# Good for the Heart, Good for the Soul: The **Creative Arts** and **Brain Health** in Later Life

The human brain supports—perhaps thrives on creative activity and certain types of creative challenges—ones that may foster repair and growth of brain structures and their attendant behaviors.

A ny artist who has had the opportunity to do creative arts work with elders has the heartfelt knowledge that this work has a positive impact on people's mood, cognitive vitality, and general sense of well-being. They see and feel the transformations. But is there any research to support the anecdotal evidence? And from a biological perspective, why would participating in creative arts programs have positive effects on body and mind? Are there any plausible mechanisms to explain how the creative arts could influence the trajectory of human cognitive health?

This article will review some of the direct evidence that participation in arts programs does improve cognitive performance. It will also explore more speculative ideas about the evolution of the creative brain, and how the human brain supports—and perhaps thrives on—creative activity and certain types of creative challenges that may foster repair and growth of brain structures and their attendant behaviors.

Developmental psychologist Howard Gardner, who introduced the important concept of multiple intelligences, presented a significant challenge to the notion that intelligence is a single general capacity possessed, to a greater or lesser degree, by everyone (Gardner, 1983). Instead, he suggested that people possess different types of intelligence, each type manifesting within the context of specific tasks, domains, and disciplines. This pluralistic view of intelligence (and creativity) implies that there is no single route to the truth: only by expressing the full range of our creative intelligences can we capture the breadth, depth, and splendor of our existence throughout the life course.

In a similar vein, biologist E. O. Wilson observes that both the humanities and the sciences search for truth, but approach the quest from uniquely different vantage points (Wilson, 1998). We can be most confident that we have located a truth, he says, when both fields converge around similar conclusions. Wilson used the word "consilience" to describe this linkage, or coming together, of principles from different disciplines.

Finally, this article will take a look at the "consilience" of creative arts and brain health, examining how participation in creative arts

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programs exercises multiple cognitive, physiological, and emotional "intelligences," and how this exertion might delay or prevent cognitive decline.

### Direct Evidence: A Case for the Arts

In 2001, Dr. Gene Cohen conducted the first comprehensive research program to test the hypothesis that participation in the arts has health and cognitive benefits. The Creativity and Aging Study was a multisite, longitudinal study that had the goal of "measuring the impact of professionally conducted community-based cultural programs on the general health, mental health, and social activities of older adults aged 65 and older" (Cohen et al., 2006).

The study was conducted in three locations around the country in conjunction with the Levine School of Music in Washington, D.C., Elders Share the Arts (ESTA) in New York, and the Center for Elders and Youth in the Arts in San Francisco—cultural programs with a diverse array of participatory arts offerings. The study used two groups from each location: an intervention group that participated

in arts programs and a control group that did not.

Cohen perceived a number of possible mechanisms at work that could lead to positive

outcomes. He characterized one important mechanism as self-mastery; participants develop a strong sense of control and self-confidence because of their deep involvement in the creative process. They experience and benefit from the challenge and satisfaction of artistic achievement. Artistic achievement, in this case, is distinct from accomplishing arts and crafts activities. Arts and crafts projects, often called "busy work," may serve to keep people occupied whereas artistic activities go farther and engage the mind, body, and emotions, sparking curiosity, problem solving, and artistic accomplishment.

Data from the Levine School of Music singing group revealed "better health, fewer

doctor visits, and less medication usage, along with more positive responses on the mental health measures and a higher level of social engagements" (Cohen, 2008) in comparison to the well-matched control groups. This group also performed at various public venues, such as Washington, D.C.'s Kennedy Center, and experienced an added degree of pressure and challenge to do well. Performance, or some form of making the art public, may be an important element in building self-mastery.

Rehearsal and performance also lead to increased levels of physical activity, mental stimulation, and social interaction, which have been shown in numerous studies to enhance cognitive function (Hertzog et al., 2009). The pressure of public performance may, ironically, induce low levels of stress, which in turn stimulate the production of protective hormones. Mark Mattson and Tim Magnus report that activities like physical exercise, mental stimulation, and dietary restriction "have been shown to protect neurons against dysfunction and death in animal models of neurodegenera-

### Creativity is radical: it breaks the bonds of stability and encourages us to go beyond the boundaries of routine and practiced responses.

tive disorders. This occurs, in part, by induction of a mild stress response that induces the production of neurotrophic factors..." (Mattson and Magnus, 2006). We surmise that the benign stress of performance, rehearsal, and the sharing of personally meaningful creative products may stimulate a similar protective effect.

The ESTA program conducted at New York's Casa Boricua Senior Center also yielded positive results: a sense of mastery reverberated in the Center's life and culture. The teaching artists reported that "the center was buzzing with excitement about their new visual arts program. By the second year, the group gained confidence in itself. A creative fever swept through it. The participants' focus heightened. Their work began to change, becoming bolder and more experimental. They were using bright corals, teal blues, and jade greens. Tito, one of the few men in the group, bragged to his friends that his wife had a renewed love for him since he created a beautiful necklace of her favorite colors. Another group member, Antonia, proudly stated, 'I only knew work, now I am an artist.'"

In the Writing from Life Program, the ESTA program at Morningside Retirement Health Services in New York, one participant, Edith, said: "One good thing about writing is that it sharpens your memory. I write now, come rain or shine."

Dr. Cohen noted that increased self-mastery boosts the immune system, saying that "the immune-enhancing function results in more T cells (lymphocytes), fighting off infections and more NK (natural killer) cells combating cancer" (Cohen, 2008).

### A New Field Emerges

The emerging field of creativity and aging has benefited from a convergence of research, practice, and policy. The confluence was spurred by the National Endowment for the Arts' (NEA) interest in policy issues around creativity and older people, and now builds upon more than two decades of practice by community-based arts organizations that focused on providing quality arts programs to elders.

The National Center for Creative Aging (NCCA), which was created in 2001 with support from the NEA, is an organization dedicated to fostering an understanding of the vital relationship between creative expression and healthy aging, and to unite research, practice, and policy. The NCCA developed a research committee specifically to build on Dr. Cohen's seminal work by finding and supporting further research in this important area. In 2009, the committee, led by Linda Noelker of the Benjamin Rose Institute, conducted a literature review of studies that measured the health outcomes of participatory arts programs—those led by professional artists—in community settings. Of the more than 2,000 research papers initially reviewed, only eleven met the focused criteria for this review. Evidence from those eleven studies confirmed that "there are a variety of benefits for health and functioning from participation in creative and performing arts programs for older adults" (Noelker et al., 2009).

Perhaps the strongest research found in the literature review was the body of work conducted by the husband-and-wife team of Helga and Tony Noice; two of their research projects are particularly relevant here. The first study, A Short-term Intervention to Enhance Cognitive and Affective Function in Older Adults (Noice, Noice, and Staines, 2004), aimed to determine whether one month of intensive training in theater could raise various measures of cognitive and affective (mood) health. The training consisted of nine ninety-minute sessions, with the first and last sessions devoted solely to preand post-intervention testing. Three types of cognitive tests were administered: a word recall task, a listening span task, and a problem-solving task. Two mental health measures, a self-esteem scale and a psychological well-being scale, were conducted. The control groups consisted of a visual arts course and a no-intervention group. The control groups took the same tests and got the same information as the theater and visual arts groups, but received no training.

In the theater course, participants engaged in acting situations that mimicked real-life situations. The exercises were designed to become increasingly demanding and were structured so that participants could "become so engrossed in the drama that obvious situation-specific cognitive, affective, physiological alternations occurred in their [participants'] demeanor."

The visual arts course, used as a control, included activities that examined a work of art and speculated on the artist's intention or the interpretation of ambiguous images. Every class focused on a different art medium and encouraged strong involvement. The results showed that the theater participants improved significantly from pre-test to post-test over no-treatment controls on two out of three cognitive variables—recall and problem solving. They also improved significantly on psychological well-being (Noice and Noice, 2009). Interestingly, the theater group scored significantly higher than the visual arts group on both problem solving and psychological wellbeing, even though participants praised the arts training and had considerable cognitive and social stimulation. Both the theater and arts groups scored better than the control group.

In a subsequent study, *An Arts Intervention for Older Adults Living in Subsidized Retirement Homes* (Noice and Noice, 2009), the Noices set out to extend the successful intervention for

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community-dwelling older adults to possibly at-risk older adults living in subsidized, primarily low-income, housing. Participants in this group were older and less well-educated than the participants in the previous study; more than half had mobility challenges and used walkers, canes, wheelchairs, and motorized chairs. This intervention compared theater training, voice training, and a no-intervention control group.

The results with this higher-risk group of participants were similar to the previous test. The intervention produced significant cognitive and affective gains in the acting group, with marked increases for both the acting and singing groups in the affective measure. What mechanisms could account for the positive changes in cognition and mood associated with the theater intervention?

The Noices suggest a number of mechanisms that echo those cited by Dr. Cohen. Arts activities are fun and pleasurable activities that may have the beneficial effects of decreasing stress while increasing a sense of mastery and control. Complex theater activities, like most arts activities, involve forms of physical activity, mental challenge, and social engagement. Each of these activities has been associated with protection against cognitive decline and dementia (Hertzog et al., 2009).

Noice and Noice suggest that the development of acting skills can lead to improved life skills. Since the acting exercises encourage and rehearse habits of mind that lead to deep processing of stimuli, this "complex multitasking might result in increased efficiency in handling real-world dual tasks." Further, they observe that "theater training may be unique inasmuch as it requires expending considerable yet pleasurable effort in close association with others, thus fusing intellectual and social factors known to enhance cognitive ability and mental health" (Noice and Noice, 2009).

Complex, multi-modal arts interventions, like theater, may also cause neurological changes, stimulating positive plasticity of brain structures. Noice, Noice, and Staines (2004) speculate that "engaging in demanding, multi-modal activities might result in increased cerebral activation that, in turn, would contribute to improved cognitive performance." If mental activities can change the brain's structure in such a way as to make it more difficult for disease to take hold, or could stall disease progression, it might be possible to strengthen neural systems through these novel, effortful programs.

In addition to positive plastic change, complex creative interventions might contribute to the development of cognitive reserve that can protect against cognitive decline. Most theories of cognitive reserve suggest that enriched environments and cognitive stimulation across an extended time period can provide protection. Based on the results of their intervention, the Noices suggest the possibility that "adding a highly enriched multi-modal environment over a short period late in life can also produce the kinds of benefits associated with the protections offered by cognitive reserve."

The Noice's 2009 report lists the unique combination of elements found in successful aging studies. "It [acting] is novel, effortful, enjoyable, multi-modal-multi-factorial, and mentally and physically stimulating. It requires participants to truthfully react to fictional situations, an experience that is at the core of the process. Moreover, it encourages bonding in a social situation and is emotionally activating. We are not aware of any other form of leisure activity that encompasses all these elements in such concentrated form."

This last point is extremely important. Recent research into the biology of brain health points to the effectiveness of behavioral interventions. Physical exercise, mental stimulation, social interaction, and activities that reduce chronic stress, for example, are proving to be protective against cognitive decline and dementia (Hertzog et al., 2009). Increased engagement with any one of these activities is beneficial, but the best results occur when all of the lifestyle improvements work in concert-a finding emphasized at the recent Second Cognitive Aging Summit, sponsored by the National Institutes of Health, when one neuroscientist remarked that the best lifestyle interventions are "combinatorial" and involve "immersion" activities.

Combinatorial programs are those that combine multiple different types of activities. There is interesting evidence that, when done in sequence, physical exercise and mental exercise promote neurogenesis. It is now known that the human brain can continue to grow new neurons in the hippocampus, the brain's memory maker, and that physical exercise stimulates growth of new brain cells. But neurogenesis is a two-step process. The newly generated brain cells must be put to work or they will atrophy and die. Mental stimulation does the trick. The combination of physical exercise followed by mental stimulation is the necessary formula for promoting the growth and survival of new brain cells in the hippocampus, at any age (Kempermann, 2008).

As the Noices point out, it is likely that creative arts programs are effective, in part, because participants engage in "combinatorial activities." Serious creative work, particularly work in the creative arts, requires the active integration of diverse cognitive, physical, and affective skills. Acting and dance, for example, are highly physical activities that require participants to explore and expand their range of movements, gestures, and facial expressions. Painting, sculpting, or playing a musical instrument demands the development of expert control of fine motor movements. The creation of art requires aesthetic judgments that reflect both personal and public standards, and that search for a vibrant dynamic between expectation and surprise. Simply put, these are complex cognitive activities. Participation in creative arts requires people to explore a complex combination of physical, cognitive, and emotional skills.

It is worth adding that one of the big challenges for any behavior modification campaign is motivation—getting people to do the activity. The idea of "immersion" is that we are more likely to participate in brain healthy behaviors if they are embedded within other activities that we enjoy doing repeatedly. It is a bit like sugar-coating the bad-tasting medicine. While we may resist spending thirty minutes on the treadmill or twenty minutes with a cognitive training computer program, we will happily spend an hour rehearsing a new dance or creating a complex collage. People engage in creative arts programs because they are fun and fulfilling, not because they feel the need for a cognitive workout.

## Evolution of the Creative—and Incredible—Brain

The human mind evolved to be creative. The evolutionary psychologists Leda Cosmides and John Tooby posit that human beings have enjoyed evolutionary success because they were able to establish a new form of adaptive advantage. The central distinguishing innovation of human evolution "has been the dramatic increase in the use of contingent information for the regulation of improvised behavior that is successfully tailored to local conditions—an adaptive mode that has been labeled the cognitive niche" (Cosmides and Tooby, 2000).

Human beings established and dominated this "cognitive niche" not with sharp fangs, speed on foot, or size and strength, but through creative, improvisational thinking that adjusted quickly to the demands of each unique environment. Where other animals are restricted to a narrow set of behaviors designed for a unique ecological niche, human beings inhabit an environment bounded only by the imagination. Human brains have imagined preferred situations and used their improvisational skills to turn those visions into reality. The adaptive pressures of the expanding cognitive niche required the continual improvisation and invention of new behaviors that could adapt to the changing environment.

#### Improvisation, invention, and play

One of the creative arts' core values is that they exercise the human brain's flexible and adaptive talents. To survive and thrive, human beings have had to hone their cognitive skills of improvisation and invention. The connection between the creative arts and play is instructive in this regard. The young of all human cultures engage in developmental periods of intense play during which they explore and experiment with the environment, and learn how to fit into the social network of other children. Play serves as their safe training ground: they can learn about the world and develop and test their emerging skills and intelligence without risking real danger.

Unlike most other animals, humans never grow out of this developmental stage, maintaining an extended period of immaturity and learning, called "neotany," throughout life. Animals, such as wolves, cut short their period of play and, with maturity, settle into relatively routine patterns of automatic behavior. These behaviors work fine for wolves as long as they are not forced to leave the environmental niche for which their behaviors were adapted. The expanded challenges of civilization and culture, the cognitive niche that humans inhabit, however, require the human animal to engage in constant learning and adaptation. As the developmental psychologist Eric Erikson put it: "It is human to have a long childhood; it is civilized to have an even longer childhood" (Brown, 2009).

As we mature, the play of childhood morphs into what we call leisure activities. We play sports, or we participate in them as active fans and observers. We spend hours of our life watching performances on television and the movies. Why are we so fascinated with the expert performances of football and baseball players, of dancers, singers, and actors? Even if we are not performing the activities ourselves, we experience a degree of vicarious (beneficial and benign) challenge that facilitates continued learning through observation and mimicry.

We also enjoy performances because the pleasure centers of our brains have been set to reward behaviors that have proven to be adaptive. We enjoy creativity because we need our brains to be good at improvisation, invention, and innovation. We learn through doing and through observation, and are entranced by expertise and creativity. Our brains have evolved to promote the self-strengthening strategy of striving for constant improvement of adaptive skills whether on the field or in the stands, on stage or in the audience.

#### Human creative ability: brain size does matter

The rise of creative abilities in humans is closely connected with the increase in human brain size. It is not entirely clear whether creativity drove brain size, or whether brain size made creativity possible. In any case, the human brain is capable of creative thinking because of the increased computational power afforded by the increased number of brain cells and the vast network of connections that developed in the brain. All of this expanded capacity, however, needs to be exercised and kept in good health if it is to reach its potential: the brain's creative powers are exercised by using the brain creatively.

The literature on the evolution of the primate brain supports the connection between an increase in brain size and a resulting increase in creativity and cultural expression. It has been proposed that behavioral innovation and the transmission of culture have been central to the evolution of the big human brain (Reader and Laland, 2002). making, and artifacts made from non-stone materials, along with strategic social strategies and evidence of religion. With the invention of culture, the adaptive pressures on the human animal centered around the need to creatively manipulate the environment and to effectively negotiate social exchange and interaction with other (creative) people.

Working memory is a form of short-term memory that enables us to hold multiple ideas in our conscious mind long enough to manipulate them (Baddeley, 2004). Creativity researcher Arne Dietrich has observed that creative think-

### Tito bragged to his friends that his wife had a renewed love for him since he created a beautiful necklace for her in her favorite colors.

As Louis Lefebvre and colleagues conclude: "Opportunism, learning and cognition imply more complex information processing than behavioral conservatism and genetic pre-programming; animals that need to store and manipulate more information about their environment will consequently need a larger neural computer" (Lefebvre et al., 1997). Increased brain size in humans expanded their ability to create the myriad manifestations of civilization. In turn, the challenges presented by having to function in increasingly complex, civilized societies drove the further evolution of increased brain power.

## Executive functions, working memory, and creativity

Archeologists Coolidge and Wynn suggest that an expansion of the human brain's executive functions, particularly working memory, propelled the explosion of culture that occurred 50,000 years ago (Coolidge and Wynn, 2005). They note that around this time, complex cultural activities became the rule rather than the exception, citing the emergence of art, personal ornamentation, symbolism, tooling can arise either spontaneously or deliberately, and can spring from both emotional and cognitive areas of the brain. But all creative roads travel through working

memory. We cannot bring new ideas into being until we make them available to the conscious mind and can hold on to them long enough to manipulate them. If Coolidge and Wynn are correct, the development of working memory was the evolutionary tipping point that turned the human brain into such an incredible engine for invention and innovation.

### The mysteries of Area 10

The evolving ability of early humans to respond creatively to a changing environment was supported by a significant expansion in computational power and by an expanded ability for the brain to communicate with itself and to coordinate its multiple cognitive modules. Michael S. Gazzaniga explores this development of unique human capabilities in his book *Human: The Science Behind What Makes Us Unique* (2008).

The human animal, according to Gazzaniga, developed a disproportionately large prefrontal cortex, which "accounts for most of the difference in the size of the brain between humans and other primates." It is the new part of the cortex, the neocortex that handles sensory perception, generation of motor commands, spatial reasoning, conscious thought, and language. And the prefrontal cortex is not only disproportionately large in humans, it is also more complex. Gazzaniga notes that while non-primate mammals have two major regions of the prefrontal cortex, humans and other primates have an extra region that is called the lateral, or granular prefrontal cortex.

Within this extra area of the prefrontal cortex there is a region called Area 10, which is, according to Gazzaniga, "involved with memory, planning, cognitive flexibility, abstract thinking, initiating appropriate behavior and inhibiting inappropriate behavior, learning rules and picking out relevant information from what is perceived through the senses."

Area 10 has some unique anatomical characteristics. "Nerve cells and clusters of neurons in Area 10 are densely interconnected to each other and also highly connected to other uniquely oversized areas of the human brain," Gazzaniga reports. More specifically, white matter, which is made up of nerve fibers that connect the cortex to the rest of the nervous system, is also disproportionately large in humans. This, he says, "suggests a high degree of connectivity in this part of the brain."

To understand why connectivity is so essential to creative thinking, it is important to remember that an idea is not a thing that is housed somewhere in the brain. An idea, like a memory, is an event. A thought is the coordinated firing of a unique combination of nerve cells, networks, and modular clusters. One idea is different from another because different brain cells and regions are involved, and are activated in a unique pattern and sequence. The more complex the idea, the more that numerous areas of the brain are involved.

The human brain's expanded computational capacity, coupled with the increased ability to connect one specialized computational area with another, made creative thinking possible. There are many ways that we think creatively and come up with new ideas: one approach is to link disparate ideas that had not previously been united, a process that requires the activation of different neural networks, the ability to keep multiple ideas active in working memory, and the ability to forge a new neural connection between the two ideas that creates a larger and more complex concept.

In addition to combining thoughts in a unique way, creativity sometimes requires the mind to break free from existing modes of thinking and give the imagination free rein. Gazzaniga raises the possibility that Area 10 and its interconnections act as an integrated brain circuitry that gives human beings their unique ability to break free of automatic responses and find novel solutions to myriad problems. Multiple connections offer multiple, alternative choices.

While the frontal lobes appear to play a critical coordination role, they are not the only brain regions needed to support creative work. Nor is creativity exclusively a right brain activity (Dietrich and Kanso, 2010). One of the reasons that participation in creativity is so beneficial for brain health is that it exercises a broad array of multiple interconnected parts of the brain.

### The Multi-Phased Creative Process

Creativity researchers recognize that the creative process involves a number of distinct phases, each requiring different cognitive skills and strategies. MindRAMP & Associates, a company that studies and promotes behavior approaches to brain health, encourages participation in creative activities as a wonderful way to engage, stimulate, and protect the brain. MindRAMP believes that the full creative cycle involves seven discrete phases (initiation, saturation, manipulation, incubation, inspiration, implementation, and evaluation), and that each phase exercises different cognitive functions. The saturation phase, for example, is the time for skill-building and the accumulation of knowledge and information. This phase requires very different cognitive skills than does the manipulation phase when ideas are

### Creative Arts Programs Must-Haves: Ten Key Elements for Cognitive Enhancement

- 1. Physical activity and movement
- 2. Mental challenge and stimulation
- 3. Social interaction, bonding, and support
- 4. The need to acquire and refine new skills
- 5. Activities that are multi-modal and combinatorial
- 6. Enriched and stimulating environments
- 7. The room to fail and the wisdom to learn from failure
- 8. Sufficient challenge to create mild (beneficial) stress
- 9. Pleasure, fun, and challenging play
- 10. Reward

broken apart and rearranged. The incubation phase is largely involved with creative work that is conducted below the level of conscious awareness. When ideas suddenly emerge into our conscious mind we are surprised and experience the "aha!" moment of inspiration. The generation of ideas requires very different cognitive skills than does the evaluation and selection of that single best idea.

As we work our way through a full creative process, we engage multiple cognitive skills and strategies and in so doing engage multiple parts of the brain. Arne Dietrich observes that "there are likely a multitude of processes and brain regions involved in the computation of ideational combinations" leading to creativity (Dietrich and Kanso, 2010). Creative thinking results from the combined and orchestrated efforts of left hemisphere and right hemisphere, conscious and unconscious thinking, and emotional as well as rational processing.

Creative arts, perhaps because the individual arts require the development of domain-specific skills, engage even more brain structures than do other forms of creativity. Visual artists become more sensitive to nuances of color, shape, and texture. Musicians hear sound differently than do non-musicians. Dancers become highly sensitive to the position of their bodies in relation to space. It is not surprising, therefore, that the creative arts stimulate motor areas, somatosensory areas, and cortical regions concerned with spatial or auditory perception (Dietrich and Kanso, 2010).

Creativity researcher Robert J. Sternberg of Yale University suggests that creativity has a dialectical relationship with intelligence and wisdom. In this construct, "intelligence represents a thesis, creativity an antithesis, and wisdom a synthesis" (Sternberg, 2001). Intelligence and learning are inherently conservative; we prefer our facts to be stable and our understanding of the world to be routine and predictable. But over reliance on stability and routine retards our ability to grow and adapt. Creativity is radical: it breaks the bonds of stability and encourages us to venture beyond the boundaries of routine and practiced responses. It is this dynamic interplay between stability and change that creates an everchanging synthesis of ideas that we recognize as wisdom. "Wise individuals," says Sternberg, "balance the need for change (creativity) with the need for stability and continuity (intelligence) in human affairs."

## Summary: Creativity Is Good for the Soul—and Cognition

The growing numbers of practitioners in the field of creativity and aging are showing increased appreciation for the profound impact that creative arts programs have on elders' quality of life. Growing old need not be a time of diminished expectations. As Gene Cohen has said, this period of later life can be a time of liberation. A small but expanding body of research is also providing evidence that creative exploration of the multiple intelligences stimulated by the arts is not only good for the soul, but is good for general health and cognitive fitness (Noelker et al., 2009).

But more research is needed. Creativity practitioners and researchers must unite to explore the consilience of their disciplines. The NCCA strives to promote this interaction by providing a meeting place where people involved in science, the arts, and the humanities can come together to promote a healthy—and happy—aging process for all.

Educator and gerontologist Michael C. Patterson is founding principal of mindRAMP & Associates, LLC, in Silver Spring, Md. Susan Perlstein is the founder of Elders Share the Arts and the National Center for Creative Aging in Washington, D.C.

### References

Baddeley, A. 2004. Your Memory: A User's Guide. New Illustrated Edition. Buffalo, N.Y.: Firefly Books.

Brown, S. 2009. Play: How It Shapes the Brain, Opens the Imagination and Invigorates the Soul. New York: Penguin.

Cohen, G. 2008. "The Creativity Fitness Movement." *Aging Today* 29(6): 7–10.

Cohen, G., et al. 2006. "The Impact of Professionally Conducted Cultural Programs on the Physcial Health, Mental Health, and Social Functioning of Older Adults." *The Gerontologist* 46(6): 726–34.

Coolidge, F. L., and Wynn, T. 2005. "Working Memory, Its Executive Functions, and the Emergence of Modern Thinking." *Cambridge Archeological Journal* 15(1): 5–26.

Cosmides, L., and Tooby, J. 2000. "The Evolution of Adaptations for Decoupling and Metarepresentation." In Sperber, D., ed., *Metarepresentations: A Multidisciplinary Perspective*. New York: Oxford University Press.

Dietrich, A., and Kanso, R. 2010. "A Review of EEG, ERP, and Neuroimaging Studies of Creativity and Insight." *Psychological Bulletin* 136(5): 822–48.

Gardner, H. 1983. *Frames of Mind: The Theory of Multiple Intelligences* (10th ed.). New York: Basic Books. Gazzaniga, M. S. 2008. *Human: The Science Behind What Makes Us Unique*. New York: HarperCollins.

Hertzog, C., et al. 2009. "Enrichment Effects on Adult Cognitive Development: Can the Functional Capacity of Older Adults Be Preserved and Enhanced?" *Psychological Science in the Public Interest* 9(1): 1–65.

Kempermann, G. 2008. "The Neurogenic Reserve Hypothesis: What Is Adult Hippocampal Neurogenesis Good For? *Trends in Neuroscience* 31(4): 163–9.

Lefebvre, L., et al. 1997. "Feeding Innovations and Forebrain Size in Birds." *Animal Behavior* 53: 549–60.

Mattson, M. P., and Magnus, T. 2006. "Ageing and Neuronal Vulnerability." *Nature* 7(4): 278–94.

Noelker, L., et al. 2009. "Impact of Arts Participation on Health Outcomes for Older Adults." *Journal of Aging, Humanities, and the Arts* 4: 352–67.

Noice, H., and Noice, T. 2009. "An Arts Intervention for Older Adults Living in Subsidized Retirement Homes." *Aging, Neuropsychology, and Cognition* 16: 56–79.

Noice, H., Noice, T., and Staines, G. 2004. "A Short-term Intervention to Enhance Cognitive and Affective Functioning in Older Adults." *Journal of Aging and Health* 16: p. 562. Reader, S., and Laland, K. N. 2002. "Social Intelligence, Innovation, and Enhanced Brain Size in Primates." *Proceedings of the National Academy of Sciences of the United States of America* 99(7): 4436–41.

Sternberg, R. J. 2001. "What Is the Common Thread of Creativity? Its Dialectical Relation to Intelligence and Wisdom." *American Psychologist* 58(4): 360–2.

Wilson, E. O. 1998. *Consilience: The Unity of Knowledge*. New York: Vintage Books.

### Resources and Further Reading

Boyer, J. M. 2007. Creativity Matters: *The Arts and Aging Toolkit*. New York: The National Guild of Community Schools.

Cohen, G. 2000. Awakening Human Potential in the Second Half of Life. New York: Avon Books.

Cohen, G. 2005. *The Mature Mind*. New York: Basic Books.

Humphries, L. 2000. "Artistic Process and Elegant Action." ThinkingApplied.com. www. thinkingapplied.com/artistic\_ process\_folder/artistic\_ process.htm.

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