

АКТУАЛЬНЫЕ НАПРАВЛЕНИЯ ИССЛЕДОВАНИЙ ТВОРЧЕСКИХ ПРОЦЕССОВ

CREATIVITY AND CONVERGENT THINKING: REFLECTIONS, CONNECTIONS AND PRACTICAL CONSIDERATIONS

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Creativity is conceived as the ability to generate new, original ideas that are meaningful and valuable in their context. Models have often debated the role of divergent and convergent thinking within creativity. This paper focuses on convergent thinking and examines ways that it has been conceptualized and operationalized. It is noted that some of these conceptualizations fit more than others with creative thinking. Finally, examples of new ways to measure convergent thinking for creativity are presented and explained. The *Evaluation of Potential Creativity* (EpoC) battery is described as a relevant new tool to assess convergent thinking, with a focus on the integrative, original synthesis, which is ultimately essential to the creative process, and the potential for resulting creative productions. Implications for measuring creativity and education are discussed.

Key words: Creativity, divergent thinking, convergent thinking, integration, measurement

Creativity refers to the ability to generate new, original work that is meaningful in its context [10; 27]. Creativity is receiving increasing attention in the 21st century. Societal challenges, including new social, environmental, economic problems call for imagination and fresh ideas. In addition, many routine intellectual tasks can be automatized using computers. Given these long-term trends, international bodies such as the Organization for Economic Cooperation and Development (OECD) have begun large-scale studies of ways that creativity can be fostered in schools. The World Economic Forum lists creativity as a top ability for employability in the next decades. The 21st-century school movement has identified creativity as one of four key abilities to be fostered throughout education.

Creativity is most often associated with great contributions by artists, writers, musicians, scientists, or inventors. When the word “creativity” is cited, people such as Van Gogh, Dostoevsky, or Einstein come to mind. However, creativity is neither limited to the great

cases nor the prototypical “arts and sciences“ domains of contribution. Consider now the different types of creative contributions and then the extent to which creativity can occur in many different domains.

Beghetto and Kaufman [1] have distinguished four “levels’ of creative activity”. The first kind of creativity is “mini-c”, which refers to creative thinking at the most personal level. An example is making a personal drawing, for oneself, which is original and meaningful to express and make sense of a person’s feelings on a topic. This drawing may be similar to other people’s work, or even a re-invention of some previously existing work by others, but it is original for the person who made it, authentic and meaningful in their own life context. The second kind of creativity is “little-c”. This refers to small, local creations in diverse everyday contexts. These contributions can be compared to those of peers in the same situations. For example, if a person wants to make a dinner and must use the available ingredients in the kitchen, which do not correspond to any known recipe, this could involve little-c, and will be recognized and appreciated by others who taste the novel dish. The third kind of creativity is called “Pro-C” because it refers to productions in a professional domain, or job setting. Those who are professional writers will hope that their work is recognized as creative by other writers, critics and editors in the literary world as well as praised by the general public. The same logic can be applied to engineers, designers or inventors who propose new products that are original and valuable or useful. Finally, a fourth C can be distinguished; it is “Big-C” or eminent creativity, in which a creative contribution, usually in a professional domain, receives large-scale recognition, by domain specialists and the public, perhaps contributing to a paradigm-shift in people’s way of thinking or acting in a domain. Einstein’s contribution to physics epitomizes this “Big-C” creativity, which is an extended version of “pro-C” creativity.

In addition to the kinds of creative contributions, it is important to note that creativity can be expressed in nearly every sector of activity. Some tasks or domains lend themselves naturally to creative work. Examples are work in the visual arts, drawing or painting (beyond simple copying), literary composition (such as inventing stories, novels or poetry), musical composition, scientific theory-building or inventing experimental methods. These are sometimes called “creative jobs” or “creative fields” because the day-to-day work involves being creative. Beyond the most historically classic domains, it is now widely recognized that creativity is central to many, various sectors, such as advertising (those who invent new ad campaigns are called the “creatives”), or entrepreneurs who bring economic actors together and create new businesses, adding value to the marketplace, with new products or services.

In some fields, creativity is less central, but still is an important additional component to success (although it is not necessarily solicited on a daily basis). For example, managers need sometimes to find new, original solutions to workplace problems. However, they often are engaged in classic management tasks of such as organizing a team, optimizing performance, following projects over time. In the culinary world, professional chefs are mainly involved in preparing known recipes with expertise and craftsmanship. They do, however, need to sometimes employ their creative talent to invent new recipes or face unexpected situations with missing ingredients or other technical constraints.

Finally, in some types of activity, creativity is a rarely needed but highly valued in those extraordinary cases. For example, an airplane pilot learns to master a complex set of rules and regulations which need to be followed carefully for safety reasons. There are, however, some very unpredictable, complex combinations of circumstances, such as extreme weather and equipment failure at the same time that lead to necessary improvisation even in a highly controlled activity. In these cases, some creative thinking can mean the difference between life and death.

Regardless of the field of creative endeavor, or the type of contribution ranging from mini-c to Big-C, creative work involves a sequence of thoughts and actions that can be called the “creative process” [11]. Creative productions in a domain-specific context do not emerge spontaneously. Although it may sometimes seem that an idea appears suddenly, with no prior thought or work, it is commonly accepted that a chain of events and thoughts, which may have been unconscious, led to the emergent idea.

Since the seminal work of J.P. Guilford [4], in the mid 20th century, the creative process has been conceptualized based on two information processing modes [18]. They are divergent thinking and convergent thinking. Divergent thinking refers to the ability to explore in multiple, diverse directions a thought space, based on an initial problem or reference point. Convergent thinking is most often described in opposite terms, as the ability to hone in on one idea, one answer that best fits the constraints of a task. According to many authors, in particular those in the creative problem solving (CPS) tradition, which was developed based on Guilford’s work, both divergent and convergent phases are part of an overall creative process [8]. There is a cyclic movement between these two kinds of processing.

As an illustration of divergent thinking, in one classic task proposed by Guilford [4], Torrance [31] and other authors, people are asked to think of all the ways to use a common object, such as a cardboard box. Those who are very capable of engaging divergent thinking will generate many ideas, from many categories of use, and will tend to have some percentage of ideas that are statistically rare and original compared to other people’s ideas. Thus, people may start by producing ideas about storing diverse objects in boxes (papers, books, pencils, clothing, ..) but could move to other kinds of uses, such as artistic uses (a surface for painting, cutting the box for shapes, etc.), or using the box for games or toy play. Finally, the box may be used to heat a room by burning it, or used as insulation to prevent heat from escaping through a window in a house. This divergent thinking mode has obvious value for finding original ideas on a topic, because it involves an expanded search space, and finding associations with other cognitive fields that may be remote from the initial box concept and its’ standard uses. Thus, divergent thinking is expansive, and exploratory. Producing many ideas is a hallmark of divergent thinking, and fluency is correlated strongly and positively with flexibility (number of categories of ideas) and the tendency to find rare, original ideas.

Moving on to convergent thinking, the situation becomes somewhat more complex. Indeed, Guilford’s work did not only examine creative thinking. He proposed a more general model of human abilities and intelligence, called the structure of intellect model (SOI) [5; 6]. In this framework, convergent thinking was often showcased in tasks that required finding the one best response, and it was usually a common reply that all

“intelligent” people could find if they took into account the constraints in each problem situation. For example, in a reasoning problem, if a series of pictures is presented with a first image of a circle, followed by the image of a smaller circle, and then a third image of yet smaller circle, the next image in the series would be logically, an even smaller circle. Providing this answer would show evidence of a person’s convergent thinking ability. Thus, convergent thinking was often operationalized in a restrictive way, focusing on getting one, correct answer, which is the opposite of divergent thinking. Convergent thinking became rapidly associated with « regular » intelligence, as measured by IQ tests. “Intelligence” conceived as convergent thinking with one right answer was compared and contrasted with creativity, conceived as divergent thinking. However, this is an obvious simplification of reality, and it can be argued a distortion of the initial more complex concepts [7; 12].

Based on Osborn’s [20] “brainstorming” approach to creative idea generation, the literature on convergent thinking developed further with the work of authors such as Parnes, Treffinger and Isaksen in the Creative Problem Solving tradition, who argued for the importance of convergent thinking for creativity [21; 8; 32]. In this context, the creative process was organized into phases, and both divergent and convergent thinking play a role in each phase. The phases were essentially (a) problem definition and formulation, (b) generating new ideas, and (c) refining and developing the solutions. To summarize and simplify greatly more than a half-century of work, divergent thinking led to many ideas and convergent thinking facilitated evaluating and selecting ideas. Convergent thinking involved deciding on criteria, constraints and opportunities offered through divergence [2; 25; 28]. Thus, there was an emphasis on identifying and refining the best “gems” to converge on a small set or best idea to be pursued. In this tradition, convergent thinking is relevant and integral to a full-fledged creative process. Convergent thinking is not however imaginative and generative in the same way as divergent thinking. In an alternative line of work on creativity, the creative cognition approach, a distinction is made between “generation” and “exploration” of new ideas, leading to finalized creative productions [3; 29]. This is somewhat similar to the creative problem solving approach, in terms of divergent and convergent thinking (see [2]).

Convergent thinking may, however, be conceived in yet another way. Several authors, following Spearman [30], have suggested that part of convergent thinking involves essentially the integration of ideas, and their synthesis. Koestler [9] in his work on bisociation argued that bringing two thought “matrices” from distant domains together, in a kind of fusion, was actually the heart of creative thinking. “Bisociation” was the term used to characterize this connection between two ideas, forming a new result. The invention of the movable type printing press by Johann Gutenberg, which revolutionized the printing of documents, is an example of bisociation. According to Koestler, Gutenberg worked in the printing business and was used to carving a page of text in a full wooden block, then pressing a page on the inked block in the paper press. One day, at a grape harvest and pressing to produce wine, Gutenberg saw some notables with their signature rings, which were used at that time to seal letters with hot wax with their initials. The bisociation of these signature rings with a press, led to the idea of many small wood blocks, each with a letter, sequenced to form longer texts, printed on a full page press. This bisociation led to a quantum leap in text composition and printing capacities.

In other work, Rothenberg [22; 23], through his analyses of case studies of eminent creative people such as Nobel prize winners, proposed a related vision of convergent thinking involved in creativity. First, Rothenberg [23] identified “Janusian thinking”, which indicates a simultaneous conception of a concept from two different perspectives. Second, he studied “homospacial” thinking, which refers to the joint blending (visually or conceptually) of information in a single thought space [24]. Homospacial thinking was examined in some empirical studies; two images were projected on each other, and the stimulation of creative thinking visually or verbally was compared to a presentation of the two images side-by-side. The homospacial presentation was favorable for creative idea production. This line of work, again, conceives of convergent thinking as the integration and synthesis of information, which is very relevant to the creative process. This synthesis may be unique, or idiosyncratic and in these cases, a very important part of creativity.

In terms of creativity tests, most focus on divergent thinking. As described with the unusual uses test, participants are solicited to generate as many ideas as possible. Often, it is clearly stated that the goal is to produce original ideas. These divergent thinking tests, such as the *Torrance Test of Creative Thinking* (TTCT), or the *Wallach and Kogan Creativity Test* (WKCT) are well-known and widely used [31; 34]. More recently, new divergent thinking tests were proposed (see [26]).

In contrast, measures of convergent thinking outside the intelligence test tradition have rarely been suggested. The most often cited measure of “convergent” creative thinking is the *Remote Associates Test* (RAT), proposed by Mednick [17]. This test consists of a set of items in which three words are presented each time, and the respondent must find a fourth word that connects with the three others. For example, if the three words are: “cheese”, “sky”, and “flower”, the respondent could reply “blue” because this associate fits with each of the supplied words (blue cheese, blue sky, bluebells). The RAT is scored in terms of the number of correct convergent associations. In each case, the answer requires finding a remote, non obvious connection between the three words provided. There is however, an expected “correct” remote associate answer for each item. In addition, the correct, expected answer is usually a word that is a relatively simple associate of each of the three words in the item. Thus, one strategy to solve these items is to generate a few associates to the first word in the item, and test each associate against the second and third words in the item. If a person supplies an idiosyncratic response, such as “poisonous” in the current example, it would be considered, usually, as a wrong answer. Thus, in the RAT, convergent thinking for creativity is operationalized in a way that is actually close to concepts of classic intelligence, and the utility of the RAT as a convergent thinking test for creativity is highly debatable.

To address convergent thinking for creativity, it is important to explore alternative measurement options that involve directly the integration and synthesis of information in original ways. The basic idea is to provide a limited set of elements and to ask participants to synthesize them in an original way. Appropriate tasks need to solicit convergent thinking in the service of creativity.

One example of this, used by Maker [16] in the DISCOVER program, is a tangram task in which individuals are presented with a limited set of geometric forms (several triangles, rectangles, etc). The goal is to create a single tangram construction using as many of the shapes as possible. This requires a synthesis of the elements and the originality

of the constructed shape can be determined, with respect to a corpus of productions by other individuals from the same population.

Another example of a convergent thinking task relevant to creativity was proposed by Urban and Jellan [33]. The *Test of Creative Thinking Drawing Production* (TCT-DP) requires respondents to complete a drawing, based on an initial set of graphic elements (a semi-circle, an “S” form, a dotted line, ...) that are provided at specific locations on the drawing page. It is possible to examine and score the number of elements used, the extent to which the elements are connected together, and the degree to which the elements, and the global drawing are employed in unusual ways (statistically rare, original ways). For example, a low degree of convergent thinking would involve using some but not all of the elements, with each element becoming its own separate drawing. In this case, the semi-circle might become a ball, the S-form a snake, and the dotted line could be part of a road. These are each distinct, unrelated things, which are, in addition, common ideas for using these graphic elements. A more integrated response may use the semi-circle as a sun, the S-form as a tree, and the dotted line as part of a house, all connected in the drawing of a “house” scene. Finally, a highly integrated response could use all the graphic elements as part of a single object, such as a large human face, with the semi-circle as an eye, the S-form as part of the cheek, and the dotted line as part of the lips. This global face drawing is highly integrative, although it is a rather common response given the elements and their placement on the drawing page (see [14]).

It is worth noting that both the tangram task and the TCT-DP were not conceived, initially, to be measures of convergent thinking for creativity. They are cited here as examples based on the perspective developed in this article. In terms of integration and creative synthesis, recent work has led to the development of a new assessment tool which seeks specifically to measure convergent-integrative thinking, as well as divergent-exploratory thinking in several main domains of creative activity; it is the *Evaluation of Potential Creativity* (EPoC) used to measure creative potential in children and adolescents [13]. There are assessments in the graphic-visual, verbal-literary, social, scientific, mathematic, musical and kinesthetic domains of expression. In each case, for the convergent thinking tasks, a limited set of elements are provided and the individual must try to integrate them in an original way. The number of elements used, the extent to which they are well integrated, and the degree to which the resulting production is original compared to what others produce in the same task are measured to yield a convergent-integrative ability score in the domain evaluated. For example, in the graphic arts, photos of eight objects are presented. The individual must use at least four of these together in a drawing. This drawing is scored for convergent-integrative creative thinking by taking into account the number of objects used, the extent to which they are combined together in the drawing, and the novel nature of the ideas presented. In the verbal-literary domain, one of the convergent tasks concerns inventing a story that uses several characters together. For the mathematics domain, a set of numbers and operators must be integrated to achieve a mathematical goal. In the musical domain, sounds of instruments are provided and must be integrated in a musical composition.

The EPoC assessment combines measures of both convergent-integrative thinking and divergent-exploratory thinking in each domain measured. This allows a child or

adolescent's profile to be assessed. Some individuals will be relatively stronger in one kind of thinking or the other (divergent > convergent, convergent > divergent). Also, the relative level of an individual compared to others of the same age can be evaluated. Therefore, the EPoC battery goes beyond others creativity measures, because it offers both measures of convergent thinking as well as the more traditional divergent thinking. In recent work, this measurement approach has been also extended with an application in adults, measuring divergent and convergent creativity in managers (see [19]).

The educational implications of taking both convergent and divergent thinking into account are important because both are part of the creative process. Most creativity training programs focus on divergent thinking, and these kind of programs have been shown to enhance it, according to a recent meta-analysis of these studies [15]. However, convergent-integrative thinking for creativity should also be a focus of training. It is likely that efficient development of creativity depends on bringing both divergent and convergent thinking to bear during problem solving, and each individual needs a differentiated, personalized training program. Thus, it is possible to conceive that in one domain of creative work, such as the visual arts, an individual could need convergent thinking training, whereas in another domain, such as verbal-literary, divergent thinking skills would need to be enhanced.

In conclusion, this paper has examined creativity and focused on convergent thinking. Convergent thinking has often been neglected compared to divergent thinking. In addition, convergent thinking has been conceived in several ways, which vary in terms of their relevance to creativity. Part of the difficulty has been to operationalize convergent thinking in a creativity-compatible way. The EPoC battery is described as a relevant new tool to assess convergent thinking, with a focus on the integrative, original synthesis, which is ultimately essential to the creative process, and the potential for resulting creative productions.

REFERENCES

- [1] Beghetto R. & Kaufman J.C. Toward a broader conception of creativity. *Psychology of Aesthetics, Creativity and the Arts*, 2007, vol. 1, no 2, pp. 73–79.
- [2] Cropley A. In praise of convergent thinking. *Creativity Research Journal*, 2006, vol. 18, no 3, pp. 391–404.
- [3] Finke R.A., Ward T.B. & Smith S.S. *Creative cognition: Theory, research, and applications*, Cambridge (MA), MIT Press, 1992.
- [4] Guilford J.P. Creativity. *American Psychologist*, 1950, vol. 5, pp. 444–454.
- [5] Guilford J.P. Structure of intellect. *Psychological Bulletin*, 1950, vol. 53, pp. 267–293.
- [6] Guilford J.P. *The nature of human intelligence*, New York, McGraw-Hill, 1967.
- [7] Guilford J.P. *Intelligence, creativity, and their educational implications*, San Diego, (CA), Robert Knapp, 1968.
- [8] Isaksen S.G. & Treffinger D.J. *Creative problem solving: The basic course*, Buffalo (NY), Bearly Limited, 1985.
- [9] Koestler A. *The act of creation*, New York, Macmillan, 1964.
- [10] Lubart T.I. Creativity, In R.J. Sternberg (ed.), *Thinking and problem solving*. New York, Academic Press, 1994, pp. 289–332.
- [11] Lubart T.I. Models of the creative process: Past, present and future. *Creativity Research Journal*, 2000, vol. 13, no 3-4, pp. 295–308.

- [12] Lubart T.I. In search of creative Intelligence, in R.J. Sternberg, J. Lautrey, & T.I. Lubart (eds.), *Models of intelligence: International perspectives*. Washington DC, American Psychological Association, 2003, pp. 279—292.
- [13] Lubart T.I., Besancon M. & Barbot B. *Evaluation of Potential Creativity*. Paris: Hogrefe, 2011.
- [14] Lubart T.I., Pacteau C., Jacquet A-Y. & Caroff X. Children's creative potential: An, empirical study of measurement issues. *Learning and Individual Differences*, 2010, vol. 20, no 4, pp. 388—392.
- [15] Ma H.H. A synthetic analysis of the effectiveness of single components and packages in creativity training programs. *Creativity Research Journal*, 2006, vol. 18, pp. 435—446.
- [16] Maker C.J. DISCOVER: Assessing and developing problem solving. *Gifted Education International*, 2001, vol. 15, pp. 232—251.
- [17] Mednick S.A. The associative basis of the creative process, *Psychological Review*, 1962, vol. 69, pp. 220—232.
- [18] Michael W.B. Guilford's view, in M.A. Runco & S.R. Pritzker (eds.), *Encyclopedia of creativity* (vol. 1, p. 785—797). San Diego (CA), Academic, 1999.
- [19] Myskowski N., Storme M., Davila A. & Lubart T. Managerial creative problem solving and the Big Five personality traits: Distinguishing divergent and convergent thinking. *Journal of Management Development*, 2015, vol. 34, no 6, pp. 674—684.
- [20] Osborn A.F. *Applied Imagination*. New York, Scribner, 1953.
- [21] Parnes S.J. & Harding H.F. (eds.) *A source book for creative thinking*, New York, Charles Scribner's Sons, 1962.
- [22] Rothenberg A. Einstein's creative thinking and the general theory of relativity: A documented report. *American Journal of Psychiatry*, 1979, vol. 136, no 1, pp. 38—43.
- [23] Rothenberg A. The Janusian process in scientific creativity. *Creativity Research Journal*, 1996, vol. 9, no 2-3, pp. 207—231.
- [24] Rothenberg A. & Sobel R.S. Creation of literary metaphors as stimulated by superimposed versus separated visual images. *Journal of Mental Imagery*, 1980, vol. 4, no 1, pp. 77—91.
- [25] Runco M.A. (Ed.) (2003). *Critical creative processes*. Cresskill, NJ: Hampton.
- [26] Runco M.A. Runco Creativity Assessment Battery (rCAB). Creativity Testing Services: CTS, 2011. <http://creativitytestingservices.com/>
- [27] Runco M.A. & Jaeger G.J. The standard definition of creativity. *Creativity Research Journal*, 2012, vol. 24, pp. 92—96.
- [28] Simonton D.K. On praising convergent thinking: Creativity as blind variation and selective retention. *Creativity Research Journal*, 2015, vol. 27, no 3, pp. 262—270.
- [29] Smith S.M., Ward T.B. & Finke R.A. (eds.). *The Creative Cognition Approach*. Cambridge (MA), MIT Press, 1995.
- [30] Spearman C. *Creative Mind*. Oxford, Appleton-Century, 1931.
- [31] Torrance E.P. *Tests of Creative Thinking*. Bensenville, IL, 1974.
- [32] Treffinger D.J. Creative problem solving: Overview and educational implications. *Educational Psychology Review*, 1995. vol. 7, no 3, pp. 301—312.
- [33] Urban K.K. & Jellen H.G. *Test for Creative Thinking-Drawing Production (TCT-DP)*. Francfort: Swets Test Services, 1996.
- [34] Wallach M. & Kogan N. *Modes of thinking in young children*. New York, Holt, Rinehart & Winston, 1965.

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КРЕАТИВНОСТЬ И КОНВЕРГЕНТНОЕ МЫШЛЕНИЕ: ОТРАЖЕНИЯ, СООТНОШЕНИЯ И ПРАКТИЧЕСКИЕ ПРИЛОЖЕНИЯ

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Креативность понимается как способность генерировать новые, оригинальные идеи, которые имеют смысл и ценность в их контексте. Теоретики часто обсуждают роль дивергентного и конвергентного мышления в развитии и функционировании креативности. В данной статье внимание сосредоточено на конвергентном мышлении и способах его концептуализации и операционализации. Установлено, что некоторые из рассматриваемых концепций в большей степени соответствуют пониманию креативности. Представлены и обоснованы некоторые новые способы диагностики конвергентного мышления, которые могут быть использованы для измерения креативности. В частности, описана тестовая батарея «Оценка потенциала креативности» (ЕроС), являющаяся новым релевантным инструментом для оценки конвергентного мышления с акцентом на интегративный и оригинальный синтез, который является самым существенным для креативных процессов и обеспечивает возможности для генерации творческих продуктов. Обсуждаются практические приложения данной проблемы в сфере психодиагностики креативности и в образовании.

Ключевые слова: креативность, дивергентное мышление, конвергентное мышление, интеграция, измерение

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