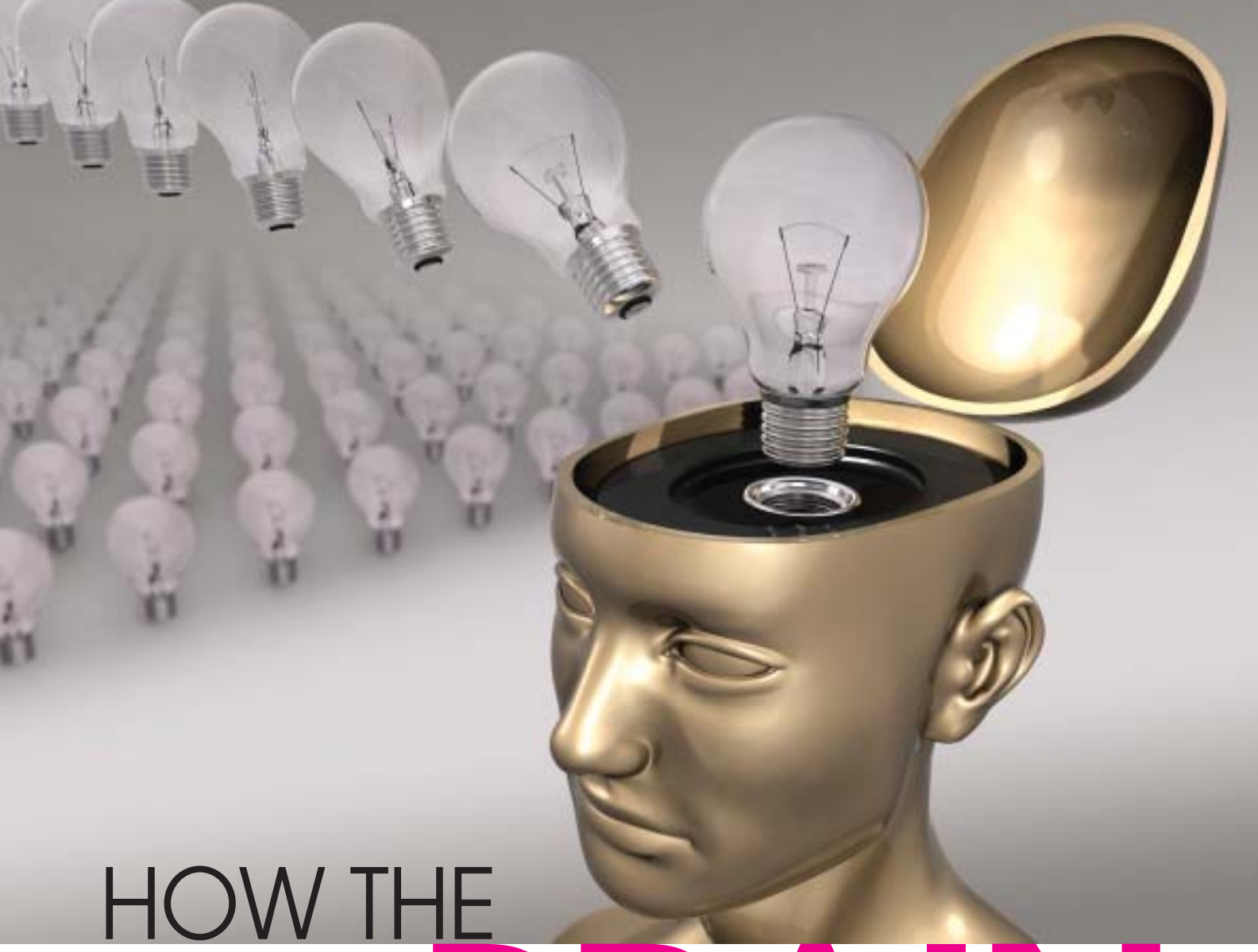

HOW THE BRAIN LEARNS BEST

BY ARLENE TAYLOR

How does the brain learn? If we knew, it would make life so much easier for everyone—parents, students, and teachers! Although we may never discern precisely how this miracle occurs, current brain-function research is beginning to crack open the door and allow us to peer through.[1]

One of the complications is that each human brain is unique, although in most cases the variations are subtle. Researchers disagree on the ways these subtle differences influence human behaviors and learning outcomes.[2]

The search for connections between brain function and learning is further complicated by inconsistency between study conclusions, ethical limitations related to the use of human subjects in research, and personal bias among those who use the research to create practical applications. Unlike animal experiments, studies involving humans are of

necessity correlative in nature.[3] Nevertheless, findings on brain function can be extremely helpful, even if the knowledge is imperfect and somewhat tentative.

Although we see through a glass darkly in terms of the mechanisms the brain uses for learning, we do know quite a lot about the way brains naturally learn *best*. That knowledge is both exhilarating and depressing[4]: exhilarating because with some effort and innovation, the educational process could be significantly enhanced for most students; depressing because millions of brains are experiencing less-than-optimal learning because the environments in which they must function are demeaning if not downright punishing.[5]

Although we see through a glass darkly in terms of the mechanisms the brain uses for learning, we do know quite a lot about the way brains naturally learn *best*.

Following are several research-based conclusions about how the brain learns best.

1. The brain learns best through multisensory processing.

Although most teachers organize their lessons sequentially (because that's how they were taught to present information), the brains of nearly all of their students learn best through multiprocessing. Recently, I Googled "sequential learning plans" on the Web and found more than 657,000 sites, contrasted with only 18,400 for non-sequential lesson plans. The brain comprehends complex topics best when they are embedded in rich sensory input. It needs multipath, multimodel, and multisensory experiences to create as many associations as possible. It is insufficient for students to merely read or hear about a topic. The more complex the topic, the more likely that the brain will master and retain the concept if the learning experience includes rich sensory input. When information enters the brain by way of two or more sensory systems, combined with some type of emotion, learning happens more readily, and retention is enhanced.[6] This combination is not usually incorporated into formal instruction. One powerful strategy that helps engage the whole brain for learning is reading aloud by both teacher and student.

2. The brain learns best in a predictable sequence.

Although the brain rarely learns in a sequential manner, learning does occur more efficiently in a predictable sequence.[7] This requires patience because the teaching process may not produce immediate tangible results. Five stages need to be included for optimal learning:[8]

- *Preparation* (priming and pre-exposure): The brain creates a conceptual map when shown how the process will proceed. This provides a framework for the new learning and primes the brain to make possible connections.
- *Acquisition* (direct and indirect learning): The brain receives information directly (e.g., through handouts, lesson plans, reading assignments) and indirectly (e.g., by reviewing related visuals and/or multimedia). Options need to be provided for learners whose preferred learning style is visual, auditory, or kinesthetic.
- *Elaboration* (error correction and depth): The brain explores the topic through a variety of explicit (e.g., reading, listening, discussing, completing work sheets) and implicit methods (e.g., role play, life experiences, simulations, field trips, guest speakers). Experimentation and feedback help to purge inaccurate perceptions and strengthen neural networks.
- *Memory Formation* (associations and encoding): The more associations that are created in the brain, the better the chance that the information will be encoded in long-term memory and available for recall. Many factors contribute to the laying down and retrieval of information. These can include rest (especially REM sleep time), nutrition, mental development, the quality and quantity of associations created in the brain, prior learning and motivation, repetition and review, emotional intensity, and so on.
- *Functional Integration* (extended usage) — Learning involves much more than simply getting neurons to communicate with one another in a predictable sequence. It requires getting the neurons to fire together enough times to create connections so that the information can be recalled and applied in diverse situations. Making connections to what the student already knows and engaging emotions can help promote long-term learning. Frequent review also helps ensure retention and retrieval.[9]

3. The brain learns best in a flexible environment.

Although all human brains are similar, every brain is unique, so learning environments need to be flexible.[10] Normal development can differ by two or more years between learners of the same chronological age.[11] This has huge implications for classroom policies.

Classroom seating needs to be flexible. In 1978, educators Rita and Ken Dunn found that at least 20 percent of learners are significantly affected by the presence or absence of seating options.[12] Varying the seating arrangement (circles, U shapes, etc.), and allowing more space between students can result in more time on task and decreased disruptive behavior. Teachers should allow students as much choice as feasible in selecting where (and in what position) to sit, regardless of the arrangement, and plan activities that encourage them to get up and move around. Some students learn well while reclining or standing, rather than seated in the traditional in-line rows of desks.

To ensure optimal learning, students need to be encouraged to stand and stretch frequently.[13] Learning can be enhanced by including physical education and movement activities in lesson plans, by having students stand up for part of the lesson, by having them periodically stand up and stretch, or by directing them to have a relevant discussion with another student. Boys especially benefit from moving around as they learn.[14]

4. The brain learns best when intrinsically motivated.

Learning increases when the child is encouraged (e.g., "You're on the right track," or "Give it your best effort") rather than praised, rewarded, or punished.[15] Unfortunately, grading has traditionally been based on external motivators such as reward and punishment. In the presence of extrinsic rewards, behaviors become more stereotypical, rigid, narrow, and predictable. Although rewards will temporarily enhance the performance of repetitive tasks, they quickly inhibit intrinsic motivation and learner creativity and, in the long term, do more damage than good.

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Intrinsic motivation is required for learner creativity, higher levels of self-esteem, reflective thinking, and motivation. In fact, Drs. Geoffrey and Renate Caine contend that behavior-oriented threats will cause learners to "downshift" into a defensive mode, which is not conducive to learning.[16]

5. The brain learns best in a healthy body and invigorating environment.

It is outside the scope of this article to describe adequately all of the components of brain-compatible environments. But here are a few examples to stimulate your thinking:

• *Water.* Make sure students ingest plenty of pure water so the brain is well hydrated. The body needs eight to 15 glasses of water per day, depending on the person's size, level of activity, and the climate.[17]

• *Classroom temperature.* Keep the classroom temperature consistently within a comfortable range—approximately 70 degrees Fahrenheit (22-23 degrees C.), give or take a few degrees.[18]

• *Humidity.* Maintain an indoor humidity between 35 percent and 50 percent. Levels that are too low can trigger dry skin and itchy eyes, and increase susceptibility to colds and respiratory illness. Levels that are too high can encourage the growth of mold, mildew, and fungus, all of which can cause serious health problems.[19]

• *Lighting.* A five-year Canadian study conducted by Dr. Harry Wohlfarth indicated a link between lighting sources and levels of stress, absenteeism and overall achievement in the classroom.[20] In 1988, Wayne London, a Vermont psychiatrist, compared illness absentee rates by replacing standard flourescent lighting with Vitalite® full-spectrum lighting that simulates natural light. Students in the classrooms with full-spectrum lighting missed 65 percent fewer days than those in fluorescent-lit classrooms.[21]

• *Air circulation.* Make sure every classroom has a constant supply of fresh, uncontaminated, and highly oxygenated air. Good levels of oxygen in the blood can positively impact brain power. Learners in a closed classroom typically exchange only 10-25 percent of their lungs' capacity with each breath. Research suggests that increasing circulation will improve learning rates.[22]

• *Plants.* Studies by the Federal Clean Air Council and NASA showed that indoor plants raised indoor oxygen levels and increased productivity by 10 percent. A single plant may affect the oxygen levels of 100 square feet of space. Preferred plants for enhancing indoor learning environments include bamboo palms, areca palms, lady palms, rubber plants, philodendrons, and yellow chrysanthemums.[23]

• *Aromas.* Specific aromas have been shown to positively impact learning. Research by Weiner and Brown in 1993 showed that certain aromas stimulate people to set higher goals, take on greater challenges, and get along better with others. Aromas that enhance mental alertness include peppermint, basil, lemon, cinnamon, and rosemary.[24]

• *Movement.* The classroom should be arranged and lessons planned to encourage physical movement. Brain exercise must be balanced with physical exercise. In a resting state, the brain utilizes 20 percent of the body's total oxygen. Exercise enhances blood circulation and lung capacity.[25] Here are some recommended policies to ensure higher levels of movement in the school environment:

Have every student engage in a minimum of 30 minutes of physical movement each day.[26]

Give students five- to 10-minute breaks every 90 minutes so that they can get a drink or walk around.[27]

Encourage learners to take frequent deep breaths through their noses and to maintain good posture.[28]

Have students engage in cross-over movement (clapping, touching the right body parts using the left hand or foot; and vice versa, etc.) to integrate learning.[29]

Incorporate role playing, charades, pantomimes, classroom scavenger hunts, and singing rhymes while jumping rope to facilitate new learning.[30]

• *Stimulating right- and left-brain learning.* Encourage

the students to breathe through the left nostril for a few minutes prior to right-brain learning (to stimulate the right hemisphere) and through the right nostril for several minutes prior to left-brain learning (to energize the left hemisphere).[31]

• *Use of color.* Colors used in the classroom are selected with an eye to brain function. For example, yellow is the first color distinguished by the brain, and is excellent for classrooms. Studies by Deborah Sharpe, author of *The Psychology of Color and Design*, showed that yellow is connected with cheer, happiness, and fun.[32] Faber Birrin in his book, *Color and Human Response*, reported that yellow elicits positive moods, while green encourages productivity and long-term energy.[33]

• *Humor.* Use appropriate humor (i.e., jokes, cartoons) to help students relax and to enhance individual and group performance.[34]

• *Emotions.* Carefully monitor the classroom climate to reduce the downshifting or primal thinking that occurs when students are anxious or afraid. This can be accomplished by offering a variety of strategies to help learners relax. Teachers and aides can help students develop their emotional intelligence, a skill that is more important to lifelong success than IQ.[35]

• *Scheduling new learning and review.* Present new information during the morning hours, and schedule afternoon activities that help integrate the new information with previous learning and students' knowledge and experiences.[36]

• *Evaluation.* Compare each student's performance to his or her previous work, rather than to the performance of other students.[37]

Learning Styles

The human brain does not have one favorite learning style. It is capable of changing styles on a daily basis or even from hour to hour, depending on what is going on in the learner's life and environment. Teachers usually prepare lesson plans with the assumption that students will all learn in a similar manner—often the teacher's favored learning style! However, because every brain develops uniquely, no single approach will work for everyone, though each student will typically have one preferred approach for organizing and processing information.[38]

To ensure optimal learning and retention, school activities need to include the strengths of both hemispheres of the brain. A plethora of models have been developed in the attempt to ensure whole brain learning. Some models address learner responses (e.g., McCarthy 4-MAT, Meyers-Briggs),[39] while others deal more with how learning is processed (e.g., Gregorc/Butler, Ned Herrmann).[40] While such models can offer useful frameworks, teachers should provide as wide a variety of different learning opportunities and choices as possible. Students should have assignment options that include several choices in each learning style.

Conclusion

We've known for some time that traditional styles of education don't work for many brains. Some approaches are actually brain-antagonistic.[41] Brains learn anyway because they love to learn, especially if teachers and mentors model a love of learning. Unfortunately, what young brains learn is often not what was intended.[42] What they learn is to hate school, avoid instructors, underachieve, and drop out.

Fortunately, brain-function researchers are shedding light on how the brain learns best, much as early navigators traveled and mapped the world. Their discoveries could change the fabric of traditional education and benefit billions of brains on our planet.

Changing "what we've always done" is a daunting task. But if we are willing to increase our knowledge about how the brain learns *best* and take one step at a time, it is not an impossible task. If teachers implement brain-friendly strategies consistently, the outcome could be remarkable.

In the words of Eric Jensen, it is no longer a question of *can we*? We know we *can* provide learners with brain-compatible environments and curricula that support the brain's natural learning abilities.[43] The question is, *will we?*

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