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Recent discoveries about brain function explain how best practices in adult learning may lead to adult learners' developmental growth.

Brain Function and Adult Learning: Implications for Practice

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Our main task in this volume has been to introduce to our colleagues research that we believe holds great promise to support our intentions as adult educators. Since many educators of adults have disciplinary competence in fields far removed from adult learning, let alone neurobiology, we asked our chapter contributors to emphasize issues that would be of particular value to practitioners. This chapter is even more explicit in connecting brain function with adult learning practices chiefly associated with meaningful learning.

As was described earlier in this volume by various authors, what we call mind results from the brain's response to what happens in our body. The brain's essential task is to maintain the organism. It does so by constantly monitoring the body's internal and external state, making adjustments as necessary. The well-known fight-or-flight response, for example, is how the brain tries to ensure survival in the face of a perceived threat. The pleasure response, which involves a different neural pathway, is another method of promoting survival, because it leads the organism toward calorific food, reproduction, and better maternal care of infants. But even when there are no immediate environmental stimuli, the brain monitors and adjusts hormone levels, breathing rate, heart rate, and so on. These responses are located in the most primitive part of the brain, the limbic system, beyond our direct awareness or control.

By contrast, the neocortex and frontal lobes, which have developed more recently but still over many millennia, are considered the civilized parts of the brain (Goldberg, 2001). Through processes I will not attempt to detail

here (see works by Goldberg, Damasio, and Siegel in the References), these two have given rise to what we now call consciousness and associate with mind. Although we still cannot control the release of hormones that signal danger or attraction, we can consciously decide to what extent we will respond to those signals. Even so, the limbic system is at the core of brain function and contributes an image of body state to every memory.

Meaningful Learning

As Pat Wolfe (in Chapter Five of this volume) pointed out, at the synaptic level learning is always about memory, that is, about creating lasting neural connections. But this definition of learning could also apply to stimulus-reward behavioral training, compared with learning that involves self-reflection and creation of meaning. I choose instead to focus on meaningful learning, and particularly on learning that encourages increased cognitive complexity—in other words, learning that changes not just *what* people know but *how* they know. My intention in working with adults is not merely to change observable behavior or add more to their memory bank of experience, but to change how those experiences and memories are stored and retrieved hereafter, because "the most important form of learning involves changing the way a person experiences, conceptualizes, or understands" (Marton, 1992, p. 253).

The changes I wish to emphasize are those that transcend mastering the content of specific courses; they are overarching objectives of adult learning, such as "the understanding that knowledge is neither given nor gotten, but constructed; the ability to take perspective on one's own beliefs; and the realization that learning and development are worthy life-long goals" (Taylor and Marienau, 1997, p. 233). Educators who have such "developmental intentions" (Taylor, Marienau, and Fiddler, 2000) are more likely to enable their learners to understand and respond effectively to what Kegan (1994, 2000) identifies as the demands of modernity. Much of my excitement about and enthusiasm for recent discoveries in brain function stems from the fact that they appear to link best practices in adult learning to the outcomes I have just described.

The major themes in this chapter—constructivism and experiential learning; narrative, autobiography, journals, and writing-to-learn; nonveridical learning; transformational learning and reflection; and the role of emotions and "teaching as care"—are ultimately overlapping and intertwined. The first three, however, concentrate on teaching and learning strategies; the last two are somewhat more focused on theory.

Constructivism and Experiential Learning

Though constructivism was initially a theoretical perspective, the new brain research seems to confirm its basic premise: that learning is constructed in

the mind of the learner. (See Caine and Caine, Chapter Seven, in this volume, for some opposing views.) Many external factors may contribute—books, lectures, media, the voices of authorities. There is also always a sociocultural environment that affects how the learning is constructed (Vygotsky, 1978). But even though people may perform functions associated with learning (such as reading and absorbing required data), if those data are not connected to neural networks as meaningful information they are not really learned, in the sense that information is useful for little besides recall. As educators know too well, data that have little meaning to the learner are usually available for recall for only a limited time. Two obvious exceptions are rote learning and mnemonics. Multiplication tables and simple formulae such as the circumference of a circle tend to stick, at least partly because we learned them when we were young—though they may fade if they are not being actively used. Mnemonic devices—such as (E)very (G)ood (B)oy (D)oes (F)ine (the notes written on the treble clef staff)—work because the words that form the phrase or image connect to prior experiences (see Sheckley and Bell's Chapter Six in this volume). In short, given how the brain embodies images, for learning to be both lasting and meaningful it must be experienced (Marton and Booth, 1997).

James Zull's Chapter One in this volume briefly describes the brain architecture that undergirds the four "pillars of learning" he calls gathering, reflecting, creating, and testing. They correspond nicely to David Kolb's learning cycle positions (1984) of concrete experience, reflective observation, abstract conceptualization, and active experimentation. This correspondence looks even more intriguing when one remembers that Kolb adapted and synthesized his model from earlier works by Piaget, Dewey, and Lewin, whose ideas about learning long antedated current understanding of brain function and were based primarily on observation, reflection, and analysis. (Let's hear it for anecdotal evidence filtered through the minds of brilliant observers!)

As Kolb's term *concrete experience* suggests, "a teacher must start with the existing networks of neurons in a learner's brain, because they are the physical form of her prior knowledge" (Zull, 2002, p. 9). Kierkegaard's parallel observation is more philosophical than physiological: "In order to help another [learn] effectively, I must understand what he understands . . . and in the way he understands it" (cited in Kegan, 1994, p 278). Yet many well-meaning instructors introduce new material to adult learners in ways that echo a professional literature review. They start with the Big Picture, situating the material in the broader field in which they are expert, and then narrow to particulars. They point out connections to previous course content as well as look forward to what will follow. Rather than focus on what the learner understands, they focus on what they themselves understand, presuming that is where the learner is also headed. Instructors do this with the best of intentions, that of creating a meaningful context for the learner. But the learner's concrete experience, in such cases, might be merely listening to the *instructor* make meaning.

Although adults may have little or no substantive prior knowledge of a topic, the brain is never a blank slate. Even infants come into the world with previous (admittedly limited) experience. With adults, the situation is reversed. They have a very full slate. Granted, they may not have many relevant neural networks for particle physics or Medieval history. Even so, the brain's approach to processing new data is to search for some experiential connection. If adult learners are not given the opportunity to create such an experience or encouraged to find existing connections that they can build on, they may revert to treating the material as something to be memorized, rather than understood.

Given that the brain embodies experience, doing precedes understanding, particularly in the development of thought (Edelman and Tononi, 2000). (See Sheckley and Bell's Chapter Six.) Because the mind arises from the brain's monitoring of the body, our knowledge of the world is always filtered first through our biological systems and then through our interactions—psychological and social—with the world around us (see Johnson's Chapter Eight in this volume). However, "those interactions do not involve a direct transfer of information" (Edelman and Tononi, 2000, p. 216); we must make meaning before it becomes our own. We are inevitably meaning-making, not meaning-taking, organisms.

On the basis of brain function, a more effective approach than starting with the instructor's Big Picture would be to start with an experience that enables the adult learner to "back into" the new topic rather than meet it head-on. For example, a frontal approach to introducing various adult development theories would probably be for the instructor first briefly to outline the emergence of the study of development within the field of psychology, then to describe major distinctions among various developmental theories, such as age, stage, life task, and so on, associating each with a major theorist.

A more experience-based approach, by contrast, might be to start by asking each adult learner to quickly sketch on a timeline the important personal and professional milestones of his or her life. The class would then be organized in small groups by age and gender, to develop a common narrative, or typical life journey, based on their combined timelines. By facilitating a comparison of these "typical" narratives across groups, an educator could draw out the framework of a developmental progression, underscoring gender and age-cohort differences.

This framework would then inform the assignment to read relevant development theories. Now, however, the course materials become an expansion of learning that these adults already embody, first as people with their own developmental journeys and again when the experience-based activity enables them to reflect on and discover this fact. Rather than adult development being a new and foreign concept, it is recognized as something familiar, of which each of them is a living example. (This and other experiential activities are described more fully in *Developing Adult Learners,* by

Taylor, Marienau, and Fiddler, 2000, which was written before I had read any research on brain function but nevertheless accords with it.)

Although some introductory context for new learning (that is, "advanced organizers") can be helpful, if that context is based almost exclusively on the instructor's knowledge and experience, the pattern-seeking organism that is the brain may not find its own meaningful connection. Most instructors probably (perhaps unconsciously) assume that the learner will make the necessary connections while reading the homework assignment. But after many years of schooling in which learning was equivalent to storing information until the next exam, many adult students approach a reading assignment planning to do exactly that.

By contrast, an experience that creates and anticipates connections between new material and what adults already know—that is, what their mindbodies have experienced—is much more likely to help them shift from passive to active readers. Metaphorically speaking, their synapses have been primed, so reading becomes more than fulfillment of a required task. This is why, for those of us who *already have* expertise in a particular subject—in other words, lots of existing neural networks based on prior experiences to which we can connect new information—reading a text, listening to a lecture, or simply having a good think can be just as effective as a more "concrete" experience.

Experience-based learning strategies are not limited to introduction of new topics. At any point in the process, learning is enhanced by activities that call on prior or tacit knowledge. (See Sheckley and Bell's Chapter Six.) One group of such activities is based on personal narrative and writing-to-learn.

Narrative, Journals, Autobiography, and Writing-to-Learn

Although these four pedagogical tools can be examined separately from one another, they share the characteristic of being means of learning through articulation. Each is the source of an extensive body of research and literature that will not be reviewed here. Rather, I link these teaching and learning methods to how the brain learns and changes.

Narrative. Some of the most compelling descriptions of the significance of personal narrative as a key to change in the brain come from the field of neuroscience: "The combination of a goal-oriented and linear storyline, with verbal and nonverbal expressions of emotion, activates and utilizes processing of both left and right hemispheres, as well as cortical and subcortical processing. This simultaneous activation may be what is required for wiring and rewiring through the simultaneous or alternating activation of feelings, thoughts, behaviors, and sensations" (Cozolino, 2002, pp. 169–170). However, the benefits of this kind of storytelling, whether oral or written, are not limited to the therapeutic environment.

When adults are given the space and time to describe their experiences with and feelings about a topic, not with the intention of coming up with a

right answer but simply to work through their own process of thinking, they are engaging in a version of the narrative procedure Cozolino described. Stephen Brookfield uses a similar approach in what he calls the "critical incident" activity (1990). Students are asked to write details about a particularly challenging professional experience. This is then used in a role-play exercise and as a springboard to ongoing self-examination and peer discussion.

Such coconstruction of narratives with peers and instructor is another important factor in the learning that ensues, because "language and significant social relationships build and shape the brain. . . . Narratives allow us to combine—in conscious memory—our knowledge, sensations, feeling, and behaviors supporting underlying neural network integration" (Cozolino, 2002, p. 292).

Journals. Journals can be considered a specialized subset of the narrative process. From Phyllis Walden's perspective, they help adult learners "develop as knowers . . . [who understand] that knowledge is constructed by the self and others and that truth is contextual" (1995, p. 13). She uses many well-known techniques, including freewriting, list making, Progoff's steppingstones exercise, and one-minute exploration to help adults find and use their individual voice, and also "to capture the present, to reflect on one's life history, and to create the future" (p. 19). This is echoed by Joseph LeDoux's description in *Synaptic Self* of the "distinction between the minimum self and the narrative self. The former is an immediate consciousness of one's self, and the latter is a coherent self-consciousness that extends with past and future stories that we tell about ourselves" (2002, p. 20).

Autobiography. Autobiography is also related to narrative and journaling, with the additional proviso that its primary focus is past experience. In describing how theories of neuroscience and psychotherapy overlap, Lou Cozolino (2002) suggests that "autobiographical memory creates stories of the self capable of supporting affect regulation in the present and the maintenance of homeostatic function into the future"; if adults access such memories, they may "maximize neural network integration" and organization (p. 63).

Engaging in autobiographical narrative can also support a shift in self-awareness associated with development of greater cognitive complexity: "To the extent that our life's experiences contribute to who we are, implicit and explicit memory storage constitute key mechanisms through which the self is formed and maintained. Those aspects of the self that are learned and stored in explicit systems constitute the explicit aspects of the self. To be self-aware is to retrieve from long-term memory our understanding of who we are and place it in the forefront of thought" (LeDoux, 2002, p. 28). Nevertheless, the implicit, hidden parts of the self, which cannot be forefronted, continue to affect everything we are and do. Therefore, to the extent that we can make explicit those aspects of our systems of thought that were formerly implicit, we develop more flexible, inclusive ways of knowing. (This is further explored in the later section on transformational learning and reflection.)

Prior learning assessment (PLA) is a specialized semiautobiographical process that most educators associate with allowing adults to petition for transcript credit for experiential, extramural learning (Keeton, 1976). Annalee Lamoreaux's thoughtful analysis (2005) of adult learners who associated personal change with the PLA process reveals more substantive outcomes in keeping with the developmental intentions described earlier, including learners' affirmation of learning from experience, consciousness of the role of tacit learning, greater capacity for taking multiple perspectives, and "awareness of consciously creating, modifying, and 'owning' their own perspectives" (p. 76). For example, a learner who, according to Lamoreaux, was coming to see "her experience as object," had this to say: "You're putting it on paper. It's *there,* it's in black and white, you are *reading* your own thought process . . . and when I do that, I [wonder,] 'Is this *really* what I value, is this really what *I'm* thinking, what *I've* learned, what *I* really want to say?' So I look at it, and its *right there*" (original emphasis, p. 107).

Lamoreaux uses a map analogy to describe the progression she identified in these changes. The first position is comparable to discovering that a map can be used to show how one arrived in a particular place; the second is analogous to the discovery that maps can be structured in various ways, depending on the assumptions of the mapmaker; the third, and most sophisticated, is that each of us can be a mapmaker, and the effectiveness of the map depends on the extent to which we recognize our own map-making process.

Writing-to-Learn. Writing-to-learn can be considered a generic form of the narrative process; as described earlier, it is a major tool in self-discovery. As valuable as oral narrative can be, describing and capturing thought in the more precise and concrete form of written prose is a further step in the "process of integration, . . . assessment and recalibration of perception" that may lead to "a set of principles" for future psychological organization (Cozolino, 2002, p. 170). Stories that can be told and (on reflection and analysis) retold "hold the potential for new ways of experiencing ourselves and our lives. In editing our narratives, we change the organization and nature of our memories and, hence, reorganize our brains as well as our minds" (p. 103).

In the absence of such narrative processes, adults may maintain the story of themselves that they internalized at the end of adolescence—a story that is constructed for them by the sociocultural surround (Kegan, 1994). Though it is appropriate at that time of life to take as one's own the rules of adulthood stipulated by one's culture, there are serious limitations to that worldview—limitations that are difficult to discover precisely because *they are* one's worldview. The eye cannot see itself: "How we think about ourselves can have powerful influences on the way we are, and who we become. One's self-image is self-perpetuating" (LeDoux, 2002, p. 320). However, as psychological therapy demonstrates, through the possibility of telling a different story, narrative activities hold the promise of encour-

aging both a shift in these perceptions and an ongoing "strategy for reediting the self" (Cozolino, 2002, p. 170).

Nonveridical Learning

Most teaching focuses on veridical learning—that is, how to get right answers to problems constructed for that purpose. According to Zull (2002), getting exact answers uses a different part of the brain than decisions that involve comparison, interpretation, and approximation. The former task resides in the front cortex, a major site of language activity. It is most like applying syntax, where the rules are already known. By contrast, examining a problem from multiple perspectives requires reflection, which is centered more in the back cortex. It also takes more time; the brain has to search and sort and then integrate among complex neural pathways. In learning situations that focus intently on coverage, there may be insufficient time to seek new meaning through new constructions of knowledge. But as Gibbs (1992) observed, the teacher's impression of what has been covered is not always matched by the learner's impression.

Veridical learning also draws primarily on the part of the brain most associated with memory, and this tends to look toward the concrete past (see Caine and Caine, Chapter Seven). By contrast, ill-structured problems—those that are open-ended, have many possible solutions, and are far more likely to occur in the real world—require the part of the brain that makes plans, decisions, and choices and creatively looks toward the future (Zull, 2002). Unfortunately, "our whole educational system is based on teaching veridical decision-making. . . . Strategies of actor-centered, adaptive decision making are simply not taught. Instead, they are acquired by each individual idiosyncratically, as a personal cognitive discovery, through trials and errors. Designing ways of explicitly teaching the principles of actor-centered problem solving is among the most worthy challenges for educators" (Goldberg, 2001, p. 83).

Problem-based learning and case studies, when constructed to avoid veridical outcomes, appear to meet Goldberg's worthy challenge. Indeed, many experiential learning activities that include reflection on learning as a process (Taylor, Marienau, and Fiddler, 2000) are likely to invoke adaptive pathways of the brain.

Transformational Learning and Reflection

According to Cozolino (2002), "A basic assumption of both neuroscience and psychotherapy is that optimal health and functioning are related to increasingly advanced levels of growth and integration. On a neurological level, this equates to the integration and communication of neural networks dedicated to emotion, cognition, sensation, and behavior. On a psychological level, integration is the ability to experience important aspects of life while employing a minimum of defensiveness" (p. 26).

Mezirow's description of emancipatory or transformational learning strikes a similar note; it can lead to ways of thinking that are increasingly "inclusive, discriminating, and integrative of experience [as well as open] to alternative perspectives" (1991, p. 156). By contrast, people who do not learn or develop such ways of thinking have "rigid and highly defended thought patterns" (p. 156). This suggests that what constitutes optimal health and functioning from the perspective of brain function and psychotherapy is among the goals of adult education. Not incidentally, these are also characteristics of adults who are more epistemologically complex (Kegan, 2000).

Transformational learning practice emphasizes meaning making based on discourse and critical reflection. Such reflective learning depends on discovering and challenging one's own and others' assumptions as a step in establishing new meaning perspectives. These new perspectives can lead to more than just reframes of current ideas; they foster qualitatively more complex ways of understanding and knowing (Kegan, 2000). The frontal lobes, also called the "executive brain," which Goldberg (2001) identifies as the "most uniquely 'human' of all the components of the human brain . . . the 'organ of civilization'" (pp. 23–24), are the most likely seat of this accomplishment.

Such qualitative changes in the form of knowing (epistemology) are "trans-*form*-ative" (Kegan, 2000, p. 49) compared with acquisition of knowledge or modification of behavior. In describing the significance of these changes as outlined in his constructive-developmental model, Kegan (1994) uses an educational metaphor of "contemporary culture as a kind of 'school' and the complex set of tasks and expectations placed upon us in modern life as the 'curriculum' of that school" (p. 3). The developmental task for most adults is to bring to awareness and challenge the premises of beliefs about *how life is* (or *should* be) and *who I am* (or *should* be) that they internalized at the end of psychological adolescence. This is a paradoxical endeavor, however, because it requires examining one's own way of knowing—that is, looking *at* one's lenses of perception, not just *through* them.

Goldberg's description of how the brain might create such new constructs is strikingly similar to Kegan's more psychological description (2000): "the organism must go beyond the mere ability to *form* internal representations . . . [or] models of the world outside. It must acquire the ability to *manipulate* and *transform* these models . . . [that is, to] go beyond the ability to see the world *through* mental [models]; it must acquire the ability to work *with* mental [models]" (original emphasis, Goldberg, 2001, p. 25).

Though often exhilarating, such changes in perspective are not without cost. Questioning the assumptions that have directed one's choices may lead to new and more compelling choices, but many families, communities, and cultures prize continuity over change. The kind of support adults need in order to grow and develop in these ways is discussed further in the section on teaching as care.

Cozolino (2002) suggests that "self-reflective language most likely requires higher levels of neural network integration . . . *Reflexive* language keeps us in the moment, reacting to stressors in the midst of survival. *Reflective* language demonstrates our ability to escape from the present moment, gain perspective on our reflexive actions, and make decisions about what and how we would like to change" (emphasis added, pp. 293–294). In this instance (and somewhat different from common usage), reflexive means reactive, automatic, immediate, not thought through, whereas reflective means the opposite: considered, deliberate, and thoughtful.

This echoes Mezirow's description (1991) of the third form of reflection, critical reflection, which he associates with the potential for transformative learning. The first form of reflection is hypothetical-deductive problem solving, which is the basis for the natural sciences. (In the wake of Hurricane Katrina, one might ask, "What combination of higher levees and restored marshland would limit flood damage in future hurricanes?") The second form of reflection expands beyond the content of a particular problem and its possible solution to the *context* of the problem and one's approach to the solution. This shifts attention from particulars of a specific situation to analysis that has wider application. ("How do we decide, and who decides, what to rebuild following a natural disaster?") However, from a still broader perspective, critical reflection involves questioning the very assumptions or premises that created a particular situation *as* a problem. When, instead of trying to find a solution, attention is turned toward what the question is and why, there is an opening to reflect on and transform "epistemic or psychological presuppositions" (Mezirow, 1991, p. 105). ("How might our view of the relationship between ourselves and the natural environment influence what, where, and whether we decide to rebuild—or build—in the future?")

Veridical learning requires only the first form of reflection Mezirow described. Taking "multiple perspectives" may require the second form of reflection, but if this can be accomplished in an instrumental way—such as by simply citing both sides of a controversy—then it is possible to avoid challenging one's own suppositions. To effectively support critical reflection, learning situations must be constructed that include premise reflection, or "dialectic-presuppositional" logic (Mezirow, 1991). Among the tools that can be a springboard to such reflection are journals, narratives, and other writing-to-learn activities. To encourage transformational learning, however, use of these activities must be "guided by identifying and judging of presuppositions" (Goldberg, 2001, p. 117)—the kind of mental activity that resides in the executive brain.

Reflecting on and questioning presuppositions can bring about changes in how people understand aspects of themselves and their world; such changes become in turn the framework for new beliefs and actions. Vaill (1996) calls this "learning as a way of being" and claims that in today's world of constant challenge and change, which he terms "continuous white water," such sub-

stantive, meaningful, and lasting learning is essential. Indeed, in their longitu-
dinal research on "learning that lasts," Mentkowski and associates (2000)
found that "when learners reflect on deeply held personal beliefs and assump-
tions, they embrace a transforming developmental challenge, pulling their self-
awareness into an awareness of themselves in a wider world" (p. 202).

The Role of Emotion and Teaching as Care

Emotions are the undercurrent of cognition (Damasio, 1999). As described
earlier, whatever we experience leads the brain to alter our body chemistry;
these changes are the substrate of emotion. In recognizing these emotions,
we discover feelings that tell us what we need to know about the current sit-
uation. Hormones can lead us to run away from a bear, or toward a lover.
They can also enhance or retard our capacity to learn. If activated in the way
that is associated with "Aha! What's this? Maybe something interesting?"
(which Caine and Caine in this volume call "quiet attention"), they are
enhancers. The brain is on alert in a positive, receptive way. But if hormones
are pumping because of a perceived or potential threat ("The instructor is
going to call on me and I won't know the answer"), the brain is *less* avail-
able for learning. Indeed, "emotions influence our thinking more than
thinking influences our emotion" (Zull, 2002, p. 75).

Long-term memory—that is, circuits made up of durable neuronal pat-
terns—is particularly affected by emotions. Generally, the more powerful the
emotion that accompanies the initial experience, the more lasting the mem-
ory. The exception is when the initial experience is so traumatic that disso-
ciation occurs; under these circumstances, memories may be deeply buried
or completely inaccessible to recall (see Perry's Chapter Three in this vol-
ume). Memory is the embodiment of emotion tied to experience—not just
"what happened" but "how my body reacted to what happened." Much of
this is implicit memory of which we are not consciously aware, although our
brain is (Gladwell, 2005). This is why a new acquaintance who resembles
someone we loved or despised—that is, who activates neural circuits in the
brain associated with that person—may evoke an instantaneous response of
pleasure or revulsion, even if we do not consciously notice the resemblance.

Unfortunately, "evolution favors anxious genes" (Cozolino, 2002, p.
235). The more fearful and reactive our early forebears were, the more likely
they were to live and reproduce. But in today's less threatening world (at
least in the immediate sense), the tendency toward anxiety can limit our
effectiveness and happiness. (I refer here not to the kind of anxiety that is
diagnosable as a neurosis, but rather the biophysical remnant of our cave-
dwelling ancestor whose life depended on constant alertness to possible
threats.) As described earlier, the more complex kinds of self-awareness—
involving higher brain functions, and with the potential for changes in
neural networks that correspond to changes in our way of knowing—can-
not be accomplished when a person feels anxious and defensive. "A *safe and*

empathic relationship establishes an emotional and neurobiological context conducive to the work of neural reorganization. It serves as a buffer and scaffolding within which [an adult] can better tolerate the stress required for neural reorganization" (Cozolino, 2002, original emphasis, p. 291). In other words, adults who would create (or recreate) neural networks associated with development of a more complex epistemology need emotional support for the discomfort that will almost certainly be part of that process (see Johnson's Chapter Eight, this volume).

That said, I would like to revisit a theme introduced in the Editors' Notes: the difference between a therapist and an adult educator. Even as we attend to learners' emotional states, we do not "do therapy." For one thing, it is not our training; but even for those few of us who may have a counseling background, this is not our appropriate professional role as educators. Nevertheless, we cannot escape the fact that many outcomes of approaches to teaching and learning described in this volume are likely to parallel outcomes of professional counseling: greater self-awareness, less anxiety, heightened self-responsibility, increased cognitive complexity. The appropriate role for an educator fostering these outcomes has been described by Daloz in terms of "teaching as care."

Adults who experience education as growthful and changing can nevertheless feel they are standing on the edge of a precipice: "Transformative learning, especially when it involves subjective reframing, is often an intensely threatening emotional experience in which we have to become aware of both the assumptions undergirding our ideas and those supporting our emotional responses to the need to change" (Mezirow, 2000, pp. 6–7). As Brookfield has famously pointed out, learning to question assumptions can, in some communities, lead to "cultural suicide" (1990, p. 153).

Though writing-to-learn, co-construction of narratives (described earlier), and various self-reflective activities can encourage awareness and growth, learning experiences such as these are most effective when they take place within a supportive relationship. Before publication of most of the current literature on brain research, Larry Daloz (1999) used the story of Mentor to describe the kind of relationship that can help another human being along the journey to new ways of perceiving and understanding. There are no simple directions for this kind of attention to and care for another's experience of growth, but Daloz offers memorable and meaningful accounts of his work with adult learners: "When we no longer consider learning to be primarily the acquisition of knowledge, we can no longer view teaching as the bestowal of it. If learning is about growth and growth requires trust, then teaching is about engendering trust, about nurturance—caring for growth. Teaching is thus preeminently an act of care" (Daloz, 1999, p. 237).

This care and nurturance must nevertheless include sufficient challenge. Kegan's description of the "holding environment," the environment on which all development depends, underscores this fact. Kegan (1982) based his notion of the holding environment throughout the lifespan on

Winnicott's observations of infants who, despite the fact that they were fed, clothed, and sheltered, failed to thrive if they were not also held.

According to Kegan, the holding environment comprises three parts: "holding on," "letting go," and "sticking around," or confirmation, contradiction, and continuity. In the learning environment, confirmation affirms the learner by focusing on what he or she has done right, hailing effort, and applauding even small achievements. Contradiction stretches the learner beyond what is comfortable at the moment. Similar to an athletic coach, the educator encourages greater effort, sets high but attainable standards, and helps the adult focus on what remains to be accomplished. Continuity accepts that over time the adult learner's emerging way of being will likely change the structure of the relationship. The power differential shifts as the learner establishes herself as a peer, which invites the educator/mentor to become companion, ally, and colearner (Bloom, 1995). This rarely happens within the confines of a single course, however, and tends to happen more frequently with graduate rather than undergraduate adult learners.

The efficacy of this approach to the mentoring relationship, a balance of support and challenge, is confirmed by the literature on brain function: "We appear to experience optimal development and integration in a context of a balance of nurturance and optimal stress" (Cozolino, 2002, p. 62).

Conclusion

You may have noticed considerable overlap in this chapter's subtopics. For instance, when subject to critical reflection, journaling and autobiography can be ways to construct (and reconstruct) knowledge. Similarly, working with ill-structured problems tends to foster the kind of questioning of premises that leads to transformational shifts in perspective. All of these approaches are most effective when the learner feels supported by a holding environment or mentoring relationship. Furthermore, these teaching and learning strategies can be described in terms of Kolb's learning cycle.

We do not intend to claim, however, that the literature on brain function is the Philosopher's Stone of adult learning. Nor do we imagine that our colleagues in the field of education will become fluent in describing brain architecture (we most certainly are not!). We do, however, hope with this volume to expand the boundaries of the discourse on teaching and learning practices.

In doing so, we realize how important it is to recognize that we adult educators are also engaged in a lifelong process of development and may be experiencing challenges similar to those that we pose for our learners. How do we respond to ideas that call into question our beliefs about our role as educator? How effectively can we bring multiple perspectives to bear on our own practice? Though it has in many ways confirmed my experience, the literature on brain function challenged me to expand beyond my comfort zone. For example, irritated at having to contend with so many unfamiliar anatomical terms, I allowed a thick pile of books to sit on my must-read pile

for months, until my responsibilities to a student required action. Even as I resisted and resented the imposition(!), I saw more clearly than ever how many adult learners must feel when their assumptions about their role as learner are called into question.

"The growth and integration of neural networks," Cozolino writes, "is the biological mechanism of all successful learning, including parenting, teaching, and psychotherapy. . . . Challenges that force us to expand our awareness, learn new information, or push beyond assumed limits can all change our brains" (2002, pp. 290–291). More important, however, such new awareness has the potential to change more than the individual's brain: "If you become aware that something *is* in a certain way, then you also become aware that it *could be* in some other way" (original emphasis, Marton and Booth, 1997, p. 207). Adults in whom such awareness develops are likely to be less reactive and more considered in personal, workplace, and political decisions, as well as better able to adapt to changing circumstances. They are also better able to recognize the need for more just, humane, and equitable economic and social structures. In short, they are prone to be more deliberate, responsible, and competent in working toward the health of the commons. For all these reasons, we turn enthusiastically toward research that may support us in encouraging this kind of awareness in our adult learners and ourselves.

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