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# Learning Styles

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# What are learning styles?

Theories of learning styles rest on two fundamental claims.

First, there exist identifiable and robust learner preferences for perceiving or processing information that can be used to classify individuals into distinct learning style groups.<sup>1</sup> The detection of learner preferences is typically achieved through self-report questionnaires that query learners about the instructional methods or modalities they believe enable them to learn best. Although the validity and reliability of such self-reports have been frequently criticized by researchers, there is no doubt that learners express instructional preferences when surveyed (Stahl, 1999). A vast catalog of learning style taxonomies exist in the literature with some (e.g., VAK, Kolb, and Dunn & Dunn) more familiar than others. Each of these distinct theories emphasize different attributes or dimensions along which learner preferences are claimed to meaningfully impact instructional efficacy. Examples include learning styles based on sensory (verbal/auditory/kinesthetic), social (individual/collaborative), and cognitive (sequential/holistic thinker) preferences. One research group identified 71 distinct learning style theories in their comprehensive review of the literature (Coffield, Moseley, Hall, & Ecclestone, 2004).

The second claim underlying theories of learning styles is that students learn most effectively when instructional methods are tailored to their preferred learning style and less effectively otherwise. Learners that prefer receiving information in a visual modality, for instance, are said to learn most successfully when they experience instruction emphasizing images and less well when instruction relies primarily on verbal explanations (Kirschner & Merriënboer, 2013). This second claim, which links the identification of learner styles to improved learning outcomes, is critical for establishing the value of learning styles in education.

Together these two claims have been referred to as the *style-matching hypothesis* (Pashler, Mcdaniel, Rohrer, & Bjork, 2009). Establishing the legitimacy of learning styles depends on finding evidence to support this style-matching hypothesis. If learning styles are an effective strategy for improving learning outcomes then we should see evidence that matching learners to instructional methods tailored to their learning style improves learning outcomes compared to learners instructed in methods contrary to their preferred style. Is there research to support the style-matching hypothesis?

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<sup>1</sup> One must be careful to not confuse learning styles with cognitive abilities. Cognitive abilities are intellectual capacities (memory or mathematical aptitude) of which it is generally undesirable to have less whereas learning styles are considered different, but fundamentally equivalent, habits or strategies that students have for processing information (see, Willingham, 2009).



## Research on learning styles

An initial survey of the voluminous research literature on learning styles appears to support the theory's efficacy in education—thousands of articles and books have been published on the topic in recent decades. However, a closer examination reveals that a much smaller number of these articles have been published in peer reviewed journals, prompting researchers to note that the majority of academic work on learning styles is done under the radar of legitimate scholarly critique (Lilienfeld, Lynn, Ruscio, & Beyerstein, 2011). In fact, references to learning styles have been absent from many of the most prestigious journals of psychology, including the *Annual Review of Psychology*, and other authoritative references on learning research for decades (Coffield et al., 2004; Sawyer, 2015). A number of efforts to evaluate the massive literature on learning styles have been carried out in recent years by distinguished research teams.

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The overwhelming conclusion of scholarly reviews conducted on learning styles research is that available studies have almost universally failed to employ the type of research design required to substantiate the style-matching hypothesis.<sup>2</sup> As a result, there is a striking lack of evidence to support the core learning styles claim that customizing instruction based on students' preferred learning styles produces better learning than effective universal instruction. Consequently, the learning styles research literature is weak and unconvincing despite its vastness (Rohrer & Pashler, 2012). For example, in one review of learning styles research, conducted on behalf of the American Psychological Association, a team of researchers were able to locate only a handful of studies that met the design requirements to substantiate the style-matching hypothesis and, apart from one methodologically questionable study, all findings from these studies were negative (Pashler, et al., 2009). Similarly, Coffield and associates conclude after an exhaustive examination of the available literature that learning styles researchers systematically fail to employ the type of experimental design required to justify their claims of pedagogical improvement (2004). The conspicuous absence of empirical support for the efficacy of using learning styles in education is a conclusion that has been consistently echoed by researchers investigating the topic (Arbuthnott & Kratzig, 2015; Hattie, 2009; Kavale & Forness, 1987; Lalley & Gentile, 2009; Scott, 2010; Stahl, 1999).

Although these reviews highlight the lack of historical support for theories of learning styles, it might be wondered whether the style-matching hypothesis has any greater validity in the modern context of computer-based instructional

<sup>2</sup> An appropriate research design would require dividing students into different learning styles groups and then randomly assigning the members of each group to different instructional conditions tailored to each style. After receiving instruction in different styles, all students would be given same test of learning. The instructional efficacy of learning styles would be supported only if students assigned to their preferred instructional type did better than their learning style peers who were assigned to a different instructional method. This is referred to in psychological research as a crossover effect.

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In one carefully designed study to investigate this question, Massa and Mayer (2006) found no support for the style-matching hypothesis with respect to verbal/visual learners in a series of computer-based training lessons where learners were grouped according to learning preferences and randomly assigned to either verbal or pictorial support conditions.

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environments. In one carefully designed study to investigate this question, Massa and Mayer (2006) found no support for the style-matching hypothesis with respect to verbal/visual learners in a series of computer-based training lessons where learners were grouped according to learning preferences and randomly assigned to either verbal or pictorial support conditions. Additional research investigating the impact of allowing participants in a computer-based setting the ability to select the modality of instructional presentation based on their learning style (visual/verbal) also found no effect on learning performance (Kollofel, 2012). Finally, in a study utilizing web-based learning modules researchers found no evidence that matching learners according to their sensing/intuitive Felder-Silverman learning style had any effect on learning outcomes (Cook, Thompson, Thomas, & Thomas, 2009). Negative findings such as these are typical of research that is well designed to explore the existence of any interaction between learning styles and instructional methods.

So what conclusion should be drawn from the available research on learning styles? It would be a mistake to conclude that the style-matching hypothesis is definitively false. It is impossible

to definitively prove an effect doesn't exist and future research may validate the usefulness of learning styles in education. That being said, the current consensus among academic researchers, as Hattie and Yates (2013) note, is that learning styles theory is a non-productive area of research with respect to improving learning and instruction. Pashler and colleagues end their comprehensive report on learning styles with the conclusion that “the widespread use of learning-style measures in educational settings is unwise and wasteful use of limited resources” (2008). Less generous researchers, lamenting the continued popularity and influence of learning styles in education despite the lack of evidence, refer to learning styles as an unfortunate “urban legend” of educational psychology and widespread “neuromyth” (Geake, 2008; Kirschner & Merrienboer, 2013; Lilienfeld, et al., 2011). Ultimately, until proponents of learning styles can provide sufficient experimental support for the style-matching hypothesis, it is impossible to recommend learning styles as an effective strategy for improving learning outcomes. Fortunately, researchers in the learning sciences have identified many powerful methods for improving learning and several alternatives to learning styles are considered in the next section.

## Beyond learning styles

Given the consistent experimental finding that matching instructional methods with students' learning styles has no educational value, what instructional strategies might educators incorporate instead?

The following suggestions are based on two well-supported findings in the learning sciences:

- 1) learners are more alike than different in how they learn and
- 2) effective personalization should be begin with learners' prior knowledge.

### Outcomes and content should drive instructional choices

Allowing students to drive decisions about instructional methods is rarely effective and can often be detrimental to learning (Clark 1989; Clark 1982). Instead, research suggests that instructional strategies ought to be informed primarily by instructional learning goals and the nature of material to be covered (Merrill, 2000). For instance, different instructional approaches (e.g., receptive, directive, and guided discovery) are appropriate for different learning goals (see the white paper *e-Learning Design Architectures* for more information).

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Furthermore, instructional decisions about how to present material (e.g., visually or verbally) should be motivated by the nature of the material to be taught (Willingham, 2009). All students will likely experience additional learning gains from a geography lesson that includes extensive use of imagery or an engineering lesson that provides opportunities to apply abstract principles using concrete objects. That being said, the more ways a learner is exposed to an idea (e.g., through multiple sensory modalities or exposure to different perspectives) the more durable that knowledge is likely to be. While it is inevitable that some students will require additional examples or explanation to fully understand an idea, such personalization efforts should be made after the selection of an appropriate instructional approach that reflects the desired learning goals and material being taught.

### Focus on cognitive commonalities

Any individual differences in how we learn are greatly overshadowed by our shared cognitive architecture. Extensive research on human memory and learning has illuminated a number of effective instructional strategies for improving the learning outcomes of all students. For example, instruction that incorporates opportunities for students to engage in retrieval practice, through frequent formative or low-stakes testing and quizzing, improves student learning significantly over instructional methods relying primarily on information transmission (Black & Wiliam, 1998; McDaniel, Agarwal, Huelser, McDermott, & Roediger, 2011). Spacing instruction and review of a topic over time rather than massing instruction into a single session also results in demonstrable learning gains for students (Bird, 2010; Taylor & Rohrer, 2010). Finally, employing instructional techniques that prompt students to engage in explanatory questioning, asking questions like “Why is this the case?” or “How does this connect with another idea?” have been shown to significantly

improve student retention of material (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Roediger & Pyc, 2012;). While these suggestions lack the quick-fix promise of improving learning through style-matching, they are consistent with decades of research indicating that robust learning is the result of difficult and sustained learner effort (McDaniel & Butler, 2011).

### **The importance of learner prior knowledge**

While matching instruction to students' learning preferences has proven to have little educative value, tailoring instruction in response to students' prior knowledge has consistently been found to be a powerful factor for improving learning outcomes (Lalley & Gentile, 2009). For instance, students with little prior knowledge of a topic will benefit substantially from instructional scaffolding

that helps them connect preexisting ideas with novel material (Zull, 2002). Research in multimedia learning has also found that learners with varying levels of expertise benefit from different instructional formats (Kalyuga, Ayers, Chandler, & Sweller, 2003; Mayer, 2005). And students entering an instructional situation with misconceptions about the material are likely to retain their faulty beliefs in the absence of instruction explicitly confronting and challenging these ideas (Ambrose & Lovett, 2014). By using tools like diagnostic tests and learner surveys, instructors can better understand the prior knowledge of their students and tailor instructional strategies to genuinely improve learner outcomes.

## **Where can I learn more about learning styles?**

This paper has focused primarily on evaluating the style-matching hypothesis; however, theories of learning styles have been criticized on several additional fronts. The cognitive scientist Daniel Willingham (2005) argues that theories of learning styles are based on a conceptual confusion and demonstrate a lack of understanding of how the brain works. Critiques of the validity and reliability of the self-report measures employed by learning style models can be found in Duff & Duffy (2002), Stahl (1999), and Veenman, Prins, and Verheij (2003). For a broader criticism regarding the lack of effort among learning styles advocates to develop a common conceptual framework and the pervasive influence of commercial interests see Coffield, et al., (2004).

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