Overlearning, Fluency, and Automaticity

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Research concerning the retention and application of skills has focused on three general concepts: overlearning, fluency, and automaticity. These three concepts have been viewed as different, although not necessarily independent, characterizations of performance. However, examination of the literatures surrounding these terms suggests that the three apparently distinct concepts may be the same. The confusion concerning these terms may be partly the result of their development and use in separate literatures.

Overlearning

The concept of *overlearning* arose primarily from early verbal learning research (Binder, 1987) and is studied most frequently in the human factors literature. In the overlearning literature, the term refers to training that leads to improved retention (Baldwin & Ford, 1988; Binder, 1987; Hagman & Rose, 1983; Ivarie, 1986). As a procedure, overlearning is defined as practice of a skill beyond 100% accuracy or beyond successful performance, defined by some predetermined criterion (Baldwin & Ford, 1988; Binder, 1987). Overlearning is also used to refer to an improved level of performance, however. For example, Ivarie (1986) defines overlearning as learning a skill beyond the point needed for immediate recall, implying a measurably different level of performance.

The literature has failed to make a clear distinction between these two definitions. When using the term overlearning, authors in both the traditional educational and human factors litera-

tures alternate between the definitions, seemingly unaware of the term's dual role. Consider, for example, the literature's suggestion that overlearning leads to improved retention. Hagman and Rose (1983) state that "a primary determinant of retention is the degree to which a task is learned initially" (p. 200). This refers to levels of performance. The degree to which a task is learned, however, typically refers to the number of practice sessions following successful performance of the task, not the level of performance attained during this additional training (e.g., Hagman & Rose, 1983). This example demonstrates the confusion about overlearning as a procedure of extra practice and overlearning as a degree of learning.

Given the history of behavioral measurement and the development of the overlearning literature, it is easy to understand how the term became dually defined. Because the overlearning research measured performance in terms of accuracy alone, experimenters were unable to measure directly improvements beyond 100% correct performance (Binder, 1987, 1993). Performance reached its asymptote as measured, yet additional practice resulted in improved retention (hence the origin of the term). Additional practice beyond acquisition resulted in improved performance. Thus, overlearning could be defined not just as a procedure but in terms of its results.

The term *overtraining* has begun to replace the term overlearning in the human factors literature (e.g., Hagman & Rose, 1983), although the change in terms does not seem to have been precipitated by confusion regarding overlearning. Perhaps the reservation of overtraining for additional practice of a skill beyond a predetermined perfor-

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mance criterion will minimize this confusion. Overlearning might then be best used to refer only to an improved level of performance.

Fluency

The term *fluency* or *proficiency*, which is most often used in the behavioral education literature, is defined as responding accurately, quickly, and without hesitation (Binder, 1987; Wood, Burke, Kunzelmann, & Koenig, 1978). Because of the emphasis on speed, fluency of a skill is typically measured in terms of rate of performance.¹ Fluent performance is attained by fluency building or overlearning the skill (Binder, 1987; Ivarie, 1986). It is suggested that by practicing a task beyond 100% accuracy, the learner's rate of performance improves (i.e., increases fluency). Thus, the use of temporal response measures permits direct assessment of overtraining effects (Binder, 1993).

The literature suggests that establishing a fluent performance has several advantages. First, fluency (mastery at high rates), like overlearning, is characterized by improved long-term and short-term retention (Binder, 1987; Haughton, 1980; Olander, Collins, McArthur, Watts, & McDade, 1986; White, 1984). Second, fluency is associated with increased endurance on a task. In contrast, dysfluency results in short durations of performance, which may be characterized as high distractibility. Fluent performers are less likely to be distracted from the task and are more likely to engage in the task for extended periods of time without tiring (Binder, 1987, 1993; Binder, Haughton, & Van Eyk, 1990; White,

1984). A third advantage of establishing fluency is that it improves the performance of related, more complex skills (Binder, 1987; Evans, Mercer, & Evans, 1983; Haughton, 1980; White, 1984; Wood et al., 1978). An individual can perform a complex task only as fast and as accurately as he or she can perform the component skills. Thus, fluency of superordinate skills is not possible unless the prerequisite skills can be performed fluently.

Automaticity

The term *automaticity* appears most frequently in the traditional education and information-processing literatures. It refers to the ability to perform skills without conscious attention (Bloom, 1986; Hasselbring, Goin, & Bransford, 1988; Samuels, 1976). Automatic behavior is said to have two characteristics. First, conscious attention impedes their execution. Second, other behavior may be engaged in simultaneously (Bloom, 1986). Fluency and automaticity are often addressed as different concepts. For example, Fries (1963) stated that automaticity "is not simply a matter of speed and fluency" (p. 130). Binder (1987, 1993) and LaBerge and Samuels (1974), however, view automaticity and fluency as being synonymous. Automatic and fluent behaviors are both defined as expert, easeful, and efficient in their respective literatures. Like fluency, automaticity is assessed with temporal measures.

The development of automaticity parallels that of fluency by requiring practice beyond 100% accuracy, in other words, overtraining (Bloom, 1986; Samuels, 1976). Furthermore, the benefits of establishing automaticity as specified by its literature are similar to those of fluency. Automaticity results in improved long-term and short-term retention (Bloom, 1986), is characterized by resistance to distractibility (LaBerge & Samuels, 1974), and also plays an important part in the acquisition of related complex skills (Bloom, 1986; Hasselbring et al.,

¹ Routinely defining fluency in terms of rate may be an unwise practice. Fluency is a concept that can be applied to a variety of skills, for some of which high rates are unimportant. Whether rate of performance is a relevant dimensional quantity depends upon the task. Thus, as Binder (1987) suggests, it may be more prudent to define fluency in terms of accurate performance at an appropriate pace.

1988; Spring, Blunden, & Gatheral, 1981). A proposition not paralleled in the fluency literature is that automaticity allows more of the limited information-processing capacity to be used for other tasks, permitting an individual to engage in other tasks simultaneously (Bloom, 1986; Hasselbring et al., 1988).

Conclusion

The reviewed literatures suggest that overlearning, fluency, and automaticity are closely related and, perhaps, even serve as different tacts for the same behavioral phenomenon. All three involve practice beyond acquisition and are characterized by improved short- and long-term retention. Furthermore, fluency and automaticity are said to be demonstrated by improved endurance on tasks as well as applicability of skills. Although these last two claims have not been specifically addressed in the overlearning (overtraining) literature, one might speculate that overtraining also leads to improved endurance and applicability because overtraining leads to fluency and automaticity.

The disagreement surrounding these terms may be due to their development in different theoretical camps, each of which relies on different behavioral measures. Usage of these terms depends on behavioral measures that influence the criterion for the termination of training. Researchers in the overlearning literature typically rely on percentage measures and a specified number of overtraining trials (e.g., Baldwin & Ford, 1988; Binder, 1987, 1993); rate of responding is rarely mentioned or examined. Researchers in the fluency literature typically use temporal measures and performance standards (e.g., Evans & Evans, 1985) rather than a specified number of overtraining trials. Accuracy data, as described by percentage correct, are not collected. In addition to describing responding in terms of rate or latency, researchers in the automaticity literature also rely on

qualitative descriptions. For example, automatic reading would be described as occurring at high correct rates and "with expression" (Fries, 1963; LaBerge & Samuels, 1974). Ideally, training continues until skill execution is automatic, that is, it doesn't require conscious attention (Hasselbring et al., 1988; LaBerge & Samuels, 1974).

Thus, what distinguishes these concepts may be the extent of training and the behavioral measures used to assess the effects of training rather than some fundamental difference in phenomena. Overtraining, fluency building, and automatizing may represent a single level of learning, carried out to different degrees as specified by performance criteria. If so, these terms are synonymous. In addition, the outcomes of this level of learning may appear to be distinct as a result of differing amounts of practice and the different behavioral measures employed. If multiple measures of performance were recorded during learning, perhaps as the number of practice trials increases, an observed improvement might also occur in the temporal measures of performance. Confirmation of this supposition would suggest that overlearning, fluency, and automaticity are not essentially different. Future research should pursue the question of whether these terms are serving as tacts of the same phenomenon for researchers in different literatures or should clarify the fundamental differences among them.

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