CAHPERD Journal, Volume 28, Number 1, Fall 2003

Review

Massed versus Distributed Practice: Which is Better?

Steven R. Murray, D.A., and Brian E. Udermann, Ph.D., ATC
Department of Human Performance and Wellness, Mesa State College, Grand Junction, CO and the Department of Exercise and Sport Science, University of Wisconsin—La Crosse, La Crosse, WI

When studying the educational process the area of practice and how it is performed is often a topic of interest. In physical education, instructors are invariably trying to find more efficient, successful methods of teaching motor skills to their students to improve learning, performance, and retention that are occurring. These methods of teaching will always involve some form of drill, rehearsal, or practice of the students. Specifically, in physical education, two types of practice are important: massed and distributed. Much research has been conducted in this area, and we shall concentrate on the topic of practice to provide information for the physical educators. We shall define massed and distributed practice, list advantages and limitations to each type of practice, discuss how these two methods of practice affect learning, performance, and retention, and examine past research findings concerning these two methods.

Massed practice is generally defined as practice that occurs without rest between trials (Burdick, 1977). Schmidt (1991) defines massed practice more loosely as, "a practice schedule in which the amount of rest between trials is short relative to the trial length." Moreover, Wek and Husak (1989) believe that massed practice can have small breaks or "pauses" during the practice. They write:

> The classical definition of massed practice is continuous practice with few or no pauses for rest even of short duration relative to the work interval.

However, Schmidt (1991) discusses the concept of rest during massed practice. He states that massed practice can have small amounts of rest; yet, it only provides "relatively little rest between trials."

The common and accepted definition of distributed practice is "practice interspersed with rest or other skill learning" (Burdick, 1977). Another definition of distributed practice is "a practice schedule in which the amount of rest between practice trials is long relative to the trial length" (Schmidt, 1991). Schmidt (1988) further adds that "the amount of rest between the trials equals or exceeds the amount of time in a trial" when the practice is distributed. Thus, it seems that the defining detail of distributed practice is that rest must be accompanied with the practice; that is, rest is "distributed" during the trials.

However, as stated earlier, some believe that rest can be used during massed practice. By the strict definitions of massed and distributed practice as provided by Burdick (1977), if rest were involved in the practice session, it would then be considered distributed practice. Schmidt clarifies this point when he writes, "There is no fixed dividing line between massed and distributed practice, but massed practice generally has reduced rest between practice trials, whereas distributed practice has more rest."

The advantages and limitations of massed and distributed practice are based on fatigue, time constraints, and number of participants. Physical fatigue, as well as mental fatigue, plays an important role in what type of practice is used (Schmidt, 1991). First, if numerous practice trials are to be performed, and if they are very tiring, a reduction in rest time or no allotment for rest at all will lead to a build-up of fatigue. The fatigue could degrade the performance of the task and possibly interfere with the learning processes involved in performing the trial. In addition, the fatigue build-up could actually lead to the development of "bad habits" and teach and support improper movements. Thus, fatigue must be taken into consideration when a practice schedule is being made.

Furthermore, time will play an important role in the decision of what type of practice should be employed. If the physical educator has a limited amount of time for a large number of individuals, massed practice could be difficult to use. For example, it would be very difficult for 30 students to have massed practice of a soccer goal kick if only one goal were available for each student to practice the kick for a period of ten minutes continuously. The time constraints here are obvious. A much better approach would involve distributed practice of various skills and group work. The students would be involved in the activity for a more concentrated effort and would hopefully have less time off-task.

Also, the advantages and limitations to the type of practice used are dependent on the motor skill being performed (e.g., discrete or continuous tasks). Schmidt (1991) discussed this and states that "[n]early all the massed practice experiments have involved long-duration continuous tasks, but a few have had relatively rapid discrete tasks." The reason for this is very obvious. The discrete tasks take a very short time to perform (tenths of a second); thus, making the rest periods short enough to have an effect on performance is very difficult. In fact, even in laboratory situations where rest periods were held to 300 ms, no decrement in performance or learning has been noted for massed practice (Carron, 1967; Lee & Genovese, 1988; Schmidt, 1991). So, massed practice almost always is used for discrete tasks. Schmidt describes this best by writing:

> It is best to say that for these discrete tasks, such as shooting a basketball or fielding a baseball, there is no evidence that reducing the rest time through massed practice degrades learning, and it may even benefit learning in some cases.

Continuous tasks such as swimming, cycling, and running lend themselves to the build-up of the "fatigue like states" where "decreasing the rest between trials has larger effects on recovery from fatigue and on subsequent performance" (Schmidt, 1991). Thus, continuous tasks that involve massed practice can have detrimental effects on performance because of fatigue; however, learning only is affected slightly through transfer tests on retention (Stelmach, 1969; Schmidt, 1991).

Lee and Genovese (1988) summarized the principles of massed and distributed practice as follows:

> A reduction in the rest of practice trials has the following effects:
>
> - For rapid, discrete tasks, almost no effect on performance or learning and maybe even a slight benefit to learning
> - For long-duration continuous tasks, strong detrimental effects on performance during practice because of buildup of fatigue like states
> - For continuous tasks, only slight negative effects on learning as measured on retention or transfer tests (cited in Schmidt, 1991).

The build-up of fatigue has been shown to have a slight negative effect on learning (Lee & Genovese, 1988). However, it should be noted that "even very high levels of fatigue lead to very efficient learning, fatigue during the practice session is not a worrisome problem" (Schmidt, 1991). It only becomes a "worrisome" problem if it leads to the development of bad habits or possibly could endanger the student (e.g., fatigue while swimming could result in drowning). A caveat also should be mentioned here. Schmidt believes that it is "good to explain to the learner that even though fatigue may come during practice, he or she is still learning effectively." In addition, the student also should be informed that the learning gained during the fatigue will become evident in the future after the fatigue subsides.

When discussing various practice styles, it is often the case that learning is used to evaluate and judge which style is more efficient and thus better. So, a definition of learning is paramount. Schmidt (1975) defines learning as "a change as a result of practice (experience), in a relatively stable internal state." In addition, he believes that learning is best defined "in terms of the gain in the underlying capability for skilled performance developed during practice, with the improved capability leading to improved performance" (Schmidt, 1991). However, performance and learning are not totally linear. That is, learning can occur without a direct link to performance. In fact, Burdick (1977) states, "learning and performance may not be increasing at the same rate." In addition, Schmidt (1991) states that "[i]mproved performance is not, by itself, learning. Rather, improved performance is an indication that learning has occurred." He writes that the whole idea of learning and performance can be summarized in the following formal definition of motor learning:

> Motor learning is a set of processes associated with practice or experience leading to relatively permanent changes in the capability for skilled performance.

Thus, the differences of learning and performance provide evidence that close scrutiny of past research should be done in order to determine if what occurred was learning or an improvement of performance.

In fact, Burdick (1977) believes that "one of the problems with early research [on massed and distributed practice] was the failure to properly distinguish between learning and performance." He describes that in physical education it has been generally accepted that distributed practice is the most efficient method of practice in maximizing the learning and performance of motor skills. This idea was supported by the early research on massed vs. distributed practice where higher performance levels were detected during post-tests and practice sessions (Carron, 1969; Digman, 1972; Murphree, 1971;

Singer, 1965; Stelmach, 1969; Whitley, 1970). However, as noted by Burdick, the differences that were attained in these studies were differences in performance levels rather than in learning. Thus, the difference between performance and learning is of chief importance.

Stelmach (1969) studied the efficiency of motor learning with distributed and massed practice. He used 160 male volunteers who were systematically assigned to various groups. The subjects performed two gross motor tasks and all received the same amount of practice during the sessions. During the massed practice times, the subjects practiced continuously for 8 minutes while the distributed groups practiced with a 30-second work/30-second rest regimen. After the 8-minute trial, all groups received 4 minutes of rest. The groups were then placed in distributed practice schedules for 6 more additional trials. The study revealed that initially the distributed practice regimen produced significantly favorable results. Yet, performance was similar for the groups after the 4-minute rest period. Thus, the author surmised that the type of practice did not affect learning. In fact, he believed that learning was based on the number of trials instead of the type of practice.

Whitley (1970) performed a similar study on fine motor tasks. He used 60 college-age males broken into two equal groups performing massed and distributed practice each. The subjects performed 25 trials of a foot tracking task under a massed or distributed practice schedule only. They would then rest 5 minutes then finish with 10 trials of a distributed work/rest schedule. The schedule of massed practice was 25 seconds of work with 5 seconds of rest. The distributed practice schedule was 25 seconds work followed by 35 seconds rest. Results of the study indicated that learning occurred during both groups; yet, no significant differences were noted for the groups. However, the author found that “performance was significantly favored under the distributed practice condition.” The author concluded that “performance rather than learning was affected by the type of practice condition.”

Another study that examined the effects of massed and distributed practice on the learning of a novel gross motor skill was performed by Murphree (1971). In this study, there were four groups: massed practice group (24 consecutive trials for 3 days), two distributed groups (practiced 12 times per day with rest intervals), and a control group (no trials practiced). The results of the study revealed that learning, measured by performance, was significantly higher for the distributed groups during the practice phrase. However, retention of the skill was significantly higher for the massed practice group. Thus, this experiment supported previous research that massed practice primarily affected performance and not learning.

Another study found that performance was affected rather than learning with different practice conditions. Singer (1965) examined the effects of massed and distributed practice on subjects performing a novel basketball skill (i.e., bouncing a basketball off the floor and into a basket). He used four phases during the study (i.e., pre-test, practice, post-test, and retention test). Subjects in the study were put into groups of 40 that included: a massed practice group who shot 80 consecutive shots with no rest, distributed group who shot 4 sets of 20 shots with 5 minutes rest between sets, and a second distributed group who shot 4 sets of 20 with a 24-hour rest between sessions over four days. Results of this study found that skill acquisition was favorable for the second distributed group with respect to immediate learning. However, performance did not differ significantly between the first retention tests. Instead, on the final retention test, the first two groups of massed and distributed practice were found to be favorable. In the discussion of the results, Singer believed that “performance rather than learning was dictated by the condition practice.” Burdick (1977) summarized Singer’s discussion as follows:

> . . . he explained the depressed performance levels evident during the massing of practice to be caused by a fatigue-like mechanism called “reactive inhibition.” Rest, as was present in the distributed group 2's practice condition, allowed the reactive inhibition to dissipate enabling performance to be higher during the practice and post-phase of the experiment. In the same manner, rest between the post-test and retention tests allowed the performance levels of the massed practice group and the distributed group 1 to rebound to the levels of the distributed group 2's performance.

Much research has been conducted on massed and distributed practice. Most of the research supports the hypothesis that performance is affected by practice more than learning. Some exceptions are noted for this. Schmidt (1975) states that skills that include high elements of danger (e.g., diving, gymnastics) and skills that require great amounts of effort are some exceptions. Generally, under these conditions, performance decreases under massed conditions of practice and increases under distributed conditions of practice. However, research supports the hypothesis that practice conditions generally affect performance rather than learning. Thus, the decision to use one practice type over another should be based on the desired outcome and the demands of the skill being practiced.

References

Burdick, K. J. (1977). Effects of massed and distributed practice on the learning and retention of a novel gross motor skill. Master's Thesis, Western Illinois University.

Carron, A. V. (1967). Performance and learning in a discrete motor task under massed versus distributed conditions. Doctoral Dissertation, University of California, Berkeley.

Digman, J. M. (1972). Growth of a motor skill as a function of distribution of practice. *Readings in Motor Learning*. Philadelphia: Lea & Febiger.

Lee, T. D. & Genovese, E.D. (1988). Distribution of practice in motor skills acquisition: Learning andperformance effects reconsidered. *Research Quarterly for Exercise and Sport*, 59, 277-287.

Murphree, T. R. (1971). Effects of massed and distributed practice upon motor learning and retention of a novel gross motor task. Doctoral Dissertation, North Texas State University.

Schmidt, R. A. (1991). *Motor learning and performance: from principles to practice*. Champaign, IL: Human Kinetics Books.

Schmidt, R. A. (1975). *Motor Skills*. New York: Harper & Row.

Singer, R. N. (1965). Massed and distributed practice effects on the acquisition and retention of a novel basketball skill. *The Research Quarterly*, 36(1), 68-77.

Stelmach, G. E. (1969). Efficiency of motor learning as a function of intertrial rest. *The Research Quarterly*, 40(1), 198-202.

Wek, S. R. & Husak, W. S. (1989). Distributed and massed practice effects on motor performance and learning of autistic children. *Perceptual and Motor Skills*, 69, 107-113.

Whitley, J. D. (1970). Effects of practice distribution on learning a fine motor task. *The Research Quarterly*, 41(4), 576-583.