Inside The Mind's Maker-Space: A Review of *The Nature of Human Creativity,* edited by Robert J. Sternberg and James C. Kaufman

By Anthony Brandt
Email: abrandt@rice.edu

One of the most disturbing fall-outs of the current attacks on science is that the slightest uncertainty or controversy is treated as a sign of weakness. Doubt does not make science "fake news:" it is a through-line of the profession. A scientific colleague once told me that his job consisted of putting forth a hypothesis, and then throwing everything possible at it to tear it down.

"The Nature of Creativity" consists of articles by thirty psychologists counted among the most prominent researchers in the field. In these pages, they wrestle with one of the most complex questions in psychology: what makes humans creative? Reading their perspectives is to witness science in its full bloom of questioning and debate. Here are scientists who not only celebrate their discoveries but continually seek out open questions.

After more than a half century of research, the field has arrived at a consensus on some key issues. If you were to poll these authors asking whether or not everyone is creative, they all would answer in the affirmative. The authors generally concur that certain key character traits are necessary to fully leverage human inventiveness, including openness to experience, curiosity, and a tolerance for risk. It is widely accepted that above-average intelligence is an asset—but after a certain point, higher I.Q. does not translate into greater creativity. Most seem persuaded that even the greatest innovations do not spring fully formed into the world but are the reworking of what already exists. Furthermore, creativity does not exist in a vacuum: even those who celebrate the giftedness of eminent creators discount the "myth of the lonesome genius" and acknowledge the infrastructure and social interdependency needed for talent to flourish.

Explicitly or implicitly, the so-called inverted U—in which a median point represents the optimal condition—also shows up frequently, as a way of illustrating that there is a sweet spot for many facets of creativity. For instance, too tame an imagination is dulled by predictability, but too wild an imagination risks incoherence. Finally, though they might disagree on the methods, the majority agree that creativity can be taught. Only Adrian Furnham dissents: "Just as I do not believe that you can train intelligence…so I believe creativity is normally distributed and not particularly prone to change" (p. 90).

A few findings have approached canonical status. J.P. Guilford first coined the term *divergent thinking* (Peel, 1956)--the process of generating multiple alternatives to a creative prompt. Although these authors might place varying amounts of weight on its importance, all would recommend generating a host of solutions rather than grabbing at the first answer. Dean Simonton's equal odds rule—which posits that the *quantity* of a creator's output is the most accurate predictor of the *quality*—is also widely accepted (Simonton, 1996). Or, to quote Maya Angelou, "You can't use up creativity. The more you use, the more you have" (Elliot, 1989, p. x).

Although a perfect definition of creativity has proven to be elusive, most agree that it's not enough for an idea or product to be "novel"—there is another threshold to meet. Mark Runco proposes "effective" (p. 247). Arthur Cropley suggests "useful"(p. 53). Teresa Amabile favors "appropriate" (p.1). As Paul Silvia remarks, "this novel-and-appropriate definition is in all the textbooks and first-paragraphs of articles" (p. 292). He and Robert Weisberg, though, question putting a value judgment on creativity: Weisberg instead prefers to define a creative product as something that is "novel and produced intentionally" (p. 351) .

Beyond these oases of general agreement, however, lie vast plains of exploration. For instance, is creativity domain-general or domain-specific? This is a key question, with implications for testing and education: will an art class help train a more innovative engineer? Cropley believes that it is possible to instill "habits of mind" that are transferable. Guided by the maxim "the best way to learn how to do it is to do it," Joseph Renzulli has mentored teachers and students on core behaviors and strategies that can nurture creativity in "all areas of the curriculum" (p. 214). Others, like Simonton, are not so sure: they point to the fact that creative geniuses are rarely eminent in more than one domain. John Baer writes that divergent thinking skills can be improved through training, but "the effect is very narrow with little or no transfer" (p. 21).

Is there a continuum between everyday creativity and landmark innovation? Weisberg sees indications that "creative advances come about through the thought processes that we all employ every moment of every day…There is no difference between the thought processes underlying the most radical advances and those underlying our ordinary interactions with the world" (p. 371). Others are less convinced. Howard Gardner posits that "creative individuals are characterized less by strength in one intelligence (the so-called expert) and more by the distinctive ways in which they combined two or more intelligences" (p. 99). Furham sees connections between creativity and madness: both creatives and the mentally ill have more porous filters for seemingly irrelevant information, and thus share the "'ability' for more unusual associations between words and ideas compared with 'normals'" (p. 87).

What about the creative process? Like life on this planet, do ideas evolve thanks thanks to blind variation and selective retention? In other words, are our minds an eco-system in which ideas randomly mate and mutate and a few survive? Or, as Thomas Ward argues, does creativity involve structured imagination and controlled thinking—in which our roaming thoughts work more effectively when they are tethered to constraints? You can learn about settled scientific doctrine in a textbook. It is only in a compendium like this that you can witness a field grappling with its unknowns.

Researchers have introduced a host of competing models to explain our species' aptitude for inventiveness. Gardner distinguishes between "Big C Creativity" for epoch-making works and "little-c," for the everyday. What separates Big-C creatives from the rest of us? In addition to their weaving together of multiple intelligences, Gardner cites Big-C creators' fascination with the anomalous, their dedication and perseverance, and the desire to share what they have made.

James C. Kaufman and Ron Beghetto feel Gardner's dual categories are too discontinuous, so they have put forth the 4C model, to which they add "mini-c," which is seed to the sapling of little-c, and pro-C, which acknowledges expertise that has not yet achieved eminence.

To highlight that creativity is as much as social phenomenon as an individual one, Mihaly Czikzentmihalyi has articulated the Systems Model of Creativity: a creator's work in a given domain is evaluated by experts—what Czikzentmihalyi terms the "field"--who determine the work's merits and fate (Czikzentmihalyi & Czikzentmihalyi , 2015). In a related way, Cropley's innovation phase model describes the stages of the creative process, from initial preparation to communication and external validation.

Amabile has put forth the Dynamic Componential Model of Creativity, which is made up of four key components: expertise and skill in one's domain; the requisite personality traits and work habits; task motivation; and a supportive host environment. Todd Lubart's 7C model is even more expansive: it includes creators, creating, collaborations, contexts, creations, consumption, and curricula.

Sternberg takes a different tack: he views creativity as fundamentally as an act of "defiance…against conventional views in favor of a new view" (p. 318). His triangular model distinguishes between "defying the crowd, defying oneself, and defying the Zeitgeist" (p. 296).

To investigate such a broad-based human trait, methodologies encompass lab experiments, field observations, and case studies. To explore "what's old about new ideas," Thomas Ward has asked subjects to invent imaginary sports and animals on other planets. He found a clear trade-off: those who drew more literally on existing archetypes produced products that were less inventive but more practical, whereas those who treated the archetypes more abstractly created works that were more original but less feasible. Sandra Russ sees children's pretend play as a particularly unadulterated way to study the creative process. For another close-up view, as well as to understand group dynamics, Keith Sawyer has documented how theater improvisers interact. Simonton has pioneered the use of historiometric measures: for instance, in one study, he analyzed the reception over time of nearly five hundred operas. His conclusion: cultural reputation is not stable, but varies cyclically (Simonton, 1998).

In one form or another, everyone wrestles with how to measure creativity—and whether that is even objectively possible. Guilford and Torrance developed early approaches. In the Alternative Use Test, subjects were asked to come up with as many uses as possible for a household object such a brick or paper clip. Judges evaluate the respondents according to four criteria: fluency, how many solutions they generated; originality, how uncommon those solutions were; flexibility, how diverse; and elaboration, how well articulated. In the related Consequences Test, subjects are asked to write down all the consequences they can think of an imaginary scenario—for instance, what if everyone went blind or we no longer needed to eat? Runco and Beketayev have recently developed computer software to measure the ideational indicators: after all, originality can be treated as a statistical measure of how rare something is.

Still, many have questioned whether these lab tests, which are often one-size-fits-all and involve anodyne tasks, are the most accurate way to evaluate creative ability. Some have responded by incorporating multiple prompts to evaluate a richer battery of thinking styles. Silvia has found that metaphor-generation is a useful alternative. Others have turned instead to self-reporting,

asking people to track the range and quality of whatever creative activities they engage in. The limitation there is that subjects often inflate their productivity.

In order to assess not only individual differences but how an entire group might be nurtured or stifled in real world settings, Amabile invented the consensual assessment technique (CAT): participants are given a creative task, such as making a collage or writing a story. A jury of experts in that domain rate the creativity of the results: the difference here is that the judges do not have to spell out their reasoning. Amabile writes:

> The assumption underlying CAT is that, although even experts might have difficulty articulating the qualities that lead them to rate one collage more creative than another…they can generally agree with other experts. To the extent that they do agree, these ratings can be considered valid measures of creativity. (p. 4)

Beth Hennessy writes that "more than thirty years of research have, in fact, clearly established that product creativity can be reliably and validly assessed based on the consensus of experts" (p. 114).

Still, creativity testing remains a contentious issue. Furnham writes: "This is for me the crucial issue that is holding researchers back from doing good research in the area….I know of no robust and psychometrically valid tests of any sort that can be claimed to be a good measure"(p. 88). When it comes to giftedness, Renzulli compares "traditionally measured achievement" which tends to "remain constant over time" with task commitment and creativity, which are "not always present or absent" (p. 218) but rather emerge at different times and circumstances for different people, making them harder to assess.

Many of the authors write in personal terms about their life trajectories, describing the unexpected twists and turns that lead to their chosen vocation. Hennessy's chapter is titled "I never intended to be a research psychologist." Rather than going to graduate school, she took a job as an apprentice teacher: observing the relationship between creative play and learning excited her interest in the field. When Joseph Renzulli was a graduate student in psychology, one of his professors asked him to review a manuscript in her stead. The book—Gerzels and Jackson's *Creativity and Intelligence* (1962)—jumpstarted Renzulli's interest in the subject (p. 318). For a long time, the study of creativity was off the beaten track, and few of the pioneers write of being offered much encouragement. Beghetto reports that, during an annual review as an untenured assistant professor of education, he told his chair that he wanted to examine creativity in the classroom. The chair replied, "Creativity is dead," and urged him to stick with "mainstream" topics (p. 33). Simonton describes a virtual obstacle course of impediments. Especially for those who put their careers on the line to pursue an emerging field, it must be rewarding to see a once marginalized research area become so central to our understanding of self.

Scientific inquiry is a collective endeavor, and each chapter is a distinctive weave, as the authors chart not only their own insights but the work that has impacted them. Such is the richness and variety that the reader is often left wanting more. Thankfully, each chapter includes copious citations, with plenty of interesting trails to follow.

Kaufman and Sternberg conclude with a list of thirteen questions for "now and tomorrow." For instance, to what degree is creativity an innate trait (or set of traits) that is largely immutable, versus a state of mind or attitude towards life that can be cultivated and enhanced? Barron once said: "The creative person is both more primitive and more cultivated, more destructive and more constructive, occasionally crazier and yet adamantly saner, than the average person" (p. 231). Czikszentmihalyi has proposed that highly creative people are not distinguished so much by enhanced character traits as by a broad spectrum of possible behaviors: they can both daydream and focus; proliferate and decide; isolate themselves and connect. It is this cognitive flexibility and ability to "switch gears" at will that may be their strongest suit (Czikzentmihalyi, 1996).

At a time when creativity is undervalued in American education, how best to teach creativity remains a touchstone issue. If creativity is primarily a trait, does education have much effect other than identifying and nurturing talent? On the other hand, if creativity is largely a state of mind, what are the creativity "killers" and "boosters"? What is the appropriate mix of incentives? Many of the same issues in the classroom apply to the boardroom. For instance, in brain-storming, is it better to have an "anything goes" attitude or are results improved when teammates are constructively critical?

The lens gets even wider when looking at culture. To what extent and how do different communities, with their distinctive traditions and value systems, guide and condition the creative output of their citizens? If outside judgment is required to assess the value of creative work, who judges the judges?

How creativity changes with age remains one of the least explored issues. Pretend play is a human universal, but what happens as we become adults? How and when is creativity sustained throughout our lifetimes? Does creativity have long-lasting benefits for mental health and well-being? Is it ever too late to try?

Amabile writes, "Every advance in the history of humankind has resulted from creativity, the production of new, appropriate ideas" (p. 1). For Kaufman and Sternberg, "creativity is the only way human beings and our society can make any pretense of 'going forward'" (p. xviii). In a world whose pace seems constantly to be accelerating, as Runco observes, "it allows humans to deal with rapid change" (p. 247). Or, as Ruth Richards and Terri Goslin-Jones put it, "Who is against creativity? It is fun and healthy, we want our own chance, and we want our kids to have it too" (p. 224). Yet while the authors unanimously view creativity as a healthy, necessary part of human experience, Amabile, Cropley, and Sternberg point out that is not moral: it can do harm as well as good. As the technical prowess and global footprint of innovation reach extraordinary heights, to what degree does creativity need to be tempered by ethics? If so, how?

One surprise is that, while the neuroscientific study of creativity is a growing enterprise, there is scarcely a mention of it from this volume's psychologists. For the time being at least, the two means of probing the creative mind—by observing behavior and analyzing brain matter--are operating on separate tracks. Brain imaging is still in its youth, and the restrictions on time and motion in the scanner have presented impediments. But there have been important breakthroughs: most significantly, the discovery that our brains remain plastic throughout our

lifetimes (Doidge, 2007), and that creativity is not localized in one brain region--or even hemisphere--but widely distributed: it is a "whole-brain" phenomenon (Beaty et. al., 2018). With recent advances like mobile EEG caps (Cruz-Garza et. al., 2017), and the anticipation of further technological advances, it's not hard to envision that the next generation of creativity researchers will find ways to link such concepts as functional connectivity and divergent thinking, tying together brain's cross-talk with the mind's imagination.

For the science to continue to flourish, there are impediments that must be overcome. Longitudinal studies are hard to fund and often discouraged, especially for those whose advancement relies on a steady stream of publication. Such an inherently inter-disciplinary field is often held back by the siloed design of institutions of higher learning. And both researchers and their subjects are too culturally uniform: while still a generous sampling, all but three of this book's authors teach at American universities; the remainder are European.

There will be fresh opportunities as well. As the twentieth century edges into the rearview mirror, the rise of mass media, and the more copious preservation of data and cultural artifacts will no doubt give the historiometric methods pioneered by Simonton a boost. Technology offers new capabilities. Already, Lubart and colleagues have designed virtual workplaces: he writes of "results that show the positive impact of putting participants in creative-looking avatars, which boosts performance in idea generation tasks" (p. 140). Computers have been able to invent unexpected strategies for the game Go (Silver et. al., 2016). Who knows to what extent artificial intelligence, neural networks, and deep learning may yield new revelations about the mechanisms of inventiveness?

The editors clearly gave the authors free rein in how to approach their chapters: styles vary from the scholarly to the more discursive. Overall, it makes for compelling reading: everyone has something unique to contribute. For readers wishing to get a grasp of the big questions in creativity research, this is a judicious place to start.

Throughout history, creative inspiration has often been viewed as the province of dreams and the muses, and originality the ineffable product of an individual mind. Collectively, one admires the perseverance, rigor, and creativity of these scientists to bring this most intangible of human mental efforts out into the open.

Even the so-called hard sciences are constantly being remodeled. Who would have thought a few decades ago that we would be studying photographs of a black hole or entertaining serious conversation about multi-verses? Thanks to our abiding curiosity and the on-going labors of human imagination, even the sturdiest of theories are perpetually on the drafting table. It's not surprising that so many questions about something as complex and diverse as creativity remain unresolved. "The Nature of Human Creativity" is a celebration not only of discovery but also of scientific quest--an engaging tour of a field in the midst of fervent investigation and debate.

Anthony Brandt
Chair, Composition and Theory
The Shepherd School of Music
anthonybrandt.net

https://runawayspecies.com
www.musiqahouston.com

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