The Learning Brain: Using Cognitive Neuroscience To Rethink Traditional Assumptions In Student and Staff Training

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The human brain is the most complex object in the universe that has ever been studied. While studying the brain is more difficult than rocket science, the basic principles of how it operates are beginning to be understood, and applications of these principles are within the reach of outdoor educators. Essentially, the more we understand how the brain works, the better we can design and teach in a way that it is effective.

This presentation will briefly review how the emerging brain science field of cognitive neuroscience is affecting educational theory and practice. Cognitive neuroscience provides a more predictable basis and comprehensive foundation for application to instruction than badly out of date but traditional learning theories of behaviorism (stimulus-response) that many in outdoor education still appear to use, and is even more powerful than the cognitive theories of the past 30 years. We will briefly examine how the brain learns and provide points of potential instructional intervention for both students and staff along with real field examples.

The brain is still undergoing major growth changes until the mid-twenties, which is observed in a variety of brain scans. Youth and adult's brains are different. They learn differently and literally do not process information the same way, nor do males and females no matter what their age (no surprise there!). There are major brain processing differences between youth, adolescent, and young adults (about age 24) compared to older adults over 25. To further complicate matters, many of our clientele and instructors may have AD/HD (attention deficit disorder), this includes one of the authors, a former guide.

Differences Between Adult and Youth Brains

There are differences between adolescent learners & instructors younger than 25 compared to adults over 25. Two primary differences are in brain growth. During youth, the brain is busy pruning, or eliminating, neurons that aren't being used (use it or lose it). Simultaneously the frontal region of brain, especially the front half called the prefrontal cortex, is completing the myelination of neurons by wrapping them in an insulting sheath of fat cells. The net result is increased efficiency in processing. Brain maturation is reached when the process of pruning and myelination is completed in the mid twenties, well after physical maturation. Students and young instructors may be able to perform outstandingly difficult physical tasks, but their judgment considerably lags as we'll see further on in this presentation. The combination of developmental and gender processing differences between our younger clientele/instructors vs. older clientele/instructors suggests that not only is a greater awareness of staff developers and instructors needed, but that different training and staff development styles may be appropriate. Specific brain processing differences and field training examples will be the focus of the remainder of this article.

Decision Making in Adolescents

Because the brain of an adolescent is still growing until approximately age 24, their decision making, while it may be impulsive, lacks the resources of experience. As a result some decisions that would be virtually automatic in an adult must actually be pondered for a while. For example, if we presented the question, "Would you want to ride your bicycle down a steep stairway," most adults would not have to think about that, they can foresee the consequences almost immediately: "No! That would be dangerous!" The teen might pause for a couple of moments and respond, "That'd be cool!" (An ADHD person might also respond similarly). Fast forward to our field activities that are often more exciting and accompanied by higher levels of risk. We may be more likely to do a bold climbing lead with poor protection when we are 25 than when we are 45, when we know ourselves better and can more accurately assess the combination of our skills (or lack thereof) and consequences of their application.

Learning

Learning is a bio-chemical process, and with respect to education it is the creation of a retrievable long-term memory. If no memory is created, then what will the student or staff person have learned? Memory, however is not limited to mere facts

and skills, but is also the creation of attitudes, habits, and ways of thinking. All of these require patterns to be established and preserved in neural networks of the brain, hence, a memory. For example, it is less effective to train staff in a punctuated series of sessions disseminating volumes of information, then asking them to perform tasks to expectation. When looking to create memories of complex processes, like those we train and expect our staff to perform, a mentoring process is highly effective. Give staff the information they need to perform the task and then model or mentor the correct performance of those expectations. The next, often overlooked, step involves observation of your staff performing the same task and correcting any misconceptions or missed processes. Observation and correction of the memory is vital to the success of the learning process.

Students, who are often unfamiliar with many of the concepts we want them to learn, need complex processes broken down. Teaching sequentially, using various teaching styles, will increase the likelihood of memory creation. Incorporating mantras, or sayings, provides a ready means for accessing the memory later. One example from SROM is the sunscreen mantra "Re-apply or Fry." Additionally, teaching students skills during 'classroom' sessions a day before they will be required to perform them will allow the session to transfer to long term memory, thus creating a successful learning experience.

Attention

If we are to have even a remote chance of something getting into memory we must first pay attention to it. The attention system has several parts that integrate incoming information for what, where (spatial), and who. The system is limited and can easily be overwhelmed. We simply can't pay attention to many things all at once, especially if they are new. This is why driving and talking on cell phones or trying to eat while driving frequently contributes to accidents. One can learn to multitask, but after the tasks have become automatic after much practice. The instructor or student needs to be focused on the task. Literally having eye contact can help improve later memory and performance. However, we've all experienced the glazed over—zoned out look either with students or in our own learning sessions—how boring!

Gender differences in attention

Males tend to be more attracted by tasks with action and females are more attracted to tasks that are more emotive, where they can express their feelings. For example, your male students may be less engaged during debriefs that occur while sitting down, and your female students may be less engaged in activities that provide for little socialization.

ADHD

This condition is not outgrown but as the brain's prefrontal lobes mature the person (either instructor or student) tends to be able to manage their behaviors more appropriately. The prefrontal lobes that constitute the executive functions of emotional control, decision making and impulsivity generally are underactive, and a person may seek out stimulation, perhaps in a form of self-medication (this is why stimulants are often prescribed or a person self-medicates with caffeine such as coffee, tea, Mountain Dew). It is not surprising that many climbers, extreme sport junkies, guides tend be ADHD. The activities help satisfy their need for movement. Yet impulsivity and inattention is a hallmark of ADHD, combined with action or fierce concentration in boys and excessive talkativeness in girls. In that respect, outdoor and experiential schools are more ideal for persons with this disorder. However, instructors need to be on constant alert regarding how well their instruction is being attended to. For example, initial instruction should be in small groups of four to six, where eye contact with each person is reasonable. It should also involve demonstrative action, like tying the knot in front of the instructor multiple times to verify attention and comprehension.

Debriefing

Debriefing the activity can also verify attention. Debriefings could include the student modeling the skill back to the instructor or explaining the concept in their own words.

Emotional (Limbic) System

Whether we continue to give the task attention or not, depends less on the instructor and more on how the student or staff person perceives the information. The more personally important the information is, the more likely they will pay attention to it and get it into memory for later use. This is the emotional component in processing by the limbic system. One key player is the amygdala, deep inside the temporal lobes, which are just above your ears The amygdala helps the brain to rapidly make judgments about what to keep or to discard, all without letting you know about it. Essentially, the amygdala crudely filters the information on the basis of, "Is this a threat to me or not?"(LeDoux, 1998) If the brain judges the information is not a threat, hence not terribly important, it dumps the information and the person's mind start to drift. On the other hand, if a threat is perceived, attention systems signal high alert, heart & respiratory rate jumps and we are instantly more focused. Some stress, and some concern are helpful to maintain the attention. But if the associated threat and stress are too great, judgment, even if practiced hundreds of times, may go right out the window. *The major reason experiential education is so effective is that real threats and natural consequences are inherent in the methodology and emotional significance is established through them.* For example, when confronted with the seriousness of the belayer's job, indi-

viduals are highly likely to pay attention. To connect the belayer to the gravity of his/her mistakes during mock belaying, having him/her apologize to the mock climber for 'almost killing' them capitalizes on the emotional significance of their duties.

Another highly effective but uncommon technique for staff training is to build staff-administrator relationship by using an in-field mentoring process, and then conclude training with a discussion of policies and rules. If your staff training consists simply of policies and rules, your training will likely be translated into "this is important because they will fire me." Additionally, building that relationship in the field validates the administrators to staff and demonstrates staff value to the administrators.

Further, emotions are based upon physiological states, including changes in the brain chemistry (Damasio, 1994). A person who is upset or depressed may have no outward expression, but the mental state may continue for hours, days or weeks, until the brain chemistry has changed. Physical activity, with accelerated heart and respiratory rates, has been found to help.

Gender differences in emotional engagement

It does not take a brain scientist to know that men and women use the same words but do not speak the same language. While men do not have fewer emotions than women, they do process them in different ways. That also means they are accessed through different language keys. While a woman will respond to, "What are you feeling?" a man is more likely to respond to, "What are you thinking?" Another effective question for men is, "What do you remember about…?" while for women, "What was it like when…?" is a better choice. Using effective language keys to emotionally engage your group can be the difference between a life changing experience and a boring chat.

Working Memory

Once the new information is paid attention to and gets past the initial filtration by the amygdala, we consciously start thinking and working with the information. Working memory is what is in the front of your mind right now, what you are thinking about at this moment (Baddeley, 1994). Working memory includes visual-spatial information and auditory information. Like the attention system, working memory has a limited capacity and time frame. Information that is worked with is in a temporary store for between one second and one minute; it would be as if you had a very flighty word processor that you kept having to hit save at least every minute or more frequently, or the information would disappear. In working memory you have to keep reviewing information or it rapidly fades. To increase the likelihood of information being saved, a person should be both actively thinking about the task and physically engaged in the task. Direct physical involvement grabs the attention system and increases the personal significance and emotional involvement. Learners are ACTIVE, not passive listeners. Additionally, the more they can provide their own examples, especially in staff development, the more their performance improves (Schenck, 2003). Role-playing from personal experience can be an asset when training on situations requiring complex problem solving, judgment, and creativity. For students, safety checks can be complicated and unintuitive for beginners. They do not have the experience to know where to look for safety hazards. Having students review (in brief) and point to/indicate each safety check they have learned before moving on the next will greatly increase retention.

Stress, emotion and effect on long-term memory and learning

Slight stress can enhance memory, but when there is great stress or emotional charged events a person will often remember the gist quite well, but the peripheral details are frequently lost. In the field, to overcome this loss of information, debriefing of students or staff can help facilitate rebuilding their memory and understanding. Don't wait until hours later. Generally, the closer a short debriefing is to the event, the more solid the learning and memory will become. One of the common factors that seems to be involved in cementing a lot of these memories is adrenaline. *If your learning task accelerates the heart and breathing rates, requires focused attention, active participation, with personal emotional significance and followed by a reflective exercise, you're more likely to establish stable learning.* Examples include: after a brief walk to a classroom site, after walking to a climbing site, or pointing out major safety issues and have students discuss why certain boundaries are necessary before students have taken off their packs and settled. Students can also actively reflect upon many facets of the peak accent they just experienced.

Long-Term Memory

Long-term memory is at the end of the food chain of the learning process. All that has gone on before affects it: attention, emotional involvement, environmental stress, body state, method of instruction, and working memory being overloaded all impact memory formation and retrieval.

Long-term memory (LTM) that can be retrieved under field conditions is the functional goal of instruction. Although LTM is anything that lasts more than a minute clearly both student and staff need to have very long-term retention. The debriefing process during the day of the learning and physical reviews (not just verbal) on subsequent days in the context of actual use will help to stabilize the memory. If the learning event has a significant emotional value because of personal consequences then students are likely to remember the core details of the lesson, but peripheral details to which their attention was not so well focused are likely to be fuzzy. The subsequent reviews

and practices can help fill in the details, especially if the students are demonstrating or teaching others.

To verify long-term memory, students or instructors can be voluntarily debriefed when they come out of the field. Have them tie a learned knot with their eyes closed, discuss what they though was the most significant part of the trip, or elaborate on where they have seen personal growth and where they still need to experience growth. Continually, the quality of the long-term memory is determined by how long it is retrievable. How long do your students remember what you taught them? The next day? To the end of the course? For the rest of their lives? For example, what would a student recall about their course instructor in 10 years? What attitudes or behaviors changed?

Assessments

No assessments should be performed the same day as the skill is taught. You're not assessing a stable long-term memory but an unstable one. Too frequently we witness law enforcement and military trainers review errors and re-assess the same day. Quotas look good, but later performance is lousy. Sleep is vital to the transference of the memory from short term to long term. Also, before conducting the assessment, have the students reflect and review what they are about to do. This allows them to rebuild and refresh their memory.

As another method of assessment, student feedback can demonstrate how well the staff is communicating concepts and expectations. For example, if students complain that they had to keep moving their tent, you don't rip into them for poor selection but refocus on your instruction and their understanding before setting the tent. Student performance is a reflection on the quality of the instruction, checking for understanding, and your supervision of their practice. Furthermore, how well the staff performs is also a reflection of their training, organization policy, expectations, and empowerment to meet those expectations.

Field performance

Ultimately, all the learning comes together in the field performance of both the staff and the students. If one designs their instruction to consider the various properties of the brain that we have outlined, and all staff use feedback, you'll improve learning and decrease risks due to negligence.

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