Chapter 8
Content Matters: Why Nurturing Creativity Is So Different in Different Domains

John Baer

Abstract Creativity brings joy, wonder, efficiency, excitement, and pleasure into our lives. Although creativity can also be malevolent (see, e.g., Cropley et al., Creat Res J 20(2):105–115, 2008), for the most part creativity makes life better, and most of us would like to have and to experience more of it. Nurturing creativity is therefore something that many of us would like to do. We'd like to help our students, our colleagues, our employees (or employers), and of course ourselves be more creative.

Creativity brings joy, wonder, efficiency, excitement, and pleasure into our lives. Although creativity can also be malevolent (see, e.g., Cropley, Kaufman, & Cropley, 2008), for the most part creativity makes life better, and most of us would like to have and to experience more of it. Nurturing creativity is therefore something that many of us would like to do. We'd like to help our students, our colleagues, our employees (or employers), and of course ourselves be more creative.

And we can. Research has shown that many kinds of creativity training can be very successful. Scott, Leritz, and Mumford (2004) conducted a quantitative meta-analysis of creativity training research covering a half century of research on the effectiveness of creativity training. Their review included 70 published and peer-reviewed studies. They reported that "well-designed creativity training programs typically induce gains in performance" and that "more successful programs were likely to focus on development of cognitive skills and the heuristics involved in skill application, using realistic exercises appropriate to the domain at hand." (p. 361). Creativity training works, but note the last few words in the quote: "appropriate to the domain at hand." This, in fact, was their key finding. Creativity training worked when the training and the goals of the training (and the ways the effectiveness was tested) were *in the same domain*. "The most clear-cut finding to emerge in the

J. Baer (✉)
School of Education, Rider University, Lawrence Township, NJ, USA
e-mail: baer@rider.edu

R.A. Beghetto, B. Sriraman (eds.), *Creative Contradictions in Education*,
Creativity Theory and Action in Education 1,
DOI 10.1007/978-3-319-21924-0_8

overall analysis was that the use of domain-based performance exercises was positively related ($r = .31$, $\beta = .35$) to effect size" (p. 380).

Creativity training doesn't lead to an increase in creative performance across the board. It leads to increased creativity of the kind used in the training. If one wants to write more creative poems, one kind of training will work, but if one wants to build more creative structures, another kind of training will work. This effect was shown quite directly in a study (Baer, 1996) in which 157 middle school students had either taken part in a variety of divergent-thinking activities related to poetry-writing creativity, such as brainstorming words that could stand for other words or ideas (metaphor production) and brainstorming words with similar beginning sounds (alliteration) or had simply attended their regular English/language arts classes. The 157 students constituted the entire seventh-grade of a middle school, and the classes that had been randomly selected as the experimental group had the training during their language arts class time. A week later students in all the classes wrote poems and stories as part of their regular language arts class activities (the experimenter was not present and the activities were not linked to the training), and those poems and stories were later judged for creativity by groups of experts who did not know which students were in which group, using Amabile's consensual assessment technique (Amabile, 1982, 1983). The creativity training led to significantly more creative poems, but that same training did *not* lead students to write more creative stories, even though poetry-writing and story-writing are from the same larger domain of writing. This finding indicates that even within what might seem like a domain, smaller, more narrowly focused subdomain or task-specific effects may be quite different. This need for sub-domain specificity to properly gauge the effects of creativity training echoes what Pretz and McCollum (2014) cautioned about the need for extremely domain-specific analyses when looking at research results: "Perhaps prior studies of domain-specific creativity were not specific enough" (p. 233) to uncover effects that more specific assessments might have revealed.

Dow and Mayer (2004) considered another carefully targeted kind of creativity training: how to solve insight problems of different kinds. They addressed the issue of domain specificity/generality very directly:

> The purpose of this research was to investigate whether insight problem solving depends on domain-specific or domain-general problem-solving skills, that is, whether people think in terms of conceptually different types of insight problems. (p. 389)

Their motivation in conducting this research was the fact that creativity training has had a rather spotty record of success—perhaps from a failure to follow Pretz and McCollum's (2014) warning that "prior studies of domain-specific creativity were not specific enough" (p. 233):

> Training of creative problem solving has a somewhat disappointing history, because learning to solve one kind of problem rarely supports solving of other types of problems (Chase & Simon, 1973; Chi, 1978; Mayer, 1996, 2002; Ripple, 1999; Thorndike, 1906). (p. 397)

Dow and Mayer trained subjects to solve either verbal insight problems or spatial insight problems. Their training was successful: subjects receiving the training

improved their skill in solving the kinds of insight problems on which they were trained. They then compared the effects of training on skill in solving the other kind of insight problems (i.e., how well did subjects trained to solve verbal insight problems solve spatial insight problems, and how well did subjects trained to solve spatial insight problems solve verbal insight problems). Their results were "consistent with the domain-specific theory of insight problem solving, namely, the idea that insight problems are not a unitary general category but rather should be thought of as a collection of distinct types of problems" (p. 397). There was no evidence of transfer: subjects' increased ability to solve one kind of insight problem (in comparison to untrained subjects) did not improve their abilities in solving other kinds of insight problems:

> What is learned when someone learns how to solve spatial insight problems? Our research suggests that students learn a general strategy that applies only to a subcategory of insight problems—that is, learning to overcome self-imposed constraints in solving spatial insight problems. We propose that insight problems should not be thought of as a unitary category of problems, but rather as a collection of distinct problem types. The distinguishing feature of each problem type is the general strategy that can be used to solve it. Consistent with theories of transfer based on specific transfer of general strategies (Mayer, 2002; Singley & Anderson, 1989), when one learns how to solve spatial insight problems one learns a general strategy that applies to other spatial insight problems but not to mathematical or verbal problems. What enables transfer is that the to-be-solved problem requires the same general solution strategy as a source problem that the learner already knows how to solve. (p. 391)

Not only does training in solving one kind of insight problem solving not transfer to other kinds of insight problem solving, but recent research argues that insight problem solving may have very little in common with real-world creative behavior. Beaty, Nusbaum, and Silvia (2014) looked at the correlations between success at solving two classic insight problems and real-world creative achievement and concluded that there was "no evidence for a relationship between insight problem solving behavior and creative behavior and achievement" (p. 287). Insight problem solving, they concluded, was a discrete domain of creativity that was unrelated to other kinds of creativity. Dow and Mayer's (2004) study showed that even within the domain of insight problem solving, further domain specificity was called for, in line with Pretz and McCollum's (2014) suggestion that micro-domain or task-specific analyses might be needed to ferret out the true impact of creativity training.

For those who have followed the debate about domain specificity and creativity, these findings should not be surprising. Although creativity was once generally thought of as a domain-general kind of trait—so that if a person was highly creative in one kind of activity it could be assumed that, other things being equal (such as access to the kinds of materials and specialized training that might be needed in some domains), that person would tend to be more creative, on average, than others in all or at least most activities—that view has undergone a radical shift. In the only Point-Counterpoint debate that the *Creativity Research Journal* has ever published (now almost two decades ago), the topic was domain specificity, and even the

debater arguing for domain generality acknowledged at the outset that history had not been kind to his point of view:

> Recent observers of the theoretical (Csikszentmihalyi, 1988) and empirical (Gardner, 1993; Runco, 1989; Sternberg & Lubart, 1995) creativity literature could reasonably assume that the debate is settled in favor of content specificity. In fact, Baer (1994a, 1994b, 1994c) provided convincing evidence that creativity is not only content specific but is also task specific within content areas. (Plucker, 1998, p. 179)

This shift has been caused by an avalanche of research looking at actual creative performance (see Baer, 1998b, 2010, 2013, 2016 for summaries of this research) rather than such things as creativity test scores, which assume domain generality,[1] or self-assessment of creativity, which have serious validity problems—but even such self-assessments show evidence of domain specificity; see, e.g., Brown, 1989; Dollinger, Burke, & Gump, 2007; Kaufman, Evans, & Baer, 2010; Pretz & McCollum, 2014; Reiter-Palmon, Robinson, Kaufman, & Santo, 2012; Rowe, 1997; Silvia, Wigert, Reiter-Palmon, & Kaufman, 2012).

The fact that creativity is very domain specific—and that being creativity in one domain tells us nothing about creativity in other, unrelated domains—does not mean that polymaths can't exist. In fact, domain specificity predicts the existence of polymaths. It just says they should be fairly rare. Zero correlations don't mean things cannot go together; lack of correlation simply means that there is no consistent pattern that links two variables. They may or may not co-occur, they just don't do so consistently. Guitar-playing skill, the ability to read Latin, height, and living in Ohio are (I assume) pretty much unrelated things. One would not assume because someone can play guitar well that she can (or cannot) read Latin, that she is either tall or short, or that she lives in any particular state. But that does not mean there are no tall guitar-playing Ohioans who can read Latin. Lack of correlation doesn't mean things can't go together, only that there is no reason to expect it. So it is for creativity in diverse domains. The fact that a person is a creative chef tells us nothing about that person's poetry-writing creativity, her mathematical creativity, or her engineering creativity, but that doesn't mean she cannot be highly creative in all four domains.

If we want to nurture creativity in diverse domains (such as the four just listed, cooking, poetry, engineering, and math), we can't simply nurture creativity in general and expect creativity in all domains to increase. Just as we can't teach

[1] It is interesting that when creativity tests do identify particular domains, even though claiming to be domain-general tests, they inadvertently offer strong evidence of domain specificity. The most widely used tests of creativity are the Torrance Tests of Creative Thinking (Kim, 2011a, 2011b, 2011c; Long, 2014; Torrance & Presbury, 1984), which come in two forms, verbal and figural. Both measure divergent thinking, but do so in different domains. (Divergent thinking is hypothesized to be a contributor to creative thinking, which is how a test of divergent thinking gets to call itself a test of creativity.) Torrance himself found that these two tests were almost completely orthogonal, correlating at the level of .06 (Cramond, Matthews-Morgan, Bandalos, & Zuo, 2005). This means there was almost no shared variance at all—or, put another way, that the two tests of creativity were measuring two discrete, unrelated skills.

domain-general content knowledge (it's hard to envision what that would be), we can't teach domain-general creative-thinking skills.

And creativity isn't the only kind of thinking skill that is domain specific. Without wading into arguments about general intelligence (*g*) and IQ testing,[2] consider the kinds of thinking skills that have come to be known as "higher-order" thinking skills, following Bloom's Taxonomy of the Cognitive Domain (Bloom, Englehart, Frost, Hill, & Krathwohl, 1956). I worked in a school long ago that had a "Higher-Order Thinking Skills Lab"—really, there was a room that had a sign that said that over the door!—where students were to be taught application, analysis, synthesis, and evaluation skills. The trouble was, that's impossible, at least as domain-general skills that can be applied and transferred across domains. Those skills are important, but what they mean, and the actual cognitive skills they require, vary by domain and task. There are no domain-general, decontextualized thinking skills, only domain- and content-specific thinking skills (2006; Baer, 1993; Kaufman & Baer, 2005; Owen et al., 2010; Redick et al., 2013; Thompson et al., 2013; Willingham, 2007, 2008).

Consider dissection, which is a kind of analysis. Being able to dissect a frog, dissect an argument, dissect a triangle, and dissect a villanelle are all wonderful skills, but they are unrelated skills that share a generic name and little else (and the fact that a student can do any one of these tells one nothing about her ability to do any of the others). Ditto for being able to synthesize chemicals, synthesize musical sounds, synthesize columns of data, or synthesize two philosophical arguments. Cognitive skills at the level discussed by Bloom are remarkably domain- and content-specific.

The appeal of domain-general conceptions of thinking skills (including creativity-relevant thinking skills) is obvious: teach one set of skills and students could use them everywhere. This is certainly the appeal of brain-training programs like Luminosity, Jungle Memory, and CogniFit (Day, 2013), even though there is no evidence supporting such cross-domain transfer (Katsnelson, 2010; Owen et al., 2010; Redick et al., 2013). As Owen et al summarized:

> 'Brain training', or the goal of improved cognitive function through the regular use of computerized tests, is a multimillion-pound industry, yet in our view scientific evidence to support its efficacy is lacking. Modest effects have been reported in some studies of older individuals and preschool children, and video-game players outperform non-players on some tests of visual attention. However, the widely held belief that commercially available computerized brain-training programs improve general cognitive function in the wider population in our opinion lacks empirical support. The central question is not whether performance on cognitive tests can be improved by training, but rather, whether those benefits transfer to other untrained tasks or lead to any general improvement in the level of cognitive functioning. . . Although improvements were observed in every one of the cognitive tasks that were trained, no evidence was found for transfer effects to untrained tasks, even when those tasks were cognitively closely related. (p. 775)

[2] There seems to be evidence that *g* and its metric, IQ scores, are related to performance in diverse domains (Neisser et al., 1996), but what those positive correlations mean is open to interpretation.

What does domain specificity mean for creativity training? Consider, by analogy, how one increases muscle strength. The kinds of exercises a body builder employs vary depending on the target muscles. Crunches will strengthen abdominal muscles but do little for biceps; if what one wants is big, Popeye-like biceps, crunches simply won't help much. (In contrast, for six-pack abs, crunches may be very effective, although I haven't personally tested this hypothesis.) And if one wants overall muscular strength, doing endless reps of the same exercise—whether one chooses crunches, pull-ups, curls, or some other exercise—is not the way to go. One needs to exercise all of one's muscle groups. One needs very muscle-group-specific exercises (recognizing that some exercises will involve more than a single muscle group, or course) to strengthen one's many muscles.

The idea that one could build muscular strength by focusing on only a single muscle and then expecting transfer is ludicrous. Equally foolish is the idea that one can exercise one's creativity thinking in a single domain and expect it to transfer to all other domains.

One more analogy: expertise. Expertise is very domain specific. To become an expert, one needs to study or work in a domain (usually for a rather long time, although that varies by domain), and there is little reason to expect that one's hard work acquiring expertise in a given domain will transfer readily to other domains. Everyone rightly values interdisciplinary thinking, but interdisciplinary thinking requires disciplinary knowledge in more than one domain. It does not mean thinking that ignores disciplines. One may sometimes be able to combine expertise in several domains to solve problems in an interdisciplinary way, but to do so one first needs disciplinary expertise. There is simply no such thing as domain-general expertise, and therefore no short-cut that would let one acquire expertise in all domains by learning expertise as a content-free, domain-general kind of cognitive skill (Baer in press).

That doesn't mean one cannot develop, employ, and strengthen expertise in multiple areas as part of a single interdisciplinary activity (which, as the name implies, will call on domain-specific knowledge or skill in more than one domain). To take the simplest kind of example, a math word problem will require both reading and math skills and may well help develop skills in both domains, but working on that word problem will probably have no impact on one's singing, mountain-climbing, or woodworking skills unless the problem directly involved one of those domains. It is possible to design activities that will call upon a wide range of skills and require content knowledge from diverse domains, but those skills and that content knowledge remain domain specific (just as salt and pepper are difference spices, even though one might use them together in the same recipe).

So how do we go about creativity training now that we understand the domain specificity of creativity? First and foremost, *content matters*. If creativity were domain general, then it wouldn't matter what kinds of creativity training exercises one did. That would be like having a single muscle that one could exercise and become strong in all ways. But research has shown us that this doesn't work and that domain-specific exercises are needed. Because creativity is domain specific, creativity training is like developing expertise, which must be done domain by

domain (even though sometimes we can work on a few domains at the same time, as in the word problem example above), and like developing physical strength, which must be done muscle group by muscle group (even though some kinds of exercises might work on two or more muscle groups through a single activity). If one's interest is only on nurturing creativity in a single domain (as in the poetry-specific training study discussed above; Baer, 1996), then choosing all exercises from a single domain makes sense. If one's goal is to enhance creativity in many domains, however, then the content and focus of one's creativity-training exercises need to come from a wide variety of domains.

The most widely taught and practiced skill (actually a very diverse collection of skills) in creativity-training programs is divergent thinking, but divergent thinking is not a single thinking skill that one can simply call up like a computer-programming subroutine and use in any domain. The term "divergent thinking" describes many completely different thinking skills that only seem similar from the outside while on the inside (as cognitive processes) the various cognitively discrete and functionally unrelated skills may have little or no connection or overlap.

That doesn't mean the label "divergent thinking" is without value, just as the labels "red," "games," and "expertise" have value, even though the set of all things red, the set of all games, and the set of all kinds of expertise will each include an incredibly diverse collection of things or ideas. Consider the term "expertise," which can usefully describe a wide range of totally unrelated sets of skills and knowledge (such that expertise in red wines and expertise in accounting can both be described by the term "expertise" but have no overlapping content whatsoever—or at least I hope not when my accountant is doing my taxes). Similarly, the term "divergent thinking" can be used to lump together many totally unrelated sets of skills, each applicable only in its respective domain.

If divergent thinking were just one, domain-general skill, it would certainly make creativity training easier. Teach students that skill and they could apply it when working on any problem, no matter the discipline or content. But we know that's not how divergent thinking and creativity work. Thinking of unusual uses for a brick, unusual ways to decorate a theatrical set, and unusual metaphors for beauty are different kinds of thinking, just as the trapezius and the quadrilaterals are different muscles one might work to strengthen and red wines and accounting are different domains in which one might acquire expertise. Having a general concept called "divergent thinking" can be helpful because (like expertise) the general concept of divergent thinking may point us to some very domain-specific skills that we might want to develop in a particular domain to promote more creative thinking in that domain (as in the poetry-specific divergent-thinking training study discussed earlier). This is true even though the skills that constitute divergent thinking in one domain are most often completely different from the skills important for creativity in any other domain (and therefore require entirely different kinds of training, just as acquiring expertise in different domains requires different kinds of study or practice). But it's important to remember when we categorize things in this way that calling things by the same name does not make them the same.

So if one's goal is to improve divergent thinking in a single domain one should use exercises that relate to that one domain, but if one's goal—as is more common—is to nurture creativity in many domains, then the divergent-thinking exercises one uses must come from a wide range of domains.

Creativity training isn't limited to divergent-thinking training, of course, but the same kind of domain-specific thinking should guide any creativity-training program. Consider what we know about attitudes related to creativity. There is evidence that intrinsic motivation leads to higher levels of creativity than extrinsic motivation, which tends to both drive out intrinsic motivation and lessen creativity (Amabile, 1983, 1996).[3] Programs have been developed to inoculate students against the impact of extrinsic constraints or to increase their intrinsic motivation, with generally positive but also somewhat mixed results (Baer, 1997a; Baer & Kaufman, 2012; Cooper, Clasen, Silva-Jalonen, & Butler, 1999; Gerrard, Poteat, & Ironsmith, 1996; Hennessey, 1995; Hennessey & Zbikowski, 1993). But there is an inherent problem with such training, which could account for the rather mixed results. Like divergent thinking, intrinsic motivation is not a single, domain-general thing. It is a wide variety of totally unrelated things that have a single similarity (rather like the set of all things that include the color red). A person's level of interest in the field of anatomy, for example, tells us nothing about her interest in the fields of alchemy, algebra, aviation, or art, and the same personal satisfaction that might drive someone to create a beautiful work of art might not be at all motivating when it's time to solve an algebraic equation. What we call intrinsic motivation describes many completely different kinds of motivation, and one cannot build intrinsic motivation across the board, in a domain-general way. As with teaching divergent-thinking skills, one must build intrinsic motivation domain by domain.

Is there nothing that one can teach about creativity that is domain general? Assuming that there are some things, like divergent thinking and intrinsic motivation, that although varying by domain are nonetheless valuable in all domains,[4] then there is perhaps some value in sharing those insights. It might be useful to learn, for

[3] There is an on-going dispute about the impact of extrinsic motivators like rewards and anticipated evaluations on creativity (Baer, 1997b, 1998a; Conti, Collins, & Picariello, 2001; Eisenberger & Cameron, 1996; Eisenberger & Rhoades, 2001; Eisenberger & Shanock, 2003), and it is not yet clear how this dispute may be resolve. I have suggested elsewhere (e.g., Baer, 2016) that the contradictory data that has been produced may in fact result from a failure to take domain specificity into account (because extrinsic motivation may be detrimental in some domains and beneficial in others). For the purposes of this chapter, I am simply using intrinsic motivation as an example of how domain specificity should influence creativity training, regardless of the type of training (e.g., skill development, attitude change, knowledge acquisition, etc.).

[4] It is important to note that this is only an assumption. The impact of extrinsic constraints might vary by domains, as discussed in the previous footnote, and there may be domains in which divergent thinking promotes creativity and domains in which it does not. If this turns out to be the case for divergent thinking, it might help explain recent research that questions the power of brainstorming to enhance creativity (Diehl & Stroebe, 1991; Mullen, Johnson, & Salas, 1991; Nijstad, Stroebe, & Lodewijkx, 2003; Rickards, 1999). Different findings regarding brainstorming's impact may reflect domain-based differences, with divergent thinking being helpful in some domains but not helpful in others. This is an open question awaiting carefully designed research.

example, that in the early stages of idea generation is it helpful (a) to avoid thinking about how those ideas might be viewed by others (i.e., it might be wise to avoid imposing extrinsic motivation on one's self) and (b) to generate as many ideas as one can (i.e., it might be advantageous to try brainstorming or some other technique to promote divergent thinking). But neither of those is the same as working (c) to develop the skill of divergent thinking in a domain or (d) to nurture intrinsic motivation in a domain. The latter two approaches, like (almost) all of creativity training, need to be done on a domain-by-domain basis.

Creativity training can be fun, but to do creativity training well takes time and, sometimes, a lot of hard work. There are no quick, domain-general tricks, and even when done thoughtfully there is no guarantee that any kind of training will result in brilliantly creative ideas. Fortunately, the joy of thinking creatively (and of *sometimes* producing creative results!) are well worth both the time and the effort.

References

Amabile, T. M. (1982). Social psychology of creativity: A consensual assessment technique. *Journal of Personality and Social Psychology, 43*, 997–1013.

Amabile, T. M. (1983). *The social psychology of creativity*. New York: Springer.

Amabile, T. M. (1996). *Creativity in context: Update to the social psychology of creativity*. Boulder, CO: Westview.

Baer, J. (2016). *Domain specificity and creativity.* San Diego, CA: Elsevier.

Baer, J. (in press). The importance of domain specific expertise in creativity. *Roeper Review.*

Baer, J. (1993). *Creativity and divergent thinking: A task-specific approach*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Baer, J. (1994a). Divergent thinking is not a general trait: A multi-domain training experiment. *Creativity Research Journal, 7*, 35–46.

Baer, J. (1994b). Generality of creativity across performance domains: A replication. *Perceptual and Motor Skills, 79*, 1217–1218.

Baer, J. (1994c). Performance assessments of creativity: Do they have long-term stability? *Roeper Review, 7*(1), 7–11.

Baer, J. (1996). The effects of task-specific divergent-thinking training. *Journal of Creative Behavior, 30*, 183–187.

Baer, J. (1997a). *Creative teachers, creative students*. Boston: Allyn and Bacon.

Baer, J. (1997b). Gender differences in the effects of anticipated evaluation on creativity. *Creativity Research Journal, 10*, 25–31.

Baer, J. (1998a). Gender differences in the effects of extrinsic motivation on creativity. *Journal of Creative Behavior, 32*, 18–37.

Baer, J. (1998b). The case for domain specificity in creativity. *Creativity Research Journal, 11*, 173–177.

Baer, J. (2010). Is creativity domain specific? In J. C. Kaufman & R. J. Sternberg (Eds.), *Cambridge handbook of creativity* (pp. 321–341). Cambridge, MA: Cambridge University Press.

Baer, J. (2013). Domain specificity and the limits of creativity theory. *Journal of Creative Behavior, 46*, 16–29.

Baer, J., & Kaufman, J. C. (2012). *Being creative inside and outside the classroom*. Rotterdam, The Netherlands: Sense Publishers.

Beaty, R. E., Nusbaum, E. C., & Silvia, P. J. (2014). Does insight problem solving predict real-world creativity? *Psychology of Aesthetics, Creativity, and the Arts*, *8*(3), 287.

Bloom, B. S., Englehart, M. D., Frost, E. J., Hill, H. W., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain*. New York: David McKay.

Brown, R. T. (1989). Creativity: What are we to measure? In J. A. Glover, R. R. Ronning, & C. R. Reynolds (Eds.), *Handbook of creativity* (pp. 3–32). New York: Plenum.

Chase, W. G., & Simon, H. A. (1973). The mind's eye in chess. In W. G. Chase (Ed.), *Visual information processing* (pp. 215–281). New York: Academic Press.

Chi, M. T. H. (1978). Knowledge structure and memory development. In R. S. Siegler (Ed.), *Children's thinking: What develops?* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Conti, R., Collins, M. A., & Picariello, M. L. (2001). The impact of competition on intrinsic motivation and creativity: Considering gender, gender segregation and gender role orientation. *Personality and Individual Differences, 31*(8), 1273–1289.

Cooper, B. L., Clasen, P., Silva-Jalonen, D. E., & Butler, M. C. (1999). Creative performance on an in-basket exercise: Effects of inoculation against extrinsic reward. *Journal of Managerial Psychology, 14*(1), 39–57.

Cramond, B., Matthews-Morgan, J., Bandalos, D., & Zuo, L. (2005). A report on the 40-year follow-up of the Torrance tests of creative thinking. *Gifted Child Quarterly, 49*, 283–291.

Cropley, D. H., Kaufman, J. C., & Cropley, A. J. (2008). Malevolent creativity: A functional model of creativity in terrorism and crime. *Creativity Research Journal, 20*(2), 105–115.

Csikszentmihalyi, M. (1988). Society, culture, and person: A systems view of creativity. In R. J. Sternberg (Ed.), *The nature of creativity: Contemporary psychological perspectives* (pp. 325–339). New York: Cambridge University Press.

Day, E. (2013). Online brain-training: does it really work? *The Guardian*, April 20, 2013. Retrieved online January 11, 2014 at http://www.theguardian.com/science/2013/apr/21/brain-training-online-neuroscience-elizabeth-day

Diehl, M., & Stroebe, W. (1991). Productivity loss in idea-generating groups: Tracking down the blocking effect. *Journal of Personality and Social Psychology, 61*, 392–403.

Dollinger, S. J., Burke, P. A., & Gump, N. W. (2007). Creativity and values. *Creativity Research Journal, 19*, 91–103.

Dow, G. T., & Mayer, R. E. (2004). Teaching students to solve insight problems: Evidence for domain specificity in creativity training. *Creativity Research Journal, 16*(4), 389–398.

Eisenberger, R., & Cameron, J. (1996). Detrimental effects of reward: Reality or myth? *American Psychologist, 51*, 1153–1166.

Eisenberger, R., & Rhoades, L. (2001). Incremental effects of reward on creativity. *Journal of Personality and Social Psychology, 81*(4), 728.

Eisenberger, R., & Shanock, L. (2003). Rewards, intrinsic motivation, and creativity: A case study of conceptual and methodological isolation. *Creativity Research Journal, 15*, 121–130.

Gardner, H. (1993). *Creating minds*. New York: Basic Books.

Gerrard, L. E., Poteat, G. M., & Ironsmith, M. (1996). Promoting children's creativity: Effects of competition, self-esteem, and immunization. *Creativity Research Journal, 9*, 339–346.

Hennessey, B. A. (1995). Social, environmental, and developmental issues and creativity. *Educational Psychology Review, 7*(2), 163–183.

Hennessey, B. A., & Zbikowski, S. M. (1993). Immunizing children against the negative effects of reward: A further examination of intrinsic motivation training techniques. *Creativity Research Journal, 6*(3), 297–307.

Katsnelson, A. (2010). No gain from brain training. *Nature News, 464*(7292), 1111.

Kaufman, J. C., & Baer, J. (Eds.). (2006). *Reason and creativity in development*. New York: Cambridge University Press.

Kaufman, J. C., & Baer, J. (Eds.). (2005). *Creativity across domains: Faces of the muse*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Kaufman, J. C., Evans, M. L., & Baer, J. (2010). The American Idol Effect: Are students good judges of their creativity across domains? *Empirical Studies of the Arts, 28*, 3–17.

Kim, K. H. (2011a). Proven reliability and validity of the Torrance Tests of Creative Thinking (TTCT). *Psychology of Aesthetics, Creativity, and the Arts, 5*, 314–315.
Kim, K. H. (2011b). The APA 2009 division 10 debate: Are the Torrance tests still relevant in the 21st century? *Psychology of Aesthetics, Creativity, and the Arts, 5*, 302–308.
Kim, K. H. (2011c). The creativity crisis: The decrease in creative thinking scores on the Torrance Tests of Creative Thinking. *Creativity Research Journal, 23*, 285–295.
Long, H. (2014). Empirical review of research methodologies and methods in creativity studies. *Creativity Research Journal, 26*, 427–438.
Mayer, R. E. (1996). Problem solving: Teaching and assessing. In E. De Corte & F. Weinert (Eds.), *International encyclopedia of developmental and instructional psychology* (pp. 555–558). Oxford, UK: Elsevier Science Publishers.
Mayer, R. E. (2002). *The promise of educational psychology, Volume II: Teaching for meaningful learning*. Upper Saddle River, NJ: Prentice Hall.
Mullen, B., Johnson, C., & Salas, E. (1991). Productivity loss in brainstorming groups: A meta-analytic integration. *Basic and Applied Social Psychology, 12*, 3–23.
Neisser, U., Boodoo, G., Bouchard, T. J., Boykin, A. W., Brody, N., Ceci, S. J., …, & Urbina, S. (1996). Intelligence: Knowns and unknowns. *American Psychologist, 51*, 77–101.
Nijstad, B. A., Stroebe, W., & Lodewijkx, H. F. M. (2003). Production blocking and idea generation: Does blocking interfere with cognitive processes? *Journal of Experimental Social Psychology, 39*, 531–548.
Owen, A. M., Hampshire, A., Grahn, J. A., Stenton, R., Dajani, S., Burns, A. S., …, & Ballard, C. G. (2010). Putting brain training to the test. *Nature*, *465*(7299), 775–778.
Plucker, J. A. (1998). Beware of simple conclusions: The case for the content generality of creativity. *Creativity Research Journal, 11*, 179–182.
Pretz, J. E., & McCollum, V. A. (2014). Self-perceptions of creativity do not always reflect actual creative performance. *Psychology of Aesthetics, Creativity, and the Arts, 8*, 227.
Redick, T. S., Shipstead, Z., Harrison, T. L., Hicks, K. L., Fried, D. E., Hambrick, D. Z., …, & Engle, R. W. (2013). No evidence of intelligence improvement after working memory training: a randomized, placebo-controlled study. *Journal of Experimental Psychology: General*, *142*(2), 359.
Reiter-Palmon, R., Robinson, E., Kaufman, J., & Santo, J. (2012). Evaluation of self-perceptions of creativity: Is it a useful criterion. *Creativity Research Journal, 24*, 107–114.
Rickards, T. (1999). Brainstorming. In M. Runco & S. Pritzker (Eds.), *Encyclopedia of creativity* (Vol. 1, pp. 219–228). San Diego, CA: Academic Press.
Ripple, R. E. (1999). Teaching creativity. In M. A. Runco & S. R. Pritzker (Eds.), *Encyclopedia of creativity* (Vol. 2, pp. 629–638). San Diego, CA: Academic Press.
Rowe, P. (1997). The science of self-report. *APS Observer, 10*(3), 35–38.
Runco, M. A. (1989). The creativity of children's art. *Child Study Journal, 19*, 177–190.
Scott, G., Leritz, L. E., & Mumford, M. D. (2004). The effectiveness of creativity training: A quantitative review. *Creativity Research Journal, 16*(4), 361–388.
Silvia, P. J., Wigert, B., Reiter-Palmon, R., & Kaufman, J. C. (2012). Assessing creativity with self-report scales: A review and empirical evaluation. *The Psychology of Aesthetics, Creativity, and the Arts, 6*, 19–34.
Singley, M. K., & Anderson, J. R. (1989). *The transfer of cognitive skill*. Cambridge, MA: Harvard University Press.
Sternberg, R. J., & Lubart, T. I. (1995). *Defying the crowd. Cultivating creativity in a culture of conformity*. New York: Free Press.
Thompson, T. W., Waskom, M. L., Garel, K. L. A., Cardenas-Iniguez, C., Reynolds, G. O., Winter, R., …, & Gabrieli, J. D. E. (2013). Failure of working memory training to enhance cognition or intelligence. *PloS One*, *8*(5), e63614. Retrieved online January 10, 2014, at http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0063614.
Thorndike, E. L. (1906). *Principles of teaching*. New York: Lemket and Buechner.

Torrance, E. P., & Presbury, J. (1984). The criteria of success used in 242 recent experimental studies of creativity. *Creative Child & Adult Quarterly, 9*, 238–243.
Willingham, D. T. (2007, Summer). Critical thinking. *American Educator, 8–19.*
Willingham, D. T. (2008). Critical thinking: Why is it so hard to teach? *Arts Education Policy Review, 109*(4), 21–32.