

*THE EFFECTS OF A SEATBELT-GEARSHIFT DELAY PROMPT ON
THE SEATBELT USE OF MOTORISTS WHO
DO NOT REGULARLY WEAR SEATBELTS*

RON VAN HOUTEN

MOUNT SAINT VINCENT UNIVERSITY

J. E. LOUIS MALENFANT

CENTER FOR EDUCATION AND RESEARCH IN SAFETY

AND

JOHN AUSTIN AND ANGIE LEBBON

WESTERN MICHIGAN UNIVERSITY

A seatbelt-gearshift delay was evaluated in two U.S. and three Canadian vehicles using a reversal design. The seatbelt-gearshift delay required unbelted drivers either to buckle their seatbelts or to wait a specified time before they could put the vehicle in gear. After collecting behavioral prebaseline data, a data logger was installed in all five vehicles to collect automated data on seatbelt use. Next the seatbelt-gearshift delay was introduced. The results showed that the delay increased all 5 drivers' seatbelt use, and that the duration of the delay that produced relatively consistent seatbelt use varied across drivers from 5 to 20 s. When the device was deactivated in four of the five vehicles, behavior returned to baseline levels.

DESCRIPTORS: seatbelt use, response cost, seatbelt-shift delay, data logger, reinforcement delay

Several behavioral programs have produced large sustained increases in seatbelt use and several of these techniques have been employed on a communitywide basis to increase seatbelt use in the United States and Canada. For example, publicized enforcement techniques that influence behavior via a direct punishment contingency and rule-governed behavior (e.g., "If I don't wear my seatbelt, I may get stopped by the police, get a ticket and lose points") have produced levels of seatbelt use above 80% (Jonah & Grant, 1985; Williams, Reinfurt, & Wells, 1996). Other studies have shown that providing posted feedback in jurisdictions with

a history of seatbelt enforcement can further increase seatbelt use (Grant, Jonah, & Wilde, 1983; Malenfant, Wells, Van Houten, & Williams, 1996). Feedback has been used in a number of jurisdictions and is part of the statewide "click it or ticket" program in North Carolina. A number of mechanisms may be responsible for the increase in seatbelt use produced by community feedback. First, feedback may prompt motorists to wear seatbelts, and this behavior may be reinforced as the numbers increase. Second, feedback may imply surveillance and punishment for nonuse, which may further increase rule-governed behavior.

However, the results obtained from countries with the highest levels of seatbelt use demonstrate that public education and enforcement have not produced consistent seatbelt use much above 90%. New efforts should focus on vehicle-based interventions that are both effective and socially acceptable because vehicle-based treatments can be consistently applied.

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Reprints can be obtained from Ron Van Houten, Psychology Department, Mount Saint Vincent University, Halifax, Nova Scotia B3M 2J6, Canada (e-mail: rvh@cers-safety.com).

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Many motorists buckle their seatbelts after placing their vehicles in gear, and many do so after initiating travel. One reason why motorists do not buckle seatbelts prior to placing their vehicles in gear is that it takes time to buckle the seatbelt. Buckling after initiating travel can save this time. One approach to increase use involves repeating the seatbelt reminder chime when the vehicle comes to a stop if the driver is not buckled. Berry and Geller (1991) found that a second prompt or reminder activated when the vehicle stopped was effective for 2 of 5 drivers who did not buckle their seatbelts. The remaining 3 drivers were unaffected by the treatment.

Survey data (Boyle, 1996) indicate that only 3% of drivers never use seatbelts. It follows that 97% of drivers wear seatbelts at least some of the time. A common reason offered by motorists who rarely or never use seatbelts is to avoid the "nuisance" of having to engage in seatbelt buckling. This problem can be rectified by simply delaying the driving initiation sequence by a period somewhat longer than the time required to buckle a seatbelt if the driver fails to buckle before attempting to place the vehicle in gear. Such a system could increase seatbelt use because it would delay access to reinforcement (operating the vehicle) for a longer period than it takes to buckle the seatbelt, and the delay would also serve as a powerful reminder to buckle up. Because buckling the seatbelt while in motion could be dangerous, the proposed delay may not only increase seatbelt use but might also reduce injuries caused by buckling seatbelts while driving.

Van Houten, Nau, and Merrigan (1981) demonstrated that it was possible to get people to take the stairs rather than use the elevator by increasing the elevator door delay by as little as 11 s. In other words, taking one or two flights of stairs was preferable to waiting an additional 11 s. The effort involved in using the stairs is much greater than that involved in buckling a seatbelt, so a shorter delay may be effective in increasing seatbelt use.

It has also been noted that drivers of commercial light vehicles such as vans and pickup trucks have significantly lower levels of seatbelt use than do drivers of noncommercial light vehicles (Eby, Fordyce, & Vivoda, 2002). Therefore, the drivers of commercial light vehicles would serve as an appropriate target population to evaluate a gearshift-delay countermeasure.

The purpose of this study was to determine the effects of a 5-s seatbelt-gearshift delay on the seatbelt use of drivers who demonstrate a low frequency of seatbelt use. A second purpose of the study was to investigate the effect of the duration of the seatbelt-gearshift delay on seatbelt use. The third purpose of the experiment was to interview participating drivers in a focus group to evaluate user acceptance and identify any concerns with the system.

METHOD

Participants and Setting

Participants were drivers of three Nova Scotia Department of Transportation (NSDOT) vans and drivers of two Western Michigan University (WMU) campus maintenance vans. All vans were of the same make and type (recent year GMC Savanna cargo vans), so the same wiring harness could be used to wire the data logger treatment device into each vehicle. All vans were driven by a particular driver most of the time but were occasionally driven by other drivers. Maintenance staff drove the NSDOT vans, and most trips were on urban arterials, collectors, and local streets within Halifax Regional Municipality. The WMU maintenance vans were typically used for travel between buildings on campus. All vans had automatic transmissions.

Apparatus

The apparatus used in this experiment was a microprocessor that could implement a programmable delay between applying the brake and the time the vehicle could be placed

into gear if the driver was not wearing his or her seatbelt. The system could also be adjusted in the following two ways: (a) The delay could be adjusted from 1 to 20 s, and (b) the driver could be required to depress the brake once to begin the delay or to hold the brake down for the entire delay. If the driver was required to hold the brake, releasing the brake before the delay timed out reset the delay, which then started again the next time the brake was depressed.

In all cases the driver needed to depress the brake to place the vehicle in gear once the delay had timed out. The delay could be avoided if the driver buckled the seatbelt prior to attempting to place the vehicle in gear, and it could be terminated (negatively reinforced) if the driver buckled the seatbelt during the delay. The delay was always applied when the seatbelt was fastened prior to the driver sitting in the vehicle (seatbelt buckled behind the driver).

Measures

Observational data. Research assistants collected observation data on driver seatbelt use at both sites. Observers recorded the date, time, the identification number of the vehicle, and whether the driver's shoulder belt was fastened. Observers also recorded whether the vehicles were leaving or returning from the motor pool parking lot.

Automatic data scoring. A data logger designed for this experiment scored all events with a date and time stamp. The data logger monitored the following events: (a) vehicle ignition, (b) a person seated in the driver's seat (weight sensor), (c) seatbelt closure, (d) brake use, and (e) implementation of the gearshift delay. Each time any of these events occurred, the status of each of the five events was recorded along with the date and time stamp. From these records it was possible to calculate the percentage of seatbelt use each day.

Focus-group data. Drivers were asked to discuss their responses to questions about their views on the delay, and how it could be

improved. The discussion was held during the participants' own time and lasted about 2 hr. Participants were reimbursed for participating in the focus group.

Experimental Design

A reversal design was employed in this experiment. After first obtaining prebaseline (observational data) and then baseline (automatic data-logged data) on the seatbelt use of drivers, the seatbelt-gearshift delay was first introduced in the two U.S. vehicles. After the effects of the treatment had been assessed in the U.S. vehicles, the seatbelt-gearshift delay was introduced in the three Canadian vehicles. Next the seatbelt-gearshift delay was removed for all but one Canadian vehicle. Because of a programming error, the two U.S. vehicles received the contingency that required the driver to hold the brake down for the entire delay as the first intervention. The evaluation of this contingency was not planned as part of the research project and was not further evaluated because the funding agencies instructed the research team to continue with the planned research program.

Whenever a seatbelt-gearshift delay was first introduced in any vehicle, the researcher met with the drivers and explained that a device had been installed that was designed to help them remember to buckle their seatbelts each time they drove the vehicle. They were also told that the system was designed to give them more time to buckle their seatbelts before driving and that if they did not buckle the seatbelt there would be a short delay before the vehicle could be put in gear. The researcher also mentioned that if they attempted to buckle the seatbelt behind them before sitting down, they would still receive the delay, and the only way to avoid the delay was to buckle the seatbelt. They were told that we would be evaluating the system at the end of the study and that we would want their feedback. It was necessary to explain the system so that drivers would not think the vehicle was broken if it would not go into gear right away. We also informed them that data on their

seatbelt use would be confidential and that their employer would not attempt to obtain the information or use it in any way. They were also told that the purpose of the research was to develop a system that helps people buckle up more consistently.

Prebaseline condition. During this condition, NSDOT drivers and WMU drivers were monitored to select drivers with low seatbelt use at each site. These data were used to select vehicles to be equipped with the data logger. Data were collected at the exit to the motor pool parking lot.

Baseline condition. During this condition, five fleet vehicles were equipped with the data logger. Drivers were told that the box monitored some aspects of their driving behavior and that the measurements would be anonymous and not shared with their employers.

Gearshift delay that required drivers to hold the brake for 5 s (two U.S. vehicles). This condition was implemented in error for both U.S. vehicles following the baseline condition. The driver had to hold the brake down for 5 continuous seconds before he or she could place the vehicle in gear if the seatbelt was not fastened.

Gearshift delay 5 s (all vehicles). The gearshift delay system was activated for 5 s during this condition. The driver had to wait 5 s before placing the vehicle in gear after the brake pedal was depressed unless the seatbelt was already fastened. If the seatbelt was not fastened and the driver fastened his or her seatbelt before the end of the delay, the vehicle could be placed in gear. All 5 participants received this condition.

Gearshift delay 10 s (one U.S. vehicle). During this condition, U.S. Vehicle 2 had the gearshift delay increased from 5 to 10 s. When the interval was increased, the drivers received a memo stating the following: "As you know, if you do not buckle your seatbelt before driving, there is a delay in putting your car in gear. This is just a note to let you know that the length of that delay will be altered or changed from time to time."

Gearshift delay 15 s (two Canadian vehicles). During this condition, two of the Canadian vehicles had the gearshift delay increased from 5 to 15 s.

Gearshift delay 20 s (two U.S. vehicles). During this condition, two of the U.S. vehicles had the gearshift delay increased to 20 s.

Gearshift delay 10 s (two Canadian vehicles). During this condition, the gearshift delay on two Canadian vehicles was reduced from 15 to 10 s.

Baseline 2. During this condition, all but one Canadian vehicle was returned to the baseline condition. Drivers were told that the gearshift delay was turned off but that the data logger remained in the vehicle.

RESULTS

Seatbelt Use

The percentage of seatbelt use for all participants is presented for each session in Figure 1. The baseline level of seatbelt use for U.S. Vehicle 1 averaged 8% after the data logger was installed compared to a prebaseline level of 0%. Following the implementation of a seatbelt-gearshift delay that required an unbelted driver to hold down the brake for 5 s prior to shifting the vehicle, seatbelt use increased to 79%. Changing the contingency to a seatbelt-gearshift delay that required only a single brake application initially maintained high levels of seatbelt use followed by a slow decline and then an abrupt decline during the middle of October. Increasing the seatbelt-gearshift delay to 20 s increased seatbelt use to 81%, and this level was maintained until a return to baseline when seatbelt use declined to 1%.

The baseline level of seatbelt use of U.S. Vehicle 2 averaged 14% after the data logger was installed compared to a prebaseline level of 4.5%. Following the introduction of the 5-s seatbelt-gearshift delay, seatbelt use increased to 70%. However, seatbelt use appeared to show a decreasing trend during this condition.

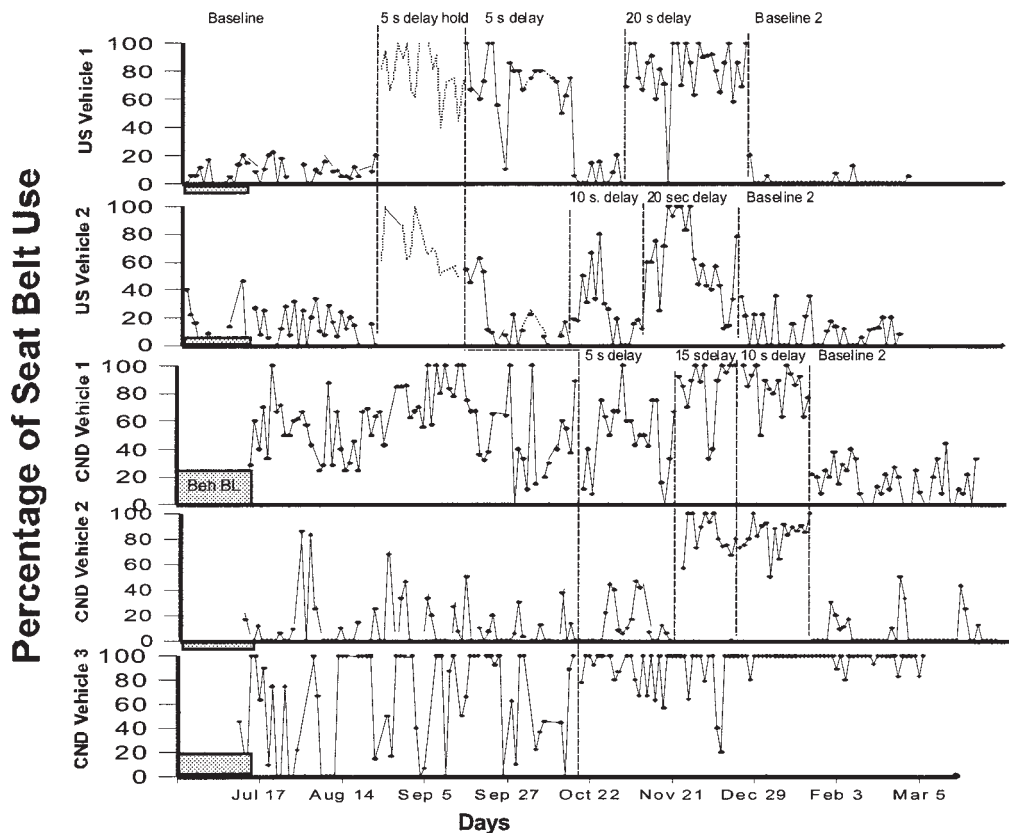


Figure 1. The percentage of seatbelt use during each day for five U.S. and Canadian vehicles. The bars at the left show the level of seatbelt use during prebaseline behavioral measurements. The vehicle data logger scored all other data.

Switching to a seatbelt-gearshift delay that required that the brake only be depressed once to initiate the timing interval led to a further decline to the baseline level. Increasing the delay to 10 s produced an initial increase followed by a marked decline to baseline levels. When the delay was increased to 20 s, seatbelt use increased to 61%. Returning to the baseline condition led to a decline in seatbelt use to 9%.

The baseline level of seatbelt use of Canadian Vehicle 1 averaged 55% after the data logger was installed compared to 30% during the prebaseline condition collected 6 months earlier. The introductions of a 5-s seatbelt-gearshift delay that required only a single brake application produced no change in seatbelt use. However increasing the seatbelt-gearshift delay to 15 s increased seatbelt use to 84%, and this

level was maintained when the delay was reduced to 10 s. The return to baseline led to a decline in seatbelt use to 15%. The baseline level of Canadian Vehicle 2 averaged 11% after the data logger was installed compared to 0% during the prebaseline. Seatbelt use increased to 16% following the introduction of the 5-s seatbelt-gearshift delay that required the driver only to tap the brake. Following the introduction of the 15-s seatbelt-gearshift delay, seatbelt use increased to 84%, and this level was maintained when the delay was reduced to 10 s. The return to baseline led to a decline in seatbelt use to 6%. The baseline level of seatbelt use of Canadian Vehicle 3 averaged 59% compared with a prebaseline of 20% collected 6 months earlier. The introduction of the 5-s seatbelt-gearshift delay that required the driver only to

tap the brake resulted in an increase in seatbelt use to 94% that was sustained for 5 months.

Focus Group

All 5 drivers indicated that the delay was effective in getting them to wear their seatbelts more often and that the longer the delay the more effective it was at getting them to wear their seatbelts consistently. When drivers were asked about when they buckled their seatbelts at home and at work, all of the drivers indicated that they did not see a need for buckling seatbelts for short trips. Examples given of short work trips were backing up to a loading bay and moving the vehicle around at a job site. They also indicated that they did not like wearing seatbelts when backing up because it was uncomfortable. The aspect of the delay that was least liked was the requirement to wear the belt for short trips. Drivers also felt the device would be more acceptable if it did not require them to wear seatbelts when traveling in reverse or on short trips. Most drivers defined short trips as trips less than 2 min in duration. When asked whether a fixed-duration delay or a variable-duration delay would be more effective, drivers felt a variable delay would work better.

When asked if they knew of any way to avoid the delay, they all indicated a number of ways that sometimes worked. These hypotheses were all tested by the research team and were found to be ineffective. These hypotheses were likely examples of superstitious behavior, because the delay randomly failed to occur about 10% of the time because of a software problem and because drivers probably did not always accurately estimate how long they waited. All of the drivers thought adding a chime when the delay is in effect was a good idea because it would prevent the operator from repeatedly trying to place the gearshift into drive.

DISCUSSION

The introduction of the delay increased seatbelt use in all participants, but not all

participants were responsive to the same delay duration. For example, the driver of U.S. Vehicle 1 initially responded to a 5-s delay activated by tapping the brake, but seatbelt use eventually returned to baseline. The driver of U.S. Vehicle 2 initially responded to a 5-s delay and later to a 10-s delay, but behavior eventually returned to baseline. Increasing the delay to 20 s was associated with more consistent seatbelt use for both drivers. The drivers of Canadian Vehicles 1 and 2 failed to respond to the 5-s delay but did respond to a 15-s delay, and seatbelt use was maintained when the delay was reduced to 10 s. The driver of Canadian Vehicle 3 responded to a 5-s delay, and this increase was maintained over time. These data suggest that a fixed delay between 5 and 20 s can produce a marked increase in seatbelt use.

The initial increase and rapid return to baseline in 2 U.S. drivers following the 5-s delay (and the similar pattern in 1 of these drivers who also received a 10-s delay) suggests that the return to baseline levels of seatbelt use may have been associated with the discrimination of the delay duration. It is possible that a variable-delay schedule may be effective with a shorter mean duration because the drivers cannot easily discriminate delay duration on any given trial.

The seatbelt-gearshift delay addressed a major reason why people fail to wear seatbelts (the time expended to buckle the seatbelt is greater than the time expended not to buckle the seatbelt). Existing patterns of seatbelt use show that the great majority of drivers buckle after ignition, and some do after placing the vehicle in gear. The explanation for this phenomenon is that it saves time. People do not appear to want to wait even short periods of time when they are ready to initiate travel. A seatbelt-gearshift delay system reverses the prevailing contingencies by reducing the time expended when the seatbelt is buckled. However, because buckling the seatbelt only takes a few seconds, one would suspect that

delays of about 5 s (the time it takes to fasten and unfasten the belt at the end of the trip) should have been effective with all drivers. Another reason that drivers may not wear seatbelts is the effort required to buckle them. Therefore, the delay duration required to induce a driver to buckle the seatbelt consistently may be some aggregate of the time and effort required to do so.

One advantage of the seatbelt-gearshift delay system is that it may not be intrusive enough to motivate drivers to disconnect it (as is the case with a complete systems interlock or an interlock on the audio, heat, or air conditioning systems) because it does not subject drivers to extended delays on any individual trial. An advantage of a seatbelt-gearshift delay system is that the behavioral contingencies, although very mild, may be sufficient to increase seatbelt use over time. Unlike interlocks on the audio, heat, or air conditioning systems (systems that work only when the motorist wants access to them), the seatbelt-gearshift delay is activated at the start of every trip and would therefore be more likely to establish appropriate stimulus control over seatbelt use. Unlike a sound system interlock, the seatbelt-gearshift delay does not motivate the driver to attempt to fasten the seatbelt while driving. Because the desire to use the sound system could occur at any point during the journey, the driver may be motivated to try to fasten his or her seatbelt at a particularly dangerous time.

The responses given in the focus group indicated that most of the drivers would rather not have to buckle their seatbelts when backing up or when moving their vehicles. One way to improve the seatbelt-gearshift delay system could be to implement it in such a way that it is transparent to drivers who do not use seatbelts for short trips. This variant could be implemented if a microprocessor that kept track of seatbelt use activated the seatbelt-gearshift delay only if a pattern of inconsistent seatbelt use was detected for trips over 2 min long. Once the

delay was activated, the driver could "earn" his or her way off the delay if the seatbelt was used consistently for trips longer than 2 min.

An additional feature of this system is that the delay for not buckling the seatbelt could be adjusted based on ongoing measurement of seatbelt use. In other words, the length of the delay could adjust over time so that reluctant seatbelt users would be subjected to a longer delay than drivers whose behavior is more readily shaped by a short delay. It would also be possible to have a seatbelt reminder chime associated with the seatbelt-gearshift delay, with the chime terminating when the seatbelt is fastened or after the delay has timed out. Members of the focus groups felt that this aspect would be essential if a variable delay is used.

The cost of this intervention is relatively modest. A device to prevent placing the vehicle in gear is already required as part of the brake-gearshift interlock, and seatbelt sensors are required as part of the reminder system. The only addition required to implement this system is a relatively inexpensive microprocessor. In new vehicles, the electrical system is sophisticated enough to handle the system without an additional microprocessor. We estimate that the cost of adding these devices to a vehicle to be less than \$10.00.

At the U.S. sites, we continued to collect behavioral observations of seatbelt use after the data loggers were installed, and it was noted that the behavioral measures of seatbelt use were consistently higher than automated measures of seatbelt use. One reason for this discrepancy was that seatbelt observations were typically made on relatively busy roads near stop signs or traffic signals. Relatively short trips might not be detected by this type of behavioral observation protocol. It is possible that drivers are less likely to wear seatbelts on short trips because they perceive such travel to be less dangerous, or they think it is less likely that they will be stopped or cited in their neighborhood. Therefore,

seatbelt-use data obtained on major highways, collectors, and arterials may not be typical of all seatbelt use. It is also possible that seatbelt use is higher during observational periods because of driver reactivity to observers. Both the United States National Highway Traffic Safety Administration and Transport Canada conduct yearly seatbelt surveys that are based on observational data. The findings of this study suggest that seatbelt surveys may be a better indicator of percentage of time belted than of percentage of trips belted.

There are two basic mechanisms that may be responsible for the increase in seatbelt use produced by the seatbelt-gearshift delay. First, there is a substantial body of evidence indicating that behavior that reduces delay to reinforcement is itself reinforced by that delay (Fantino, 1969). Assuming that the opportunity to operate a vehicle is reinforcing, the device establishes a concurrent schedule in which buckling the seatbelt produces faster delivery of reinforcement supplied by that opportunity (by placing the vehicle in gear) than other available responses. Second, there is also a substantial body of evidence indicating that avoidance of or escape from aversive conditions is also reinforcing. If the delay condition was aversive (as indicated by the drivers themselves and suggested by the data collected here), then buckling up would be reinforced by termination of the condition. Both hypotheses predict the same outcome, and it is difficult to distinguish between them given the design of the present study. However, it is clear that the delay

condition produced desirable effects on seatbelt use and thus warrants more behavior-analytic investigation.

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STUDY QUESTIONS

1. According to the authors, why do drivers fasten their seatbelts after, rather than before, placing the vehicle into gear?
2. Describe the basic operation of the seatbelt-gearshift delay apparatus.
3. How did the authors ensure that all drivers not wearing seatbelts experienced the delay contingency?
4. The authors described the experimental design as a reversal design. What other experimental-control features were included?
5. Summarize the results observed during the delay-plus-hold and the standard-delay conditions.
6. Describe the two negative reinforcement contingencies in effect during the seatbelt-gearshift delay intervention. What data would have indicated whether seatbelt buckling tended to be avoidance rather than escape responses?
7. If one assumes that at least some of the seatbelt-buckling responses during the last seatbelt-gearshift delay phase were avoidance responses, what feature of the current procedure, if eliminated, might have increased the probability that seatbelt buckling would be maintained when the delay was removed?
8. What features of the delay mechanism make it attractive from the standpoint of a behavior manager?

Questions prepared by Jennifer N. Fritz and Erin M. Camp, University of Florida