Delayed Rule Following

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Although the elements of a fully stated rule (discriminative stimulus [S^D], some behavior, and a consequence) can occur nearly contemporaneously with the statement of the rule, there is often a delay between the rule statement and the S^D . The effects of this delay on rule following have not been studied in behavior analysis, but they have been investigated in rule-like settings in the areas of prospective memory (remembering to do something in the future) and goal pursuit. Discriminative events for some behavior can be event based (a specific setting stimulus) or time based. The latter are more demanding with respect to intention following and show age-related deficits. Studies suggest that the specificity with which the components of a rule (termed *intention*) are stated has a substantial effect on intention following, with more detailed specifications increasing following. Reminders of an intention, too, are most effective when they refer specifically to both the behavior and its occasion. Covert review and written notes are two effective strategies for remembering everyday intentions, but people who use notes appear not to be able to switch quickly to covert review. By focusing on aspects of the setting and rule structure, research on prospective memory and goal pursuit expands the agenda for a more complete explanation of rule effects.

Key words: rule following, prospective memory, goal pursuit, verbal behavior, delays

Among the many functions of verbal stimuli for human interaction is the ability to specify contingencies of reinforcement or punishment. Verbally specifying contingencies in forms such as commands and advice is a cornerstone of society's control of many forms of human activity. Behavior produced or altered by such verbal statements is described as rule governed (Skinner, 1969). Fully stated rules describe a three-term contingency: a discriminative stimulus for some behavior (an S^D), the behavior, and a consequence, for example, "When W occurs, do X and receive Y," or "When W occurs, do X and Y will be taken away." In practice, an S^D may not be part of the statement when a rule is to be followed at once or is relevant any time. In addition, the consequence may be implied instead of specifically stated, based on past consequences from similar rules or rule sources.

Consequences for rule following can

derive from two types of sources. They may be arranged by the rule source, for example, the speaker who states the rule, or they may be environmentally arranged, natural consequences that are not under the control of the rule giver (Skinner, 1969). For most people, a lifelong history of exposure to varied rules and diverse consequences makes rule following a strong, generalized response to newly posed rules. Rules come from sources, however, and the likelihood that a given rule will be followed also depends on the history of consequences from a particular source.

In the experimental analysis of behavior, most research has focused on the near-contemporaneous presence of a rule, S^D , behavior, and consequences, with little delay between the statement of the rule and its applicability. A number of studies have contrasted the characteristics of rule-governed behavior with those of contingency-shaped behavior (i.e., behavior shaped directly by its consequences). Research has focused on how the presence and accuracy of rules in the form of experimenter-provided instructions affect responding on laboratory tasks (for reviews see Chase & Danforth, 1991; Hayes, Zettle, & Rosenfarb, 1989;

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Vaughan, 1989). Results show that instructions concerning task contingencies or recommended performance often produce response patterns that differ (often markedly) from those in which instructions are absent (i.e., behavior is contingency shaped), and that the effects of inaccurate instructions are often resistant to change. These studies support the view that rule following is often a strong, generalized response class in novel situations even when explicit consequences for complying with the rule are absent. Studies also show that characteristics of a rule source can affect rule following; these characteristics include rule accuracy (Galizio, 1979; Schmitt, 1998), whether a rule is instructed or shaped (Cattania, Matthews, & Shimoff, 1982), and the range of rules provided (Le-Francois, Chase, & Joyce, 1988).

Everyday observation suggests that rules are often given when the S^Ds, behaviors, and consequences occur at some future time, well after the statement of the rule. The S^Ds, behaviors, and consequences may be separated by periods ranging from minutes to months. Given the extensive evidence from nonhuman subjects showing that delays weaken the effects of consequences on behavior, it is not surprising that the effects of rules that include a delay between the behavior and its consequence have been addressed. Such delays are common. For example, a medication may take days or weeks to produce the intended effect. Studying before a test involves a delay of days before the effects on a grade can be observed. With such delays, can the consequences of rule following still strengthen rule-governed behavior? Malott and his associates (Malott, 1989; Malott, Malott, & Trojan, 2000) argue that they can, but only if the consequences are sizable and probable. If the delay is longer than a few minutes, they argue that the effect of the consequences is not direct. Instead, the prospect of failing to obtain these consequences arouses feelings such as fear, guilt, and anxiety. Rule following

is negatively reinforced by the removal of these aversive feelings (an immediate consequence). Malott et al. suggest that delayed consequences that are improbable or small, but cumulative, are ineffective because they fail to arouse aversive feelings. Little research has been conducted to support Malott's theory or the actual effects of the kinds of delays that occur in everyday settings. In a contrasting view, Baum (1992, 1994) contends that rule following can best be explained as a generalized response based on a long history of tangible and social reinforcers for rule following.

In addition to delayed consequences, two other potentially important delays are also possible. One is a delay between the statement of the rule and the S^D. For example, a doctor may tell a patient to wait for a particular symptom before taking a medication. An investment report may recommend that a stock be purchased, but only if the price drops below a certain point. Thus, the behavior is to be enacted when an environmental event matches the S^D that is stated verbally in the rule. The other possible delay is between the S^D and the behavior. For example, a doctor may tell a patient to take a medication several days after a symptom appears. A weather forecast may predict rain the following day, and the need to carry an umbrella then. Problems posed by these delays have not been investigated in research on rule following. A comprehensive account of rule control, however, requires attention to this issue, and that is the purpose of this article. It is possible to do more than just speculate. The problem of verbal statements affecting behavior has been part of research on prospective memory—remembering to make responses in the future—an area that has received increasing attention in the last decade (see Brandimonte, Einstein, & McDaniel, 1996). Most prior research on memory, by contrast, has concerned retrospective memory—remembering something from the past. Research on prospective memory has

focused on one of the unexplored delays noted above, the delay between a verbal statement to make some response (an intention) and the S^D for making that response. Prospective memory is seen as having two components: (a) when and where to perform the future action (the prospective component) and (b) the content of the future action (a retrospective component). A similar procedure involving the enactment of verbally stated intentions has also been part of recent research on goal pursuit. Although these research areas use methods very different from those used in the experimental analysis of behavior and thus are clearly not part of that literature, they do serve to describe additional variables that affect the relation between verbal statements and behavior.

PROSPECTIVE MEMORY RESEARCH

Early research on prospective memory consisted largely of field studies in which participants were asked to return postcards, keep appointments, or activate clocks over a period of days or weeks (for summaries, see Harris, 1984; Levy & Loftus, 1984). More recent research has used experimental procedures in which a behavioral goal or intention created at the beginning of a session may be carried out at one or more points later in the session. The experimenter typically creates the intention for the subject in the form of an instruction to do something. As such it resembles a rule specifying an S^D and a response. No specific consequences are stated, although some may be implied (e.g., the approval of the experimenter for doing what is requested).

Events that are discriminative of some response can be either event based or time based (Einstein & McDaniel, 1996). In event-based settings, a specific stimulus is given as the occasion for the intended response. The typical event-based setting is designed to simulate everyday prospec-

tive memory tasks in which people who are engaged in some activity must remember to interrupt it to do something else (Guynn, McDaniel, & Einstein, 1998). In a typical procedure, subjects are first given instructions with regard to a background task, such as a series of anagrams, and are then given several target words to remember. They are told to make some response (e.g., press a key) whenever they see the target word later in the experiment. The target words occur several times while the subject works on the background task. The dependent variable is the proportion of target words for which the specified response is made. In time-based settings, a particular time (e.g., 2:00 p.m.) or the passage of a certain amount of time (e.g., 10 min) is given as the occasion for the intended response. Some timing device such as a clock is usually provided. The frequency and regularity of checking the timing device strongly affect whether or not the intended response can be made accurately. In typical time-based experimental settings, subjects are told to make some response (e.g., a key press) at specified intervals while they work on a background task.

Kvavilashvili and Ellis (1996) have distinguished events that are activity based as a third type of discriminative event. Activity-based settings use the completion of one's own actions as the discriminative event for making some response. Although completing an activity can be viewed as one kind of event, Kvavilashvili and Ellis contend that the distinction is useful because an activity-based S^D does not interrupt an ongoing activity and is thus more likely to be salient and detected. They also suggest that time-based settings are least likely to produce the intended response because the designated times are not associated with an obvious stimulus and the intended response may interrupt ongoing activities.

Einstein, McDaniel, Richardson, Guynn, and Cunfer (1995) compared performance on event-based and time-based tasks for subjects of different

ages. Performance differences favoring young (college age) over old (retirement age) subjects occurred only with the time-based task, in which more on-time responses were made by the young subjects. Clock-monitoring responses on the time-based task showed the familiar fixed-interval scallop pattern, with more frequent monitoring at the end of the interval. In addition, the higher the rates of monitoring, the faster the response after the end of the time interval. The results are thus consistent with the view that time-based tasks are more difficult than event-based tasks.

Investigators have also classified discriminative events and the temporal limits for making the intended response. Frequency and regularity of the S^D determine whether it is episodic or habitual. Intended activities have been described as pulse conditions when the time period in which they must be made is very short and as step conditions when the time period is long (Ellis, 1996; Kvavilashvili & Ellis, 1996). This is similar to the notion of a limited hold. Step conditions (a long limited hold) are predicted to lead more often to the intended activity.

Several types of errors with regard to prospective responses have been distinguished but have not been studied systematically (Park & Kidder, 1996). Errors of omission, probably the most common, occur when the prospective response is not made, and errors of commission occur when the response is made on the wrong occasion. In addition errors can be made in the enactment of the prospective response (e.g., the wrong response, such as taking too much or too little of a medication).

RESEARCH ON GOAL PURSUIT

Verbal descriptions of discriminative events and behavior can differ in specificity and detail. For example, a teacher may tell students "To get an A on the next test you will have to study harder than usual," and then describes a study plan that includes what must

be done each day in preparation for the test. Or, given the long history students have with test taking, the teacher may believe that greater specificity is unnecessary and thus offers no more than the general statement. Recent research on goal pursuit provides evidence of the importance of specifying in detail when and how the goal is to be implemented.

Gollwitzer (1999) has distinguished goal intentions ("I intend to achieve x ") from implementation intentions ("I will execute behavior y whenever I encounter situation z "), which specify behaviors linked to an external cue. He suggests that when goals require behaviors that are not well practiced or are not routine, conflicting possibilities for goal attainment or conflicting activities may prevent the initiation of the means for goal achievement. Here implementation intentions can play an important role. In a series of studies, substantial increases in the frequency of goal attainment have been produced by the specification of goal intentions at the time the goal is stated. For example, Gollwitzer and Brandstatter (1997) gave college students the same difficult goal of writing a report over the Christmas holidays describing how they spent Christmas Eve. Half of the subjects were asked to form specific implementation intentions with regard to when and how they would complete the assignment. Of these subjects, 71% completed the assignment, whereas 32% of subjects who were not asked to form implementation intentions completed the assignment. Similarly substantial effects of implementation intentions on goal attainment have been found for a variety of delayed goals (for a summary, see Gollwitzer, 1999). Gollwitzer makes the assumption that the verbal specification of behaviors in such instances leads to the automatic elicitation of those behaviors when the occasion arises later. He argues that such behavior is as strong as habitual activities.

An experiment by Pham and Taylor (1999) showed the importance of es-

establishing specific implementation intentions for goals and then using those intentions later as reminders. Subjects were college students studying for a midterm examination. The investigators compared a "mental simulation" that emphasized the process required to achieve a goal with one that emphasized the outcome of goal achievement. In the process simulation, subjects were instructed to visualize when, where, and how they might study for the exam. In the outcome simulation, subjects were instructed to visualize having completed the exam and finding out that they had achieved a very high score. Groups assigned the process simulation, the outcome simulation, or both were instructed to visualize daily during the week before the exam. Results showed that the process simulation enhanced studying and improved grades compared with the outcome simulation.

The evidence thus suggests that a detailed specification of delayed activities and their occasion increase the likelihood of those activities. Earlier studies of instructions in other contexts also show that specific instructions are more likely to be followed than are more general ones (Levy & Loftus, 1984).

STRATEGIES FOR IMPROVING PERFORMANCE OF INTENDED ACTIVITIES

Field studies using tasks such as returning postcards or keeping appointments support the importance of reminders in increasing the likelihood of intended activities (Cohen, 1989; Levy & Loftus, 1984). Guynn et al. (1998) conducted four experiments that explored the effects of reminders on the probability of making prospective responses in an event-based setting. The experiments manipulated various features of the reminders, comparing the behavior of subjects who did or did not receive reminders. Each experiment targeted 3 of 100 words on a background task that consisted either of an-

agrams or word completions. A reminder appeared on an average of 3.5 min before each of the three target words. Reminders referred to either the target event, the activity, or both. Unexpectedly, subjects who received reminders that referred only to target events ("Remember the three words that you studied at the beginning of the experiment") performed no better than did those without reminders. This finding was obtained in all four experiments. Subjects who received reminders that referred only to the action ("Remember what you have to do when you see any of those three words") performed somewhat better than did those without reminders. Superior to all other groups were subjects who received reminders that referred to the target events and the intended activity ("Remember the three words you studied at the beginning of the experiment and remember the key that you have to press in the experiment if you ever see one of the three words"). Thus, the statement of the specific association between target events and the activity appears to be the feature important for improved performance. Such statements are essentially restatements of the original rule.

Marsh, Hicks, and Landau (1998) conducted three studies that investigated factors related to successful prospective memory in everyday activities. The basic paradigm required that participants identify activities that were planned for the following week (e.g., making a dentist appointment, returning something to a friend, doing homework, writing a letter, taking medicine). They then returned 1 week later to report what they had actually accomplished and gave reasons for any failures to complete the intentions. The study thus differs from laboratory experiments in studying multiple participant-established intentions, enacted or not, over a much longer period of time. Participants were classified as recorders or nonrecorders based on whether or not they used daily planners to write down plans. In Experiment 1 recorders

and nonrecorders did not differ in the number or types of plans or in their success in completing them. Overall, forgetting plans was infrequent, although plans were often revised or rescheduled in light of current demands. Recorders and nonrecorders differed, however, in how good they believed their memory to be and how good it actually was. Recorders believed that they had poorer memories, and they were in fact poorer (as shown by independent measures).

Experiment 2 investigated how frequently recorders and nonrecorders reviewed or revised their plans in the days that followed. All participants were given handheld counters to use for the next 3 days to record number of times plans were reviewed, and half the subjects were required to wear a neon green wristband as a reminder to review their intentions more frequently. Results showed that participants with wristbands reviewed their plans nearly 50% more frequently than did those without wristbands, and that nonrecorders thought of their intentions much more frequently than did recorders. Effectiveness of these procedures in actually carrying out the intentions was not assessed, however.

In Experiment 3 half of the participants who were natural nonrecorders were given daily planners and half who were natural recorders had their daily planners taken away. Half of the participants in each of these groups wore the reminder wristbands and half did not (counters were not used). After 1 week, the number of intentions completed was assessed. For both natural recorders and natural nonrecorders, carrying a daily planner significantly reduced forgetting intentions. Natural recorders without planners were most forgetful. The presence of a wristband reduced forgetting for the natural nonrecorders, but increased it for the natural recorders.

Covert review and consultation of written reminders are thus two alternatives that people adopt for remembering plans. The poorer memory

shown by people who rely on daily planners may have led to their use of planners, or the poorer memory may have been the result of insufficient covert practice caused by their reliance on planners. Covert review, unlike the consultation of text, relies on repetition to maintain accuracy of intentions. Thus it is reasonable that reminders (wristbands) reduced the forgetting only of those who used that strategy.

Reminders of a different sort have been studied in medicine, when it is often critical that patients adhere to a time-based medication schedule. Given the demands of time monitoring, a more effective procedure may be to use a signal to convert a time-based activity to one that is event based (Park & Kidder, 1996). In an early study illustrating this approach, Azrin and Powell (1969) developed a device that sounded a tone at the time that a pill was to be taken. When the user turned a knob to terminate the tone, the device delivered the pill to the user's hand. In other situations, signals might also be delivered via telephone calls, E-mail messages, and reminders from friends or family. Current technology offers new possibilities both for signaling and determining that a medication has been taken.

Schaefer, Kozak, and Sagness (1998) investigated the effects of practicing an activity to be performed later. The prospective memory task was scheduled at the end of the experimental session after subjects had worked on a task booklet. At the beginning of the session the experimenter described five preparatory activities that involved arranging various items. Subjects were told that the experimenter would be busy elsewhere throughout the experiment. To help the experimenter prepare for the next subject, they were asked to do these same things before they left the room at the experiment's conclusion. Subjects in the performed condition had the activities described for them one at a time and then carried out each of the activities. Subjects in the demonstrated condition received the

descriptions and then watched the experimenter perform the activities. Subjects in the instructed condition heard the preparatory tasks described as having been already completed for them. When the end of the session was signaled 30 min later, written instructions told subjects where to leave their materials and that they were free to leave, "having completed the requested tasks," a statement that was intentionally ambiguous. Contrary to predictions, the subjects in the instructed condition were most likely to perform the activities later, and subjects in the performed condition were least likely to do so. A majority of the subjects in the performed condition did not perform a single one of the activities later, whereas all those in the instructed condition performed at least one. The superiority of the instructed condition was also found in a partial replication of the experiment. The results thus again highlight the effectiveness of a verbal statement that contains instructions specifying the occasion and the behavior.

Collectively, the studies cited above suggest several points pertaining to rule control when there is a delay between the statement of the rule and the occasion for its enactment. One concerns the specificity with which the components of a rule are stated. In practice, the behavior and its occasion are often implied or stated generally. The evidence, however, suggests that a detailed specification increases rule following. A second point is the importance of specificity with regard to verbal reminders. The most effective reminders referred to both the behavior and occasion. A third point concerns the evidence in support of two effective strategies for remembering everyday intentions: covert review and written notes. People who use notes appear to be unable to switch quickly to covert review. A fourth point concerns the different skills required for event-based and time-based activities. By requiring time monitoring, the latter appears to

be more demanding and may show age-related deficits.

To revisit the earlier example of a teacher instructing students to study harder for a high grade on a test, the evidence suggests that the original instruction should include both the goal and specific details for implementation, including, if possible, when, where, and how studying will take place. Reminders should also include a high degree of specificity, and should not simply admonish the student to remember the earlier instruction. Plans for studying would typically include events on particular dates prior to the test, making the task time based. The evidence suggests that these should be converted to event-based tasks if possible, for example by "programming" other people or devices such as computers to remind the student what to do.

CONCLUSION

Behavioral analyses of rule control have made consequences their centerpiece. The rules studied have tangible consequences, and behavior is usually studied long enough for contact to be made with those consequences. The result has been evidence that rule following is a strong generalized response class. In studies of prospective memory, by contrast, consequences are rarely explicit, and any contact with consequences is rare. Yet rule-like statements are followed to varying degrees in settings in which there is a delay, ranging from minutes to days, between intention and an S^D . These results can be seen as supporting the notion of generalized rule control. But any stated rule also has a structure and occurs in some context with regard to events and time. The studies noted above point to a variety of setting conditions, mediating activities, and aspects of rule structure that can affect rule following.

Although studies of prospective memory and goal pursuit show that rule following can occur despite substantial delays between the rule and the S^D , they have not systematically varied

duration of the delay, nor have they investigated the effects of another delay noted above, one between the S^D and the behavior. The chain of events that includes the statement of the rule, the S^D , the behavior, and its consequences includes three possible delays, and these can occur singly or in combination. How do these different patterns affect rule following, and how do they interact with other variables involved in rule following? It is apparent that a more complete explanation of rule following in everyday situations will require a perspective much broader than is the case currently.

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