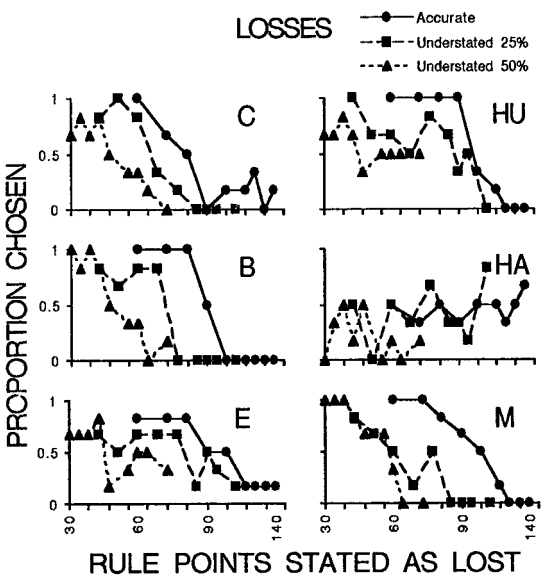

Fig. 13. Proportion of trials on which the specified response was chosen with accurately stated, 25% understated, and 50% understated losses over the range of point values stated in Condition 4 of Experiment 3.

and accurate amounts was the same for the 25% and 50% conditions, subjects' responses to the two conditions typically differed. As in Experiments 1 and 2, discrimination was poorer (i.e., lower sensitivity) with understated than with overstated rules. In Experiment 3, only 1 of 12 subjects in the two 50% overstated conditions displayed sensitivity (d') values below 1.00, compared to 7 of 12 subjects in the two 50% understated conditions.

When choosing which rules to see, subjects were often indifferent to the magnitude of misstatement, and patterns showed considerable variability across subjects. Few subjects gave descriptions for taking advice that accurately reflected the actual differences.

GENERAL DISCUSSION

Rules in the form of advice are ubiquitous. Friends, experts, books, articles, media, commercials, advertisements, and the like describe relations between behaviors and consequences. Consequences range from life threatening, as with health advice or storm warnings, to minor, as with restaurant or film reviews. Many rule givers are encountered repeatedly, and their rules are followed at least occasionally, so that stated and received consequences can be compared. Not surprisingly, experimental subjects generally chose the response specified by the accurate rule source when the stated consequences were equal to or greater than those for alternative responses (i.e., higher gains, lower losses). To try to increase the likelihood of rule compliance, everyday rule givers may be tempted to misstate consequences in a favorable direction. How does overstatement or understatement of consequence size affect control by rules? Although all but 1 subject in Experiments 1 and 2 could describe rule inaccuracies as overstatement and understatement, most did not adjust their responding equally accurately in compensation. With understated rules, subjects more often failed to adjust their choices to reflect the inaccuracy. Compared to rules with overstated gains, those with understated gains produced disproportionately fewer hits (rule-specified responses not chosen when more profitable). As a result, the specified response was chosen less frequently when advice on gains was understated than when it was accurate or overstated. Compared to rules with overstated losses, those with understated losses produced disproportionately more false alarms (rule-specified responses chosen when less profitable). As a result, the specified response was chosen more frequently when advice on losses was understated than when it was accurate or overstated. Although this pattern was not consistent across all subjects or uniformly large, there was some support for it in all three experiments, each of which entailed different conditions. In terms of facilitating compliance, the results thus seem to confirm the efficacy of attempts by rule givers to enhance the favorability of the consequences (giving so-called good news) by overstating gains or understating losses. The result may be no loss in efficacy (with gains) or some increase in efficacy (with losses) compared to the effects of accurate rules.

Horne and Lowe (1993) have contended that adult humans in reinforcing conditions often construct explicit rules for responding, and that these rules may be recalled in postexperimental questioning. In the present study, subjects' postexperiment reports suggest the formulation of rules as well. When asked how they decided to take advice or not, two thirds of subjects in Experiment 1 gave rules that included specific point amounts for all three rules (although the number of subjects who did so in Experiments 2 and 3 was much smaller). It is possible that such rules were developed during the experiment rather than at the time the questions were asked, although as with Horne and Lowe's data, no evidence addresses that point. Certainly, the present procedures, in which subjects both observed and typed various point amounts, seemed to enhance the likelihood of rule formation by college students. The question that solicited the reason for taking advice, however, made no mention of points. Thus, points might have been a part of rules used by subjects who did not report points in their answers. When subjects did mention specific point amounts for rule following, the correspondence between those amounts and the actual response patterns was often poor. Such a discrepancy might be the result, in part, of the time at which rules emerged in the series of trials. Response patterns based on all trials should not be predicted well by rules developed late in the series.

When subjects chose which type of rule to see, most did not consistently prefer either accurate rules, the consequences of which they were most sensitive to, or good news (overstated gains, understated losses). They often chose rules with bad news (understated gains, overstated losses), although exclusive choice was rare. These results, however, may not be inconsistent with previous findings showing a preference for good news when consequences are unavoidable (Fantino, 1998; Fantino & Logan, 1979). Reasons given for choices suggested that the disparity between misstated and received amounts constituted an additional consequence. A less favorable stated amount followed by a more favorable received amount, that is, an improvement, was typically preferred to the reverse. This finding is consistent with the results of other studies in which subjects have evaluated sequences of outcomes when the outcome total is held constant (e.g., Fredrickson & Kahneman, 1993; Hsee, Salovey, & Abelson, 1994; Loewenstein & Prelec, 1993; Schmitt & Kemper, 1996). Improving outcomes are preferred to ones that are constant or declining. Once subjects in the present study chose the source understating gains or overstating losses, however, the stated response was often less likely to be chosen than was the case with advice from a source overstating gains or understating losses.

Considerable variability was found among subjects in patterns of responding. One explanation may be the limited strength of the consequences used. Although point differences clearly controlled choice, differences in earnings for the various response patterns were small. Such differences were necessarily entailed in the present procedure, which varied rule consequences over a range of values relative to an alternative. Differences in choosing the specified response occurred most often near the point of indifference, and thus were found only on a minority of trials. Other experimental conditions, however, probably facilitated the emergence of effects. Time between seeing the rule and the consequences was very short, and consequences were quantified, which allowed subjects to more readily discriminate between amounts stated and received and to form point-based rules regarding choice. Studying similar conditions using a less easily quantified consequence would provide further information on these issues.

Because the present results were obtained using comparatively well-discriminated rules repeated over a large number of trials, they probably significantly underestimate the effects of misstating rules outside the laboratory. In everyday settings, the largest effects of an overstated gain or understated loss in increasing rule following should occur prior to any discrimination, particularly when sources have provided only accurate rules in the past. In such cases, inaccuracies would be treated initially as if they were accurate, and should have substantial effects. Only after experience with inaccuracies would they be discriminated as overstated or understated, with their effects diminished (as were found here).

In everyday relations, understanding the effects of advice becomes especially complex when people are the sources. People frequently give advice on an array of topics, with accuracy, overstatement, and understatement often varying by topic. Whether advice from a given source will be followed should depend on whether and how discriminations among such topics develop. Further, people are sources of orders and commands as well as advice, and their promises and threats can be accurate, overstated, or understated as well. Little is known about how histories of speaker-arranged and environmentally arranged consequences from the same source, such as a parent or employer, interact to affect compliance with commands or advice, although they surely must.

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Received February 2, 1996
Final acceptance March 18, 1998