As roles and expectations within organizations rapidly change, primary constants include increasing diversity in the workforce and technological advancement. People learn differently and at different rates (Wittrock, 1989). Training instruction, however, is traditionally presented using a “one size fits all” approach; solutions are linear and uniform for all learners, regardless of each learner’s proficiency in the necessary knowledge and skills. In order to save learners’ time and maximize resources, organizations are investing in new adaptive training technology to systematically select and present only the information that is critical to address a skill gap or knowledge deficiency.

Adaptive training instruction reduces the reliance on human instructors, increases the ability to quickly provide training to mass quantities of learners, and reduces time spent in redundant or unnecessary training activities. In this article, we aim to (a) define adaptive training, (b) discuss the methods used for developing adaptive training, (c) highlight current applications of adaptive training technologies, and (d) present research gaps along with a call to action.

What Is Adaptive Training?

Adaptive training, also referred to as accelerated learning or personalized learning, is a generic term for a family of approaches that alter the events or content presented during training based on learner needs (Durlach & Ray, 2011; Oskorus, Meyer, Andre, & Moore, 2010). These training approaches use individual difference variables (e.g., knowledge) to personalize the training experience through a highly realistic reflection of the work, culture, and job requirements (Bauer, Brusso, & Orvis, 2012).
Learning personalization is created by analyzing data that describe learners’ past or current performance and information about training needs based on skills or abilities, aptitude, personality, learning style or preferences, and performance (Bauer, Brusso, & Orvis, 2012; Spain, Priest, & Murphy, 2012). Cumulatively, learners receive tailored instruction and feedback (Billings, 2012; Lester et al., 2014).

**How Is Adaptive Training Developed?**

When adapting training there are often two ways of tailoring the content. One approach is to change the instruction within a training session, which is often referred to as *micro*-adaptation; whereas changing what a learner does between sessions is referred to as *macro*-adaptation (VanLehn, 2006).

**Microadaptation: Tailoring Training Within the Learning Session**

Two of the main methods of *micro*-adaptation or changing the instruction or content presented to a learner are *item response theory* (IRT) and *branching*.

The first, IRT, is a mathematical method of measuring a learner’s knowledge level in which the variable is continuous in nature while allowing for an individual person and item to be mapped on the same latent continuum (de Ayala, 2009). The IRT approach is based on the idea that an individual only endorses an item if he or she is close to the item on a continuum (Stark, Chernyshenko, Drasgow, & Williams, 2006). In other words, if an item is too extreme in either direction, the individual will respond negatively to the item. Adaptive training programs run mathematical IRT models to determine the best scenario or content to present next. Conceptually this approach is similar to computerized adaptive tests designed by major test development companies.

The second method often used for *micro*-adaptation is called branching. Branching techniques are a form of storytelling; learners make decisions based on the content presented, and each decision point that is developed by a training designer leads to a distinct training path (Ivec, 2014). Typically these types of branching activities allow a learner to practice a skill within a safe environment with no consequences for failing. A final summation or report of the experience will be presented to the learner, and possibly managers, to show the consequences of the decisions made and why the content was filtered in one direction based on those decisions.

**Macroadaptation: Tailoring Training Across Learning Sessions**

Approaches to *macro*-adaptation algorithms often include correlation models and various forms of Markov models, which are used to recommend a sequence of training modules deemed appropriate based on learner needs. Correlation models and predictive Markov models are computational methods for examining the relationship between environmental and learner-centric variables to identify the optimal path for learning. For instance, a Markov model is a good tool for modeling student transitions based on past
or current data about the learner (Carlin, Dumond, Dean, & Freeman, 2013). These frameworks attempt to create a method of predicting decisions or next steps based on an algorithm or model of prescribed skills and abilities. Most of the research that describes such models shows that these are best used to help identify exercises to enhance the learners experience by modeling the learner’s contextual knowledge (Kaelbling, Littman, & Cassandra, 1998).

**Application Programming Interfaces (APIs)**

Based on blended learning rules such as 70:20:10, most learning occurs outside of the classroom in informal settings (Lombar-do & Eichinger, 1996), whereas a smaller percentage of learning occurs in formal environments such as Learning Management Systems (LMS) e-learning modules. With various sources of data that exist across a variety of platforms, there are new application programming interfaces (APIs) that allow internal systems (e.g., LMS), external training methods (e.g., Coursera web-courses), and learner data (e.g., knowledge, skills, abilities or KSAs) to interact with each other in order to track and assess performance of learners over time.

With systems being able to leverage new data from other tools, organizations are able to create adaptive learner-centric environments that share information in interoperable ways. One example of this is the Experience API, or xAPI, which is a data coding method of uniformly defining and describing learner data in a consistent way so that systems can share the performance data (Advanced Distributed Learning, 2013a, 2013b). One recent example of xAPI in use is the Soldier Performance Planner (SP²), which is a prototype tool developed for the U.S. Army that enables learner performance data to be described and shared between military training simulation systems (Poeppelman et al., 2013).

Other learner data is also becoming more readily available and easily shared across social media platforms such as LinkedIn. With the permission of the learner, recent course certifications from Coursera and other information can be added to social media profiles immediately after completing the course. LinkedIn provides such APIs to allow users to also sign-in to a third party system and easily share their profile details.

**Adaptive Training Examples**

The types of adaptive training applications that have hit the market are increasing in variety. In this section we highlight some additional efforts that are advancing the field and increasing the demand for tailored systems.

**Social Experiences via LMSs**

As evidenced by their prominence at L&D conferences around the world, such as The Association for Talent Development (ATD, formerly ASTD) and Europe’s Learning Technologies, LMS solutions are rapidly improving. Many of these LMSs are incorporating cloud solutions into their systems, which allow companies to host data anywhere, anytime so that if someone is not on an internal network they can still complete
a course (e.g., Litmos LMS). In addition, branching content within the course module is becoming increasingly available. Some LMS support social learning mechanisms to share, connect, and collaborate in one place like the Tessello “total learning system.” These types of technology solutions not only allow training developers to create, track, and store learning content, but new LMSs now incorporate opportunities to create communities in which learners can interact with experts and mentors through social experiences. Each data source that is captured and included unlocks and enables personalized learning based on the learners’ actions within the system.

**Virtual Experiences: Simulations and Games**

Simulations are a broad category of technologies that replicate real-world processes and systems; they are engaging, require meaningful choices, and offer challenge-based sensory immersion, clear goals, and feedback (McNamara, Handler, & Fetzer, 2014). Some simulations have undergone gamification, or the use of game techniques, game thinking, and game mechanics to enhance nongame contexts.

**Medical applications.** Duke’s Human Simulation and Patient Safety Center develops simulations to train clinicians in crisis management, procedural skills, decision making, and teamwork. For example, computer-based, virtual training technologies include Combat Medic for treating top causes of death in the modern battlefield, Maternal Hemorrhage for managing postpartum maternal hemorrhaging emergencies, and 3DiTeams for military healthcare team coordination.

**Military applications.** Americas Army is a simulation that was developed by the U.S. Army with applications including recruitment and training. China’s People’s Liberation Army has released multiple versions of the Glorious Mission that has the dual purpose of recruiting soldiers and training personnel in combat skills and technological awareness. Other applications of military adaptive training focus specifically on medical interventions, such as vMedic that enables single- and multiplayer interactions.

**Professional applications.** One of the earliest examples of gamification for personnel training is Hilton Ultimate Team Play for customer service. Another example is UpTick! for sales force development, which provides adaptive coaching in real-time by tracking performance data. Similarly, management and leadership skills are in demand across all domains and disciplines. Adaptive tools such as LEADeR assess specific aspects of leadership capability and potential, offer detailed developmental feedback, and appeal to a broad range of organizations.

**Practice and Research Gaps**

Adaptive training technology development is outpacing the growth of the accompanying literature in the I-O world. Future research needs to:

1. Determine optimal methods for adaptive training. For new learning methods being deployed, specifically gamification
LEADeR, an adaptive simulation for leadership development, adapts the learner activities based on their choices and interactions made in real-time.

techniques, we must ensure that the games or learning opportunities help develop the right skills (Stodd, 2015). The reality is that many organizations are working hard to deploy the next cool, engaging training methods, but we must ensure they are the right ones. We must also ensure that adaptive methods are implemented based on the right skills and content that learners need to see.

2. Conduct effectiveness evaluations. There is a dearth of research isolating variables to determine effectiveness of adaptive feedback techniques (Durlach & Ray, 2011). Computer scientists tend to focus in detail on algorithms, model parameters, and software implementations utilized in a given study, but they often place less of an emphasis on the study’s theoretical framing, as well as its methodological details, such as the study population, apparatus, design, measures, procedures, and analysis (J. Rowe, personal communications, February 2, 2015). Carefully controlled research manipulating particular aspects of the training design is needed to advance the literature.

3. Identify learner reactions. One area ripe for research is learner reactions to adaptive versus nonadaptive training technologies. We need to ensure we collect learner reaction data to understand whether adaptive methods and technology systems vary and how they are translating into useful experiences for each learner. The involvement of I-O psychologists is essential to optimize adaptive training
systems. Fields currently steering the research include software engineering, computer programming, and computational modeling. I-O psychologists are uniquely suited to help determine an optimal level of challenge for learners, to decide the appropriate level of support to be provided, and to assist in the identification of errors made by the learner. Once these considerations are addressed, the adaptive training system can provide greater training efficiency (Durlach & Ray, 2011).

The research gaps and areas mentioned above represent only the beginning, we would love to hear about the ways you are working in this area. You're invited!

Join the authors of The Modern App at SIOP to discuss adaptive training and other related technologies that merit further investigation. We will tweet more details, including time and location, so follow us on twitter (@themodernapp) or email us (themodernapp@gmail.com) for more information. See you in Philadelphia!

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