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Decrease in Creativity

Kyung Hee Kim[1] and Robert A. Pierce[2]
[1]The College of William and Mary, Williamsburg, VA, USA
[2]Christopher Newport University, Newport News, VA, USA

Synonyms

Creativity crisis; Creativity slump; Decrease in creativity scores

One issue relevant to the issue of creativity is whether it can be measured objectively. In the absence of such a measure, the question of whether creativity is increasing or decreasing is merely speculation and based upon anecdotal evidence. One measure, however, provides better guidance: Torrance Tests of Creative Thinking (TTCT). Torrance developed the TTCT in 1950s, and the test has been updated five times, in 1974, 1984, 1990, 1998, and 2008. The TTCT appears in almost 40 different languages. Educators and corporate entities use and reference the TTCT more than any other creativity tests in the world. Research shows that the TTCT scores are an excellent predictor of creative achievement in later adulthood. The TTCT predicts creative achievement better than any other creativity tests or divergent-thinking tests, and based on extensive analyses, it can be concluded that the TTCT is more than just a divergent-thinking test: it is the best creativity test currently available.

Kim's (2011) study called "The Creativity Crisis" on changes in creativity over time included almost 300,000 scores on the Torrance Tests of Creative Thinking (TTCT). These are from kindergarten through 12th-grade American students as well as adults from 1966 to 2008. TTCT scores are different than IQ. The TTCT is designed to measure creative potential, and IQ is designed to measure intelligence. Creativity can elevate giftedness into eminence. Further, *creative* is not synonymous with *artistic*, and the TTCT measures creativity on many other levels

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than artistic ability. The TTCT gives a *profile* of test results on several subscales, different than test like the IQ, which give a single measure of intelligence. The TTCT measures (1) fluency, (2) originality, (3) creative strengths, (4) elaboration, (5) abstractness of titles, and (6) resistance to premature closure.

Kim's study (2011) detected a decline in the creativity of young Americans, which has persisted over the past two decades. Research needs to be done to establish the causes for the decrease in each of the six subscales (fluency, originality, creative strengths, elaboration, abstractness of titles, and resistance to premature closure) and to understand the implications. The United States has, since its inception, excelled by harboring and nurturing creativity and creative thinkers, and the trend could have significant, long-lasting, and global repercussions.

Findings

The results of Kim's 2011 study indicate that:

Decrease in Fluency Scores Since 1990

In creativity testing, fluency refers to the ability of the test takers to produce ideas based upon visual cues. It measures the number of the ideas produced. Between 1990 and 2008, individuals' ability to produce many ideas significantly decreased. The biggest decrease in fluency scores was for children between kindergarten and grade 3, and the second biggest decrease was for children between grades 4 and 6, which suggests that younger children's ability to produce many ideas significantly decreased since 1990. Contrary to popular wisdom, this result might suggest that young people, although they have access to many varieties of visual media, are less competent than earlier generations with generating many ideas.

Decrease in Originality Scores Since 1990

Individuals' ability to produce unique and unusual ideas significantly increased until 1990, but significantly decreased from 1990 to 1998, and remained static from 1998 to 2008. Originality is the only TTCT subscale that is reflective of different cultures and time. Thus, Torrance required developing and updating originality lists culture- and time-specifically. The credibility of originality scores of the TTCT based on the originality lists that Torrance developed in 1984 is problematic. The continued use of 1984 originality lists leads to an expectation that the originality scores go up artificially as time goes on until the originality lists are updated. The results showed that the originality scores decreased from 1990 to 1998 and remained static from 1998 to 2008. However, the decrease may have been underrated through the use of outdated scoring lists, and thus, originality scores may have actually significantly decreased. Examining each age group separately showed that the biggest decrease in originality scores from 1990 to 2008 was for children between kindergarten and grade 3. It can be concluded that younger children's ability to produce infrequent, unique, and unusual ideas has significantly decreased since 1990.

Determining the cause of the decrease is complicated, as the causes may be multiple. Nevertheless, the decrease runs in close parallel to the rise of the standards movement in education. The standards movement itself was a reaction to a perceived decrease in the effectiveness of American education (as reported, e.g., in *A Nation at Risk*, 1983). It is arguable that the standards movement has increased focus in American public schools with respect to identifiable targets of learning (the standards and their supporting objectives). However, the standards movement and its companion, the accountability movement (NCLB and various state-level tests), have probably decreased teacher creativity in the classroom and decreased frequency of more creative assessments. Today in school, many students are assessed only using multiple-choice testing and other objective assessments, which give students virtually no room for creativity. Over time, these assessments are likely to condition students to avoid original and unexpected responses and instead to strive for the one correct answer.

Decrease in Creative Strengths Scores Since 1990

Creative strengths scores significantly decreased from 1990 to 2008. The decrease of creative

strengths scores since 1990 might indicate that, over the last 20 years, children are becoming verbally expressive, less emotionally expressive, less lively or passionate, less perceptive, less humorous, less imaginative, less unconventional, less connecting of seemingly irrelevant things, less synthesizing, or less able to see things from a different perspective. Creative strengths capture a person's disposition toward creative outcomes and are an overall predictor of creative potential. A decline in creative strengths is a special concern as it augurs a lower future disposition. Other subscales measure attributes, such as fluency, that have some commonalities with a trainable skill. A low creative strengths score may indicate a lack of receptivity to training for creative attributes.

Isolating the cause of the trend may be difficult. Nevertheless, students' constant access to media may be partially to blame for the decrease on this subscale. Before students had handheld electronic devices, they often had to come up with their own means to pass free time. Today, students can quickly turn to videos, video games, music, and other forms of electronic entertainment. Though many benefits can perhaps emerge from this sort of use of modern electronic technologies, students may be losing creative potential: some of them no longer create forms of entertainment.

Decrease in Elaboration Scores Since 1984

Individuals' ability to think in a detailed and reflective manner as well as their motivation to be creative significantly decreased from 1984 to 2008. The decrease in elaboration scores since 1984 might indicate that people of all ages are losing their ability to elaborate upon ideas and for detailed and reflective thinking over the last 30 years. They are becoming less motivated to be creative, and the home, school, and society overall encourage creativity less. The ability to elaborate is a skill, and it can be taught, provided that teachers and parents make a commitment to do so. As the skill weakens, so will the disposition to see merit in it, or for students to engage in it. Thus, the more elaboration decreases, the more difficult it will be to reduce this trend.

Decrease in Abstractness of Titles Scores Since 1998

Individuals' ability for abstract thinking, synthesis and organization thinking processes, and capturing the essence of the information involved significantly decreased from 1998 to 2008, a little later than the decreases of other TTCT subscales, which started in 1984 (elaboration) or in 1990 (fluency, originality, and creative strengths). Abstractness of titles scores are expected to increase because they are positively associated with verbal intelligence scores, and intelligence scores have increased over time, as the so-called Flynn effect indicated. Thus, the decrease suggests that the scores may have actually decreased earlier than 1998. This result indicates that younger children are becoming less capable of the critical thinking processes of synthesis and organization and also less capable of capturing the essence of the information to know what is important.

The ability to think abstractly, to synthesize, and to organize rests on education and assessments that value these qualities. Modern technologies have, however, inadvertently worked against these skills. Endless amounts of information are easily available on every subject, and rather than engaging in deep thought and analysis, students can effortlessly search, find, and rephrase others' work product. Students can thus avoid practicing and developing the type of abstract thinking, synthesis, and organization that is necessary to perform creatively.

Decrease in Resistance to Premature Closure Scores Since 1998

Children's ability to be intellectually curious and to be open-minded significantly decreased from 1998 to 2008. Just like the abstractness of titles scores below, resistance to premature closure scores are expected to increase because they have a strong positive relationship with intelligence scores, and also intelligence scores have increased. Thus, the decrease suggests that the scores may have actually decreased earlier than 1998. This result indicates that younger children are becoming less intellectually curious and also less open to new experiences.

Conclusion and Future Directions

The results of Kim's creativity crisis study (2011) showed that creativity scores in the United States significantly decreased since 1990: elaboration by 17.39 %, abstractness of titles by 7.41 %, fluency by 7.00 %, creative strengths by 5.75 %, originality by 3.74 %, and resistance to premature closure by 1.84 %. This means that American people of all ages are becoming less creative. Creativity scores for children between kindergarten and grade 3 decreased the most, and those from children between grades 4 and 6 decreased by the next largest amount.

As noted above, the causes for the decreasing trends in creativity measures are not yet determined. Nevertheless, all of the subscales measure different aptitudes of students' desire, ability, and incentive to think deeply. Modern technologies, changing values, and changes in approaches to education have all discouraged deep thinking and pushed students to quick responses and to *objective* singular right answers to questions. As thinking skills and disposition for creativity atrophy, the skills are used less often and the condition grows worse. Overall, these changes could signal a major turning point in American society.

Though the effect on American society of these decreases could be substantial and devastating, the biggest concern is the effect that these decreases may have on children themselves, on children as individuals: the decrease in creativity may reflect specific changes in how children are reared by parents and taught by their teachers. In turn, today's children and tomorrow's future adults may have fewer internal resources with which to confront the world. This condition could well impact them materially, as they could well have fewer creative resources when facing a rapidly changing economic environment (in which they have to make a living). More worrisome is that tomorrow's adults may have fewer internal resources to face the difficulties of human existence: personal crises, life transitions, and emotional conflicts. Collectively, people with fewer creative skills have less ability to produce constructive change in response to a changing environment.

Almost everyone says, "I love creativity." Parents and teachers, television advertisements, and corporate mission statements herald "creativity." People claim to want creative students and creative solutions. Most of these people really mean they enjoy some of the celebrated end results of creativity, like Picasso's paintings and iPhones. However, when a creative idea is first presented, most people are quick to reject the idea. Most people are idea killers. They tend to explain why new ideas will fail, instead of thinking about how to make them work. Most people are uncomfortable with new ideas, challenges, changes, the unknown, and uncertainty. The decrease in creativity reflects a shift in social values, to which for developmental reasons children are especially receptive. Our society in fact values creative people and creative ideas progressively less, and children inclined toward creativity will be progressively less valued and less tolerated. Creative children, for example, are often diagnosed as having attention deficit disorders; the standard response is to medicate them. With legislation like the No Child Left Behind Act and its predecessors, we are institutionalizing the unimaginative, rewarding mediocrity by students and teachers, and rejecting creative expressions from our children. Creative children are bored and encouraged to be underachievers. The longer this continues, the more pronounced the effects will be, and the effects on any particular individual could be life threatening in the long term, as these children grow up to find solace in alcohol, drugs, and other distractions. Regardless, these children are not reaching their potentials, which is the biggest concern.

In broader point of view, creative thought has been the most important ingredient for the economy of the past and of the present, so it is expected to remain so in the future. America is a child among nations, and she has always relied on her vast reserves of creative thinkers to take her to the next level and to best every challenge. The heart of the American spirit is American ingenuity, the ability to create novel solutions. The United States used to provide creative climate that fostered creativity, provide opportunities for creative individuals,

and reward creative achievements. Americans used to celebrate individuality, difference, and independent thinking. The creative soul is part of what enabled the United States to ascend to world leader, with such an unhistoried population. Creativity used to be central to the American identity and the American spirit, and these associations explain part of the public's fascination with the study of creativity. The United States has served as a beacon for creative hearts and adventurous spirits, calling out to those in search of freedom of expression and freedom of thought. Until recently, the freedoms we enjoy here have provided fertile ground for creative people to grow their ideas and to explore. As a result, the United States has attracted more creative people from other parts of the world. Albert Einstein, Nikola Tesla, and Mikhail Baryshnikov come immediately to mind as examples. Will they still come here as the beacon of creative freedom begins to fade and as other countries are more receptive even than America in welcoming their contributions? As the United States is less and less a climate that encourages creativity, will it still continue to attract those seeking creative expression, and will it still be a wellspring of invention, innovation, and entrepreneurship? As a society, are we going to prepare young people both for ever-changing professional lives and for the emotional challenges of adult life?

Cross-References

- ▶ Creativity and Emotion
- ▶ Creativity Tests

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Decrease in Creativity Scores

▶ Decrease in Creativity

Defense Technology

▶ Innovation in Defense Technologies

Democracy

▶ Quality of Democracy and Innovation

Democracy of Knowledge

▶ Mode 3 Knowledge Production in Quadruple Helix Innovation Systems: Quintuple Helix and Social Ecology

Democracy, Theory

▶ Quality of Democracy and Innovation

Democratic Innovation

▶ Quality of Democracy and Innovation

Democratic Reforms

▶ Innovation and Democracy

Democratization

▶ Innovation and Democracy

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Design

▶ Creativity in Puzzles, Inventions, and Designs: Sudden Mental Insight Phenomenon

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▶ Applied Design Thinking Lab and Creative Empowering of Interdisciplinary Teams
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Developing Radical Inventions

Wilfred Schoenmakers[1] and Geert Duysters[2]
[1]Management Studies Group, Wageningen University and Research Centre, Wageningen, The Netherlands
[2]Brabant Center of Entrepreneurship, Eindhoven University of Technology and Tilburg University, Eindhoven, The Netherlands

Introduction

Inventions lie at the heart of technological progress of companies and of economic development in general. The word "invention" is however a very broad concept covering an extensive spectrum ranging from simple, incremental inventions to pathbreaking radical inventions. Incremental inventions are mere adjustments to existing products or technology. They typically have limited impact on the technological paradigm. Radical inventions on the other hand are in general seen as being a clear deviation away from the current technological paradigm (Hage 1980; Nelson and Winter 1982), making their impact on technological progress and economic development more prominent. This results in radical inventions often being responsible for the creation of new technological systems and sometimes even new industries. Radical inventions can thus be considered a vital basis for a sequence of subsequent developments around this original invention (Mokyr 1990).

In the past, many theoretical discussions have focused on the effect of radical inventions (e.g., Ahuja and Lampert 2001; Rosenkopf and Nerkar 2001; Dahlin and Behrens 2005; Tellis et al. 2009). Unfortunately, only very few studies have so far been undertaken to uncover the nature of radical inventions. Large-scale empirical investigations into the technological origin of radical

inventions are meager if not absent. The few studies that can be found concentrate on the Schumpeterian role of company size in the creation of radical inventions and innovations. The concluding empirical results of the different studies remain however divers (Scherer 1991). Others studies have looked at the influence of organizational aspects on the development of radical inventions (for an overview see Chandy and Tellis 1998). A study by Schoenmakers and Duysters (2010) argues that it is crucial to understand the specific technological features that influence the development of radical inventions. This thus means that this study is not focusing on the market success of an invention, as is commonly the case in many existing studies. Instead, it centers its attention on the technological origins of radical inventions. They thus do not focus on the regularly used concept of innovation but instead focus on the invention itself. They particularly focus on the classical discussion whether radical inventions are seen as following from a recombination of existing knowledge (Schumpeter 1939; Fleming 2001; Nerkar 2003) or whether they are based on totally new knowledge (Poel 2003). For organizations, it is important to better understand the building blocks of radical inventions, for this can help them in making sound decisions for the creation of new knowledge in either concentrating their efforts on internal development for the development of an original piece of new knowledge or to focus on external knowledge in their search for "neue kombinationen" (Schumpeter 1939) via strategic alliances or partnerships based on "open innovation." From the perspective of society as a whole, the importance of understanding the origins of radical inventions is in the prospective influence of radical inventions on the creation of new technological paradigms or even new industries.

How Radical Inventions Are Built

Different publications up till now have stressed the importance of radical inventions (e.g., Ahuja and Lampert 2001; Rosenkopf and Nerkar 2001; Dahlin and Behrens 2005). Among scholars and practitioners alike, there is clear agreement on the positive influence of radical inventions on technological, industrial, and societal change. The influence of these inventions on the economy as a whole or on company performance has been extensively investigated in different studies. Research into the nature of radical inventions themselves is on the other hand rather sparse. Except for a few distinguished exceptions (e.g., Ahuja and Lampert 2001) few studies have been directed toward the technical content of radical inventions. Most studies focus on the concept of innovation, rather than invention. For a definition of a radical invention, the paper by Schoenmakers and Duysters (2010) turns to the article of Ahuja and Lampert (2001) where they define radical or breakthrough inventions as "those foundational inventions that serve as the basis for many subsequent technical developments" (Ahuja and Lampert 2001, p. 523). Ahuja and Lampert thus clearly focus on the technical content of an invention. Inventions are thus not considered radical from a user or market point of view but rather from their technological importance. Furthermore, they also postulate that radical inventions are inventions that function as a basis of knowledge for many successive inventions. According to their definition, the technological content of radical inventions thus serves as input for many succeeding inventions (see also Trajtenberg 1990a, b). In the research by Dahlin and Behrens (2005), they deem technologies as radical when they are novel, unique, and have an impact on future technology. They also consider inventions as radical if they are constructed of already existing but beforehand-unconnected knowledge (Hargadon 2003). It is thus not only the individual component of knowledge that can be novel in their definition but also the new combination of existing components. Dahlin and Behrens (2005) also, just as Ahuja and Lampert (2001), focus on the impact of radical inventions on future technology. Also in the definition of Dahlin and Behrens (2005), radical inventions are those inventions with a relatively large impact on future inventions. Inventions are thus seen as being radical if comparatively many succeeding inventions use its knowledge. This means that the impact of an invention on succeeding inventions

can be considered a proxy for radicalness. All inventions that serve as an important precursor for later inventions are said to be considered as radical inventions. Schoenmakers and Duysters (2010) therefore use the impact of inventions on successive inventions as an estimate for the radicalness of that invention. They focus their attention solely on technological inventions.

When thinking of radical inventions, many people still believe that they come about by the single genius of some lone inventor who, after many years of solitary research, finally has his/her moment of glory. Even though this lone inventor still exists up till now (Dahlin et al. 2004), in today's fast changing and complex technological field, the lone inventor is rather the exception than the rule (Hargadon 2003). Nowadays inventions, and especially radical inventions, come about mostly from the joint effort of a team of experts with expertise on different technological fields. Also many practitioners and researchers alike think that radical inventions are always based on completely new knowledge (Poel 2003). There is however a vast range of literature which proposes that in fact it is the recombination of already existing knowledge which is the ultimate source of novelty (Fleming 2001; Nerkar 2003). In the late 1930s, even Schumpeter (1939) considered invention as coming from new combinations or "neue kombinationen" (Schumpeter 1934, pp. 65–66). Nelson and Winter (1982, p. 130) stress ". . .that invention in the economic system. . .consists to a substantial extent of a recombination of conceptual and physical materials that were previously in existence." Even a simple realignment of already existing components can, according to Henderson and Clark (1990), be a main cause of destabilization in key industries. Also Hargadon and Sutton (1997) have shown how firms can create novelty by simply being a technology broker and in that way bringing together already existing components. In Fleming's words: ". . .an invention can be defined as either a new combination of components or a new relationship between previously combined components" (Fleming 2001). Furthermore, according to Hargadon (2003) radical inventions are only seldom based on totally new knowledge. Radical inventions quite often are developed from a recombination of already existing knowledge. "When . . . connections are made, existing ideas often appear new and creative" (Hargadon and Sutton 1997, p. 716). Very important in this respect is the recombination of beforehand-unconnected knowledge or unconnected knowledge domains (Hargadon 2003). All these researchers have in common that they believe that radical inventions are brought about by predominantly a recombination of existing knowledge or the discovery of a new context for already existing knowledge (Poel 2003).

On the other hand, a number of researchers still would argue that a radical invention is predominantly based on truly novel knowledge and thus goes beyond simple recombination, irrespective of a few examples of inventions based on the recombination of existing knowledge or a new context for existing knowledge.

So is it completely new knowledge, or a recombination of existing knowledge, that is the main cause of radical inventions? Up till now, this has largely remained a theoretical discussion. Large-scale empirical evidence was up till now not available. Even though both views are possible, and also observable, radical inventions originating from two basic sources, the recombination of existing knowledge as well as from the creation of truly novel knowledge, recent research found that recombination is more important for radical inventions than truly novel knowledge (Schoenmakers and Duysters 2010).

If, as follows from the research by Schoenmakers and Duysters (2010), radical inventions are for a substantial part based on already existing but beforehand-unconnected knowledge, then the question becomes: What specific recombination of what kind of existing knowledge will usually lead to the development of radical inventions? For example, existing knowledge typically comes about in, broadly speaking, two different forms: mature knowledge and emergent knowledge. The recombination of existing knowledge can thus be based on the one hand on mature knowledge, or on emerging knowledge, or on a combination of mature and emerging knowledge. Currently, there is a discussion among researchers about the significance of both forms of

technologies (Ahuja and Lampert 2001; Nerkar 2003). Emerging technologies are technologies that are relatively new and which are considered to be cutting-edge technology (Ahuja and Lampert 2001). Therefore, emerging technologies offer numerous possibilities for developing new technologies via recombination. Emerging technologies have the possibility to offer firms important new knowledge components that also aid them in the advancement of radical inventions (Ahuja and Lampert 2001). A problem with emerging technologies however is that firms often do not yet have the complete comprehension of the technology. This deeper understanding is however vital for the development of radical inventions. Therefore, firms that are used to relying too much on emerging technologies will very often have problems with seeing the full potential of this new knowledge for the development of future technologies (Nerkar 2003). On the other hand, mature technologies "are usually well understood and offer greater reliability relative to more recently developed and less tested" technologies (Ahuja and Lampert 2001, p. 527); they were usually also tested and used in many diverse situations. Especially incumbent firms will favor mature technologies to emerging technologies since they are usually more familiar with these technologies. They also have more knowledge of the possibilities and the limitations of these technologies. The results of emerging technologies are thus much more uncertain. Via R&D, firms devote effort into building up absorptive capacity in their organization. Absorptive capacity is quite often path dependent and is also corresponding to a firm's earlier research. For this reason, firms will thus have more difficulty with absorbing emerging technologies. Firms can speed up their innovation process by using their absorptive capacity through focusing on existing technologies. Using emerging technologies is often difficult because of experimentation costs and in the beginning a limited output. Firms will have to go through an extensive learning curve to get a full understanding of the new technology, without having the guarantee that this new technology will eventually deliver anything valuable. Firms might also have to train their employees in how to work with this new technology or they might even have to change company routines or company practices, something which is not easily accomplished and will certainly involve considerable costs for the company (Nelson and Winter 1982). So while emerging technologies offer many possibilities, they might also create many significant difficulties. In spite of these difficulties of the use of emerging technologies, research by Schoenmakers and Duysters (2010) shows that firms also need emergent knowledge for the production of radical inventions. Mature technologies are vital, but there is an increasing agreement that emergent technologies are also very important, especially for radical inventions. Radical inventions are thus, as compared to nonradical inventions, to a higher degree based on emergent technologies.

Notwithstanding this expected positive correlation between emergent technologies and radical inventions, emergent technologies have their drawback too for the development of radical inventions. If firms, with their research, only focus on emergent technologies, then this will lead to new knowledge but only to knowledge with a limited impact on coming technologies. If firms however focus too much on mature knowledge, then this might lead to only incremental inventions (Nerkar 2003). The possibilities for mature technologies to deliver radical inventions are limited. The full potential of mature knowledge might however on the other hand not be fully used because this knowledge might not be publicly known or it was not useable at the time of its development due to lack of the development of complementary knowledge, institutions, or standards that are required to use this piece of knowledge to its full potential (Nerkar 2003). When this complementary knowledge is eventually developed and combined with the mature knowledge from the firm, this can make the development of new inventions possible. Since mature technologies, as compared to emerging technologies, are usually well comprehended, the combination of mature and emerging technologies could offer ample possibilities for the development of radical inventions. This would also make the full use of mature knowledge possible. This combination of mature and emerging knowledge was also found in the research

of Schoenmakers and Duysters (2010) to be very important for the development of radical inventions. So not only is emergent knowledge important for the development of radical inventions, so is also the combination of mature and emerging knowledge. Radical inventions are thus, more than nonradical inventions, based on a combination of mature and emergent technologies.

However valuable the combining of mature and emerging knowledge might be, many firms have a tendency to look for new knowledge locally, not only within their current technological field of expertise (Stuart and Podolny 1996) but also within the similar geographical area as where they are operating (Verspagen and Schoenmakers 2004). Different reasons are found to explain this phenomenon, like for instance: overreliance on existing company routines; employee experience lock-in effects or rigid company structures. Furthermore, firms tend to value the convenience of technological and geographic proximity in their search process. Because of this restrictive search process, companies often experience bounded rationality and build their new knowledge on a limited subset of the total available knowledge set. Granstrand et al. (1997) found that the technological competencies of large firms are heavily depending upon their past competencies and that these competencies are fairly stable over the years (Granstrand et al. 1997, p. 13). Knowledge is thus "imperfectly shared over time and across people, organizations, and industries" (Hargadon and Sutton 1997, p. 716). This could very well produce the development of "core rigidities" (Leonard-Barton 1995) and the appearance of "competency traps" (Levitt and March 1988). Firms experiencing these kinds of traps will have difficulty developing radical inventions. Firms that rely for instance more on their past knowledge produce more inventions, but these inventions will be less relevant (Sorensen and Stuart 2000).

Research by Granstrand et al. (1997), Patel and Pavitt (1997), and Brusoni et al. (2001) shows that a firm's product portfolio is usually smaller than its technological portfolio. An explanation for this observed trend might be that firms need to look for valuable technologies being developed outside of their core technological field of expertise in order to be able to make use of new technological possibilities that this new knowledge eventually might deliver (Granstrand et al. 1997). Innovating firms thus need to focus on a broader technological field, which would imply that also for the development of radical inventions a broader technological scope is necessary. This then also implies that a radical invention is not only the basis of many subsequent inventions (Trajtenberg 1990b) but also itself based upon more knowledge bases compared to incremental inventions (Rosenkopf and Nerkar 2001). This does not refer to the number of individual pieces of knowledge but refers instead to the diversity in the knowledge bases or knowledge domains where an invention is based upon. Therefore, it can be expected that radical inventions make use of knowledge coming from a larger pool of knowledge than nonradical inventions, something that also follows from the research of Schoenmakers and Duysters (2010).

Conclusion and Future Directions

Radical inventions are thus not only based more on the recombination of before unconnected knowledge, on emerging knowledge, and a combination of mature and emerging knowledge but also on a larger variety of knowledge domains.

For firms willing to develop radical inventions, besides a certain degree of absorptive capacity and flexibility, it is thus necessary to cooperate with other firms in alliances or via "open innovation." Firms increasingly need knowledge from other knowledge domains outside of their own companies. Collaboration therefore seems to be vital for the development of radical inventions. Further research into the development of radical inventions and collaboration in the form of alliances or open innovation networks will hopefully shed more light on this relationship.

Cross-References

- ▶ Ambidexterity
- ▶ Creative Management
- ▶ Creativity in Invention, Theories

- ▶ Innovation and Entrepreneurship
- ▶ Innovations of and in Organizations
- ▶ Intellectual Property Rights
- ▶ Interdisciplinarity and Innovation
- ▶ Invention Versus Discovery
- ▶ Inventive Resources
- ▶ Knowledge Capital and Small Businesses
- ▶ Knowledge Society, Knowledge-Based Economy, and Innovation
- ▶ Nature of Creativity
- ▶ Open Innovation and Entrepreneurship
- ▶ Organizational Creativity

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Development

- ▶ Quality of Democracy and Innovation

Development Economics

- ▶ From Personal to Impersonal Exchange in Ideas

Development Policy

▶ Entrepreneurship Policy

Devise

▶ Invention Versus Discovery

Dialectical Inquiry

▶ Model of Dialectical Learning

Dialogical Critical Thinking in Children, Developmental Process

Marie-France Daniel[1] and Mathieu Gagnon[2]
[1]Département de kinésiologie, Université de Montréal, Montréal, Québec, Canada
[2]Université de Sherbrooke, Sherbrooke, Québec, Canada

Synonyms

Complex thinking; Evaluative thinking; Higher-order thinking; Reflexive thinking

Origins of the Concept of Critical Thinking

Critical thinking is strongly related to formal logic. Since Aristotle, the rules of formal logic have been considered as the most refined instrument for developing human thinking. It is only at the end of the nineteenth century, with the pragmatists and especially with Charles Sanders Peirce, that logic lost some of its formality to become applied logic. With John Dewey, logic became "reflexive thinking." Logical thinking therefore became a social instrument to help individuals solve scientific, social, or personal problems. Starting in the mid-twentieth century, following along the lines laid out in the ideas of American pragmatists, the concept of critical thinking was put forth, in particular by philosopher Robert Ennis. Since then, the concept has exerted influence on Education Sciences, Medical Sciences, Engineering, Psychology, etc. Philosophers have something of a tendency to emphasize the reasoning component in critical thinking, while recent works in psychology and psychopedagogy tend to emphasize the problem-solving component or its inquiry process. There is no consensual definition of critical thinking, but it is generally recognized as a type of thinking that "doubts methodically" (Foulquié 1982), as it is the "examination of a principle or a fact, for the purpose of making an appreciative judgment of this principle or fact" (Lalande 1991).

If Ennis' definition of critical thinking outlined the path for further development of the concept, Lipman's definition offers complementary aspects. Also, Lipman is the originator of the Philosophy for Children (P4C) approach, and P4C is the context in which the model of the developmental process of dialogical critical thinking emerged.

Critical Thinking According to Robert Ennis

In 1962, Ennis defined critical thinking as logical thinking characterized by complex cognitive skills. Then he adjusted his definition to include the influence of creative thinking and predispositions (1991, 1993). Creativity presupposes skills such as inventing, associating, suggesting alternatives, making analogies, formulating hypotheses, etc. And, by predispositions, Ennis refers to attitudes such as being curious, strategic, rigorous, etc. To Ennis, thinking in a critical manner implies the ability to judge the credibility of sources; to identify conclusions, reasons, and hypotheses; to appreciate the quality of an argument; to develop and defend a point of view; to ask relevant clarifying questions; to search for reasons; to draw conclusions that are credible and viable, etc. In sum, critical thinking is reflective thinking focused on what is to be believed or accomplished. In this

definition, the term "reflective thinking" refers to the awareness that is manifested in the search for, or the use of, valid reasons; the term "focused" implies a nonaccidental intellectual activity, in other words, an activity based on reasons and consciously focused on a goal; and the phrase "regarding what is to be believed or accomplished" indicates that critical thinking can evaluate statements and beliefs as well as actions (Norris and Ennis 1989). To assess learning of critical thinking, Ennis designed tests centered on learning formal and informal logic. These tests are essentially intended for college and university students.

Critical Thinking According to Matthew Lipman

According to Lipman, critical thinking represents a tool to counter nonreflective thinking and actions. Individuals need critical thinking to help them think well and evaluate, among all the information received, the most relevant in accordance with the objectives they pursue. In contrast to current definitions of critical thinking, which limit critical thinking to its products, Lipman looks into the components that structure the processes as well as the results, in particular into the notions of "research" and "good judgment" that is, judgment that can take into account all the elements of a problem as well as the inquiry steps to which it leads. In this sense, critical thinking aims at judgment, is governed by criteria, is self-correcting, and is sensitive to context (Lipman 1988, 1991, 2003).

Although Lipman considers that there is continuity between critical and creative thinking, as they permeate each other in the formation of judgments, he also points out the discontinuity between these two forms of cognitive processing. Critical thinking involves reasoning and critical judgment and it looks for truth, while creative thinking involves artistry, craft, and creative judgment and it looks for meaning. Creative judgments are not logical inferences, they are personal and unique responses to situations. Following Peirce, Lipman considers creative thinking as "ampliative reasoning" in that it goes beyond the given and extends the thinking process. Generalizations, hypotheses, analogical and metaphorical reasoning, and so on, are instances of ampliative reasoning or creative thinking. Lipman defines creative thinking as thinking that is sensitive to criteria, is self-transcending, and is governed by context.

This discontinuity between critical and creative thinking leads Lipman to emphasize the concept of higher-order thinking. Higher-order thinking presupposes complex thinking – which is more complex than critical thinking alone; it involves both critical and creative thinking. Later on, Lipman also added caring thinking, which means valuing, appreciating, and focusing on what is respectable, valuable, and meaningful. Complex thinking is concerned with both procedural and substantive considerations, aims at resolution of problematic situations, is metacognitive (thinking that is aware of its assumptions, methodology, procedures, perspectives, as well as being conscious of the implications, the reasons and evidence that support the conclusions), and is sensitive to context and to others.

How can complex thinking be fostered in pupils? His Deweyan and Vygotskyan influences lead Lipman to maintain that complex thinking increases in sophistication in the context of peer interactions and, more precisely, in the context of philosophical dialogue within a community of inquiry – elements that constitute the essence of the educational approach he conceived, the P4C.

Philosophy for Children

In the P4C approach, philosophy does not refer to a transmission of intellectual knowledge to individuals who are mature and already capable of complex thinking. Instead, philosophy is defined as a means toward sensitizing children to instances of ambiguity and vagueness, while strengthening their questioning, reasoning, and dialogical skills so as to enable them to cope with the perplexing aspects of daily situations.

P4C is an approach put forward by Lipman in the 1970s; it is now implemented in about 50 countries and its curriculum has been translated into at least 20 languages. The curriculum includes novels for pupils aged 6–15 years old,

and manuals to help teachers facilitating the philosophical exchanges among pupils. To facilitate philosophical sessions, Lipman and his colleagues propose the following three steps: reading, collecting pupils' questions, and dialogue within a community of inquiry (Lipman et al. 1980).

Reading. Pupils read a chapter from a philosophical novel out loud, taking turns. This activity is important as marker of cooperation among peers and active participation in the P4C sessions. The novels are said to be philosophical because they are based on concepts issuing from different areas of philosophy (logic, ethics, aesthetics, politics, etc.). Yet the philosophical concepts are meaningful to pupils, as they are presented in narrative form, in the first person (the voice from within vs. the voice of authority) and in ordinary language; they are associated with real-life experiences (adventures and romance). Furthermore, the novels, due to the progression of logical concepts as a spiral, are likely to contribute to creating a schema in pupils' mind. A schema pertaining to a concept corresponds to the meanings of that concept.

Collecting pupils' questions. After reading the chapter, the pupils are invited to formulate questions that intrigue them and which they would like to discuss. This second step presupposes that they put sufficient effort into comprehending the text to question the situations described. Comprehension requires not only a knowledge of words, but also a global understanding of the text and of the context. This step encourages pupils to embark on a process of inquiry. Fostering pupils' questioning is a pedagogical objective that is not always valued in traditional pedagogy, in which the power and the right to ask questions usually belong to teachers. However, learning to question is fundamental, in that it stimulates critical and creative thinking in pupils.

Engaging in dialogue within a community of peers. The third step in the Lipmanian approach is intended to provide youngsters with elements of answers to the questions they formulated during the previous step. To facilitate the inquiry, the teacher, using the manuals, asks follow-up questions such as: *Why do you say so: can you justify your point of view? Who has a counter-example? What are the resemblances and distinctions between x and y?* and so on.

A philosophical dialogue is more than a mere conversation. Its apprenticeship is a complex process, moving from simple to more complex exchanges – from anecdotal exchanges to monological, noncritical dialogical, semicritical dialogical, and critical dialogical exchanges (Daniel et al. 2002, 2005). **Anecdotal** exchange refers principally to an account of specific and personal experiences with little or no consideration for the common question being addressed by the group. **Monological** exchange refers to a reflexive discussion related to the common question addressed by the group, but which follows its own course without being influenced by the divergent points of view expressed by peers. **Noncritical dialogical** exchange refers to an intersubjective type of exchange that is constructed in pyramid form based on peer interventions, where each point of view contributes, in varying degrees, to enriching the group's perspective. A noncritical dialogue remains simple as there is no evaluation of viewpoints. **Semicritical dialogical** exchange refers to an exchange that contains certain criticisms directed at peers, but these criticisms do not influence the pupils that receive them. Therefore, at the end of the exchange, the initial perspective is enriched but not modified. Finally, a **critical dialogical** exchange is a type of exchange that is intersubjective and evaluative; therefore it is constantly being transformed. The third step of P4C strives toward this last type of exchange.

The development of philosophical reflection presupposes not only the development of critical dialogue involving complex thinking skills and attitudes, but also an increasing sophistication of pupils' representations.

A Model of the Developmental Process of Dialogical Critical Thinking

The model of the developmental process of dialogical critical thinking arose within the context of P4C. It first "emerged" (see Charmaz 2005; Glaser and Strauss 1967) from analyses of

philosophical exchanges among pupils aged 9–12 years who were members of classes from Quebec, Mexico, and Australia (Daniel et al. 2005). The model was recently revisited in an experiment conducted with children aged 4–12 years in classes from Quebec, Ontario, and France (Daniel and Gagnon 2011, 2012). The above studies were subsidized by the Social Sciences and Humanities Research Council of Canada.

In this model, critical thinking is said to be "dialogical" because, within the context of P4C, dialogue is the main stimulus for this type of thinking. The components of dialogical critical thinking (DCT) differ from traditional definitions of critical thinking (rooted in formal logic and universal standards of rationality) in that DCT is defined by four thinking modes: logical, creative, responsible, and metacognitive.

Unlike other models of cognitive development, the developmental process of DCT is not linear nor hierarchical, but is recursive and manifests as a "scaffolding" process, that is, the thinking gradually appropriates more complex representations while keeping its anchoring in simpler representations. DCT development is rendered operational by means of epistemological perspectives, that is, it is transformed according to the sophistication of the pupils' meanings and representations of the world, which can either focus on the self (egocentricity), take into account others' points of view (relativism), be oriented toward the improvement of the common good (inter-subjectivity), and so on. The sophistication of pupils' meanings and representations underlies two processes related to decentering (from the self to others and then to the common good) and to abstraction (from concrete/particular to generalization and then to abstraction/conceptualization) (Daniel et al. 2011). The term "epistemological *perspective*" refers to the manner in which meanings and representations are constructed, no matter what object is in question. Furthermore, epistemological perspective refers to the idea of "relational epistemology" (Thayer-Bacon 2003). Finally, DCT is understood as a social research process (vs. an individual outcome).

Table 1 presents the operational components of the model of the developmental process of DCT, these being the four thinking modes and six epistemological perspectives.

The four thinking modes are defined as follows (Daniel and Gagnon 2012).

Logical: Logical thinking refers principally to informal logic in which the main characteristic is a search for coherence. Coherence is observed in the articulation of language and the convergence of ideas. The logical mode is fundamental to the developmental process of DCT because it allows congruity between the question posed and the answer provided, between the statement and its justification, etc.; in its more complex manifestation, it implies rigorous argumentation, that is, premises are justified, analyzed, and evaluated in cooperation with peers. The main manifestations of thinking skills relating to logical thinking that emerged from the transcripts – from the simplest to the most complex – are: statements, descriptions, explanations, definitions, justifications, and argumentation.

Creative: Creative thinking refers to a search for meaning, a contextualization of points of view and a transformation of perspectives. In its complex manifestations, this mode of thinking, because of the divergent relationships it creates, is fundamental to the development of DCT. Indeed, creative thinking presupposes the formulation of questions that stimulate doubts regarding the certainty of participants' representations and, in so doing, it provides access to more complex resolutions of the problem and/or explorations of the question. The main manifestations that emerged from the transcripts – from the simplest to the most complex – are: examples, analogies, comparisons, counter-examples, nuances, divergent relationships, and critical questions.

Responsible: Responsible thinking is more in line with the Deweyan perspective of "moral thinking" in that it combines cognition (explanation, evaluation, etc.) and emotion (empathy, sensitivity to others, etc.) in an interdependent relationship. The responsible thinking mode is related to reflections on social/moral beliefs, rules, actions, values, etc. From the perspective of the development of DCT, the responsible mode appears fundamental because it eventually represents the balance between the right to express oneself and the

Dialogical Critical Thinking in Children, Developmental Process, Table 1 Model of the developmental process of dialogical critical thinking (Daniel and Gagnon 2011)

Modes/epistemology	Logical	Creative	Responsible	Metacognitive
EGOCENTRICITY	Statement based on the perceptual experience of a specific and personal fact	Statement that gives meaning to a personal point of view	Statement that is related to a personal and specific behavior linked to a social or moral belief	Retrospective statement about a personal and specific task, point of view, feeling, etc.
POST-EGOCENTRICITY	Statement based on experience (personal or of someone close) + reasoning	Statement that gives meaning to a personal point of view (but distanced from self)	Particular/concrete statement linked to a moral or social rule (learned) Not contextualized.	Retrospective statement about a personal task, point of view, feeling, etc. (distanced from self)
PRE-RELATIVISM	Somewhat generalized statement that is not justified or with an implicit, circular or false justification	Statement that is new, divergent, or that presents different situations/solutions/ hypotheses (units) in relation to a personal idea or to someone else's idea	Statement linked to a somewhat generalized action in a moral or social perspective	Descriptive retrospective of a personal task, point of view, feeling, etc. (distanced from self)
RELATIVISM	Statement based on a generalization that stems from reasoning and experience Incomplete/concrete justifications	Relationship that gives meaning to a peer's point of view (by completing it or adding a nuance or a new relationship/ perspective)	Statement that expresses a will to understand/include others (from the immediate environment) with or without appealing to an integrated moral/ social rule	Descriptive retrospective of another person's task, thought, etc. (from the immediate environment)
POST-RELATIVISM/ PRE-INTERSUBJECTIVITY	Justification based on "good reasons" that stem from simple reasoning	Relationship that presents a different context that takes into account the group's perspective	Statement that justifies a desire to understand/ include others (distant environment) with or without the use of an integrated moral/ social rule	Descriptive retrospective of another person's task, thought, etc. (distant environment)
INTERSUBJECTIVITY	Justification based on criteria. Conceptualization based on simple reasoning	Evaluative relationship that provides a different meaning and transforms the perspective	Doubt that underlies the evaluation of categories (rules, principles, social/ moral values)	Evaluative statement that expresses a change in perspective following the integration of criticism
	Conceptualization	*Transformation*	*Categorization*	*Correction*

responsibility to do so with sensitivity; it anchors evaluation of facts, of points of view, and so on, in concern for others and eventually in concern for the common good. The main manifestations of thinking skills of the responsible mode that emerged from the transcripts – from the simplest to the most complex – are: statements, descriptions, explanations, and evaluations relating to a personal behavior, to group rules, or to social/ ethical values.

Metacognitive: The metacognitive thinking mode refers to awareness of a thought ("thinking about thinking") but also, in its simplest expression, to awareness of a task completed, emotion experienced, point of view expressed, etc. The metacognitive mode is fundamental to the increasing sophistication of DCT because it is the only mode that allows for retrospection that eventually leads to self-correction. The main manifestations – from the simplest to the most complex – are: recalling (expressed in the form of a statement) a behavior, task, emotion, point of view, etc.; descriptions related to a task completed, emotion experienced, point of view expressed, etc.; evaluations of a perspective, a thought, etc., that lead to correction.

Each of the above thinking modes is dynamic, and is likely to reflect an epistemology that is more or less complex. For example, creative thinking can be centered on particular and personal examples, or it can develop relationships with peers' viewpoints, or transform the group's perspective by posing new questions or proposing divergent relationships. The epistemological perspectives, as they emerged from the analyses, are defined as follows (Daniel and Gagnon 2012):

Egocentricity: This is the perspective that underlies the most simple meanings and representations. It implies certainty as well as dualistic and concrete representations of the world, which are not influenced by divergent points of view. In this perspective, statements refer to the pupil's specific personal experience, are centered on simple units (vs. relationships), are without nuance, and are formulated in "I" form. Below is an example of egocentricity as manifested in creative thinking, as a personal example serves to justify a point of view and give it meaning.

> (Pupil of 9–10 years): *(. . .) it's true because once I did something nice and then there was a lottery at the day-care and I won a prize (. . .).*

Post-egocentricity: This is also a perspective characterized by concreteness and centering, but it underlies a slight increase in sophistication of representations and meanings. Pupils' statements are somewhat decentered, referring to the specific experience of a pupil's immediate environment (e.g., family), centered on simple units, not justified and generally formulated in "we" form (including self and others) or possessive "he/she" form. Here are examples of post-egocentricity as manifested in creative thinking.

> (Pupil of 5–6 years): *Me too my dad he does the same.*
> (Pupil of 10–11 years): *(. . .) for example my grandfather he died, for sure my friend he will understand me.*

Pre-relativism: In this perspective, representations and meanings starts to become more sophisticated. Pupils describe their point of view to peers. These points of view underlie the beginnings of generalization, but remain grounded in familiar surroundings or contexts. Statements are centered on units and generally formulated with a general "we" or with a generalized "they." Below are examples of pre-relativism as manifested in creative thinking, as pupils add a different viewpoint to the group's perspective or present more than one side of a problem.

> (Pupil of 5–6 years): *I don't agree because babies they have brains like humans (. . .) because babies can think because they know they're in their mother's belly.*
> (Pupil of 7–8 years): *Sometimes there are people on boats who play at shoving each other and sometimes someone gives a big shove and the other person can fall into the water.*

Relativism: This is an epistemological perspective that presupposes a rupture in the groups' representations. Pupils seem to become aware that the world is not so simple (good/bad, right/wrong). They seem to be aware that others have different beliefs, points of view, etc., as they listen to others more actively. On the other hand, they want others to understand the meanings of their ideas, hence their statements are more elaborate than in the previous perspectives and they include a justification explicitly articulated (e.g., *because. . .*). Justifications are stated in the form of concrete and/or incomplete explanations with underlying simple relationships between points of view or contexts (vs. units that are independent from each other); justifications are still grounded in experience, but with the beginnings of generalization; they are generally formulated in "you," "we," or generalized "they" form. Below is an

example of relativism as manifested in creative thinking, as pupils agree with their peer's viewpoint but add an element that complements the peers' viewpoint in order to further develop it.

> (Pupil of 9–10 years): *I agree with F. I find it's true you have to take your responsibilities. Often parents will want the child to have responsibilities to help out in the house because when you're a large family you have a bigger house so everyone has to help out and all that.*

Post-relativism/pre-intersubjectivity: This perspective illustrates the continuation of the process of decentering and abstraction that began in the previous perspectives. It implies that statements are generalized and show the beginnings of conceptualization; they include a justification that is explicitly articulated, presented in the form of a "good reason" (supposing an underlying inference rather than linked to a practical experience), related to peers' points of view. Statements imply the beginnings of a constructive evaluation. Below is an example of post-relativism/pre-intersubjectivity as manifested in creative thinking, as the pupil brings in a different perspective which he justifies with a good reason that was not previously developed in the group.

> (Pupil of 11–12 years): *Well I don't really agree with M (that adults are more intelligent than children) because it's not just adults who are intelligent (there are) also children who are intelligent and these children become adults.*

Intersubjectivity: In this perspective, representations and meanings are complex, as statements are conceptualized, are presented in the form of questioning or as a constructive evaluation of points of view, premises, etc., underlying a search for different meanings (vs. for a single truth) that include argumentation expressed in negotiation form. Statements include justifications that are explicitly articulated, are presented in the form of criteria (subjective or objective), are well developed although not comprehensively, and are linked to peers' points of view. Statements are centered on social or ethical concerns, and sometimes explicitly include self-correction. Below is an example of intersubjectivity as manifested in creative thinking, as pupils present evaluative relationships that contribute to increasing the sophistication of, or even to transforming, the group's perspective.

> (Pupils of 11–12 years): Pupil 1: - *If it's about intelligence, I think humans are at the top of the list. I think humans are the only ones that can do mathematics. Humans invented English and mathematics. Math is like another language we invented. We use it to understand things, to do the things we have to do well, to understand the reasons behind things. Like why the sky is blue and why can't we float or fly. So we invented mathematics to explain these things. But animals, they just think "sky" and they don't really think, they don't really think about the sky. Because they have, if for us eating and mating are an instinct, for them it's their principal instinct. (. . .)* Pupil 2: - *I do not quite agree with what Pupil 1 said. Well, it does depend, because we invented maths and you can't blame them (animals) for not doing it (. . .) And people just think they're dumb because they don't know our ways, but they probably think we're dumb, if they do think. So I kind of, I don't know. (. . .) And look at us, we have massive holocausts over land and we kill thousands of people but they'll just have one old fight and then it'll be over. I kind of think animals are smarter in their own way and we're smarter than them in our own way.*

Conclusions and Future Directions

Dialogical critical thinking is a process of evaluating an object of thought (whether concrete or abstract) in cooperation with a community of peers in an attempt to reach meaningful representations of that object that are more complex and valid than representations used at the beginning of the inquiry. Dialogical critical thinking is a developmental process that manifests itself through cognitive skills and attitudes that focus on conceptualization, transformation, categorization, and (self-)correction. DCT therefore presupposes the development of four thinking modes: logical, creative, responsible, and metacognitive. These thinking modes increase in complexity through the operation of six epistemological perspectives: egocentricity, post-egocentricity, pre-relativism, relativism, post-relativism/pre-intersubjectivity, and intersubjectivity. As this definition emerged within the P4C context, further contributions could be to explore its components with pupils who have no experience with P4C, that is, in other school disciplines or in the context of informal exchanges.

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Digital Economy

► Cyberentrepreneurship and Proximity relationships

Digital Economy and Business Creation

Alain Philippe Batsale
University of Paris 12, Paris, France

Synonyms

Digitization; Information technology (IT)

Digital economy is the convergence of computing, communications, and contents. The two main components are computer industry and information treatment. It might be said that hardware is too physical to be discussed on a topic about digital, but the software cannot be considered without the hardware, and the hardware is of no use without its software. As far as business creation is concerned, the computer industry has led to the emergence of a huge industrial sector which continues to innovate. But, taking the example of France, if 1.2 million jobs have been created by the Internet, the estimated number of jobs destructed by this innovation is around 500,000 in this country. And regarding the information technology, the consequences may still be more equivocal: in matter of businesses, the process of creative destruction is engaged and is supposed to last long before a new equilibrium is reached.

A Case of Creative Destruction

The computer industry has gone through several revolutions (mainframes, minicomputers, personal computers, cloud computing) that led each time to new businesses. This industry is very emblematic of that process. Just include Microsoft, Apple, Google, and Facebook to illustrate the outstanding capabilities of the computer industry to generate start-ups that quickly become major global companies. New products, new devices, and new software, since the times of mainframes to the days of the Internet, have naturally involved the creation of new businesses.

Schumpeter (1942) separates several types of innovations that lead to business creation. The innovations set up by the computer industry consist mainly in the occurrence of new products. Mainframes, minicomputers, microcomputers, and smartphones have appeared over time, and the list is not supposed to be closed. In the computer industry, even software, which is also a kind of digital hardware, does not usually replace an existing product and frequently establishes a new kind of good. On the contrary, regarding the information treatment, it is rather a matter of new process of production or more precisely of reproduction. So the information treatment has driven a history more disturbed. The underlying process of digitizing leads to products of replacement more than real novelty. For instance, files of data instead of books, records, or films. So the information treatment has generated a new way of reading books or the press, a new kind of films and unknown types of musical records, and, in general, a new way of transmitting information. The materiality of these products has changed drastically: no more atoms, now, just bits. And this transformation involves definite economical consequences.

So besides the problems of creative destruction yielded by the emergence of new types of products in the computer industry, the proper nature of the information technology files of bits gives place to new economics: the digital economy. The economical pattern of a file of bits as a digital product is constant fixed costs and zero marginal costs (Varian 2004), so it is difficult to apply the neoclassical principle of a price equal to the marginal cost of production. This particular cost structure is the "baseline case" (Varian 2004) for information goods, particularly for digitized ones, while it is rather unusual for physical products with capacity constraint in the production process. So, in digital economy, good compliance with the laws of economics may lead to sale prices close to zero or to free. The confrontation between the new digital products and the old physical ones is therefore a very conflictual meeting, and the development of piracy is a big concern for firms implied in these markets.

New Businesses: Downsized Hardware and Digitalized Contents

The computer industry and the telecoms sector, on the hardware side, have known rather a traditional evolution; based on hardware downsizing on size and price, thanks to major innovations: transistor, integrated circuits, and microprocessor. A train of disruptive innovations (Christensen 1997) has generated a large number of new businesses. The first computer firms used to be large companies from the mechanographical (IBM) or the electric/electronic sectors. The personal computer revolution and the emergence of the Internet enabled lots of start-ups to emerge, some of them eventually becoming major companies. This was done mainly through new products downsizing traditional ones. On this hardware side of the industry, the traditional laws of industrial economics still apply generally, and the evolution of the sector has been rather similar to the one of other sectors.

The computer industry, on the software side, has known a slightly different trend which is also the logic of information technology. In the real sense, this is the digital economy which is based on the very nature of digitizing. While the hardware side leads to new products and new businesses by downsizing, there is a large freedom in the price level for digital products which sharpens the competition with traditional products, as it is the case for digital information goods. Since a digital product (generally a non-tangible public good) lacks of physical constraints in reproduction, its structure of costs (high fixed cost and low marginal cost) enables three specific pricing discrimination strategies: market for one, with highly personalized products; versioning, with different prices for different market segments; and selling at different prices to different groups of consumers. These strategies give to digital products a big competitive advantage over the (traditional) physical ones, strengthen the process of creative destruction, and threaten seriously the old firms.

In the beginning, the competitive advantage or the innovative product enables the creation of numerous firms. A lot of businesses are created, as we have seen, for instance, about digital music

or social networks (information technology) or around new devices as smartphones or tablets (computer industry) by the emergence of small firms whose usual pattern is the start-up. This moment is followed by a standardization process which organizes the industry. In the meantime, firms of the previous periods are mostly weakened.

A Specific Process of Standardization

So another important feature of the digital economy, inherited from the computer industry, is the specificity of its standardization process. It is proper to the information technology sector and influences deeply the market structure, the number and the nature of the firms, and the way businesses are created all along the life cycle of products. This process was developed by IBM with the 360 machine, and it combines openness and modularity. This kind of routine, as the evolutionary economists might say, was verified for several products.

The digital economy is a network economy regulated by what is called increasing returns of adoption (Arthur 1989), which means the greater the number of costumers, the greater the utility of the product. The first period of the process of standardization is a time of trial and error during which many businesses are created around products following different protocols not compatible with one another. There is a second period when one of these products is able to reach the status of standard, be it for quality reasons, market power reasons, agreement between firms, or whatever. If a business wants to survive, it has to join the standard, when it is possible, or perish. A big amount of the young firms that have been created during the period of trial and error are supposed to disappear with the emergence of the standard. Then a third period begins, and the standard product may develop a kind of ecosystem and give birth to a new set of businesses connected with that standard. The standardization process was experienced for the IBM 360, the operating systems by Microsoft, the microprocessors by Intel, but also for the search engine by Google or (presumably) the social network by Facebook. Meanwhile, the firm that has set up the standard becomes usually a global major company.

We can detect several economical leverages behind the standardization process (Varian 2004), for instance, the switching costs that affect a customer who tries to change after having adopted a product. Moving from one operating system to another, from one social network to another, and from one Internet Access Provider (IAP) to another is not that easy and generates significant costs. The switching costs and the increasing returns of adoption may cause a virtuous circle in favor of a standard. There is also an economical concept which is called "lock-in" to describe strategies used by firms to prevent customers to escape. These forces help a successful product, a dominant design, to supplant the other ones and stay almost alone on a market. Moreover, the victory of a winner product is still strengthened by the network externalities yielded by the complementary products that other firms may find it profitable to produce in order to make use of the ecosystem created. The network externalities are also a way to set up new businesses.

In the Search of a New Model: The Protection of Contents

The total balance sheet between new firms and businesses destructed by the development of the digital economy is still difficult to set precisely, especially concerning the digitization of contents. Even if we can anticipate that the final figures will be positive, there is a deep concern about the classic media. The regulation may be made using the law, for instance, through property rights.

The cost structure of digital products was first an issue with the development of the software industry. Large firms in the computer industry were converted experts in the management and use of property rights to cope with the ease of copying software. This is even more accurate with the growing digitization of contents over the Internet. If Facebook creates a new kind of ecosystem, pieces of music downloaded eliminate the use of a CD-ROM. Until a viable economic model is found, new businesses will be set up for the lawyers as well.

Conclusion and Future Directions

The digital economy may create many businesses, but many companies are threatened by the digitization of the economy. This is the consequence of two processes. Firstly, inside the computing sector itself, on the hardware side, by the creation of new products, mainly by downsizing and secondly, as a threat against the firms of other sectors, on the software side and with the information treatment, by digitizing processes and contents.

Regarding the hardware aspect, the traditional laws in economics still apply. For instance, Apple succeed in managing several lines of products with an astonishing marketing, a very efficient brand policy, and reduced costs of production made possible by overseas units of production. The processes engaged for this achievement are described by traditional industrial economics.

On the software side, when the information is effectively digitized, this is the very domain of digital economy. There, the marginal cost is frequently close to zero, the selling price is difficult to determine, and the virtuality of the digit seems to have attacked the economical reality. Even the price of firms seems to be affected, a young company which has not made any profit may value billions of dollars; the rise of Apple's market capitalization seems to have no ending. But, with Hal Varian, we can consider that in the economics of information technology, the old principles still work remarkably well. Only, effects that were not quite usual in the industrial economy, network effects, switching costs, or differentiated prices are the common law in digital economy. So we need to focus on these peculiarities more than to change for a new economy.

What political and economical authorities must cope with is a traditional process of creative destruction, while this process is sharpened by the extraordinary power of digitizing. The organization of a new industrial paradigm has to be set up. In the past, this process has always established the grounds of a new era of prosperity. Why would it be different this time?

Moreover, we can see a kind of new innovation ecosystem around the Internet which can be compared with the mechanical one during the nineteenth century and what happened around the combustion engine in the beginning of the twentieth century and the integrated circuit in the 1960s. These are examples of combinatorial innovation which boosted the all economy and as it is now question of bits and not atoms, at the speed of light all around the world, the development of this new paradigm may be very much faster than the former ones.

Cross-References

- ▶ Business Creation
- ▶ Creative Destruction

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Digitization

- ▶ Digital Economy and Business Creation

Direct Legislation

- ▶ Innovations of Direct Democracy

Direct Say

- ▶ Innovations of Direct Democracy

Directed Evolution® Technology

Boris Zlotin and Alla Zusman
Ideation International Inc., Farmington Hills, MI, USA

Synonyms

Guided evolution; TRIZ forecasting

Definition

Directed Evolution® is a technology involving systematic processes for building a sustained competitive advantage through the effective management of the evolution of various artificial (man-made) systems by utilizing evolutionary patterns for technologies, markets, business, social systems, etc.

Directed Evolution is a result of integration and further development of *technological forecasting* and the *Theory of Inventive Problem Solving*.

Technological forecasting was introduced in the mid-1950s as a collection of non-related techniques based on probabilistic modeling of future characteristics of various systems. While proven being useful for short-term predictions, the method failed to deliver reliable long-term results, primarily due to the tools that were utilized to develop the forecasts.

The Theory of Inventive Problem Solving originated in the mid-1940s by Genrich Altshuller is based on the assumption that inventions in technological systems appear not randomly but rather in compliance with certain statistically recurrent *patterns of technological evolution* that could be revealed and utilized for organized and structured innovation. Typically, each pattern of evolution includes multiple *lines of evolution* – more detailed descriptions of how this pattern could be realized step-by-step.

By the mid-1970s, the discovery of patterns of evolution has enabled the introduction of *TRIZ forecasting*. Unlike traditional technological forecasting, it is based on utilization of predetermined patterns offering new directions together with proven ways how they could be realized. However, while providing valuable insight on the nature of the next generations of the given systems, TRIZ forecasting could not provide reliable answers when these new generations would come to existence.

The Directed Evolution (DE) technology was introduced in the early 1990s by Ideation International's research group as a proactive approach to the evolution of technology. Instead of making a prediction and waiting for it to be confirmed, the DE process uses numerous patterns and lines of evolution for the purpose of identifying possible scenarios, selecting the most promising ones, then building a road map and planning the process of implementation. In other words, DE is a method to predict future generation of a system by inventing it. To date, DE can be applied to various aspects of human life, including product and process development, evolution of technologies, markets, organizational development, and more. Later, significant progress has been made with the introduction of Directed Evolution® software, which incorporated powerful analytical tools and substantial knowledge base for predicting and solving various problems and more.

Typical results of a DE project include:

1. A comprehensive diagnostic analysis of the DE subject, including identifying problems hindering the evolution of the given system, revealing the system's evolutionary potential and evaluation of the applicable intellectual property
2. Solving selected problems, generating new ideas, and building futuristic concepts for the short-, mid- and long-term
3. Predicting possible mistakes and undesired events associated with further evolving the system and developing recommendations for their timely detection and prevention and possibly capitalization on them
4. Providing recommendations for the effective growth of intellectual property, structuring an IP portfolio, and increasing the company's creative potential

To date, over 100 of DE projects have been completed. The list of selected DE projects

includes automotive, petrochemical, oil, medical instrumentation, electronic and other industries, consumer products, and business organizations.

Note. Directed Evolution is a registered trademark of Ideation International Inc. The name was suggested by Dr. Gafur Zainiev.

Cross-References

- ▶ Inventive Problem Solving (TRIZ), Theory
- ▶ Patterns of Technological Evolution
- ▶ TRIZ Software for Creativity and Innovation Support

Discover

- ▶ Invention Versus Discovery

Discovery

- ▶ Technological Invention of Disease

Displacement of Metaphors

- ▶ Knowledge Society, Knowledge-Based Economy, and Innovation

Disruptive Innovation in Higher Education

- ▶ Higher Education and Innovation

Distressed Finance

- ▶ Small Businesses - Value, Transmission, and Recovery

Distributed Innovation Process

- ▶ Collaborative Innovation and Open Innovation

Distributed Metacognition and Creative Ideas

- ▶ Social Metacognition and Micro-creativity

District

- ▶ Clusters, Networks, and Entrepreneurship

Divergent Thinking

Mark A. Runco
University of Georgia, Athens, GA, USA

Synonyms

Creative potential; Flexibility; Fluency; Ideation; Originality

Introduction

The theory of divergent thinking is among the most useful in all of creativity studies. Many people equate divergent thinking with creativity tests, which is not an accurate view since (a) divergent thinking is useful outside of assessment and testing and (b) divergent thinking is not synonymous with creativity. That being said, tests of divergent thinking are the most commonly used estimates of the potential for creative thinking. But divergent thinking tasks are also useful as exercises, even when there is no need or interest in measurement, and the theory of divergent thinking is useful when attempting to understand creative

thought, even when there is no need for application, data, or assessment. It is a good theory. It stands up when the criteria for what makes a good theory (e.g., broad coverage, testable hypotheses, parsimony) are used to evaluate it. This entry starts with a summary of the theory of divergent thinking and then moves to how that theory led to measurement and assessment.

Theories of Divergent Thinking

The theory of divergent thinking was developed almost entirely by two people, J. P. Guilford (1968) and E. Paul Torrance (1995). Guilford was interested in creativity and in fact pushed the entire field of creativity studies into the scientific realm when presented his 1949 Presidential Address to the American Psychological Association. It was titled "Creativity" and contained a compelling argument for why creativity could and should be examined empirically. Guilford saw that creativity is "a natural resource," an idea that is being renewed today. Of more immediate influence was his Structure of Intellect model which attempted to delineate cognitive ability. It started with approximately 80 distinct skills and capacities but after years of empirical work grew such that it included 120 of them. Right before his death, Guilford proposed that there were in fact 180 identifiable and distinct skills and capacities.

There were questions about Guilford's statistical preferences, and these brought the orthogonality of the distinct skills into question. But the distinction Guilford offered between convergent and divergent thinking proved to be enormously useful. It fit well into theories of creativity and allowed the construction of reliable tests of creative potential. Guilford himself developed dozens of tests of divergent thinking, as did E. Paul Torrance. In fact, Torrance's (1995) battery of assessments, *The Torrance Tests of Creative Thinking*, remains the most commonly used measure in creativity studies.

Note, however, in the first paragraph the idea that tests of divergent thinking should be viewed only as estimates of potential. This point must be underscored since it allows us to avoid the mistake that tests of divergent thinking measure creativity. What they do is *estimate* creative *potential*. They are estimates because there is measurement error. Of course, that is true of any test or measure (thus characterizes all research in the behavioral sciences). As a matter of fact, the reliability and validity of divergent thinking tests, when they are administered and scored in accordance with the latest procedures, are as high or higher than many other behavioral tests. They are at least as reliable and valid as IQ tests, for example, and more reliable and valid than most tests of personality. Still, they are not perfectly accurate. There is no such thing as a perfectly accurate test. Tests are predictions. They sample behavior and then predict future behavior. Tests of divergent thinking do offer reasonable predictions of future creative performances – at least certain creative performances.

Some of the original tests did not offer very good predictions. Indeed, many people rejected divergent thinking tests in the 1970s because the predictive validity studies at that time were less than impressive. But the tests have improved. In fact, both the predictors (i.e., the tests of divergent thinking) and the criteria have improved. The older studies showing poor predictions used criteria that were available at that time, but these either focused on personality traits or on socially recognized creative accomplishment. They did not focus on what tests of divergent thinking actually assess, which is ideation. Tests of divergent thinking provide information about *ideational fluency* (the number of ideas a person gives when asked an open-ended question), *ideational originality* (the tendency to give unusual or novel ideas), and *ideational flexibility* (the variety of ideas given or the number of conceptual categories in the ideational output). Sometimes *elaboration* is used (the tendency to exploit one conceptual category) but not often. The only appropriate criteria when checking the predictive validity of tests of divergent thinking must also focus on idea. One measure was designed for exactly that (the *Runco Ideational Behavior Scale*, or RIBS) and studies using it are

the ones that give reliability and validity in excess of what is found for IQ tests or personality inventories.

Additional Indices and Tests of Divergent Thinking

Tests of divergent thinking have been scored for *appropriateness* of ideas, as well as fluency and so on. This is notable because of the claim that tests of divergent thinking only estimate creative *potential*. They do not guarantee actual creative *performance*. Of course, if you want to measure actual creative performance, it is easy to administer an inventory of creative accomplishment. These are self-reports and as such are open to certain biases, but they do reliably index how many specific creative performances (e.g., "How many times have you had something published?" "How many patents have you been awarded?" "How many public recitals or concerts have you given") and accomplishments. The distinction between potential and actual performance is a critical one, especially for educators or anyone choosing a measure of creativity. It is discussed in detail in this same volume ("► Four Ps in Organizational Creativity").

The appropriateness index was developed for tests of divergent thinking because although they offer good information about originality, creativity is more than originality. Creativity requires some sort of appropriateness, effectiveness, or fit. It an idea is just original, it is not creative. In fact, highly original ideas that lack effectiveness may be crazy and not at all creative. Originality is necessary but not sufficient for creativity. Other newer indices and scores for divergent thinking tests focus on the metaphorical impact or degree of transformation, but none of these has been studied extensively. Most research uses only fluency since it is highly correlated with originality and flexibility, but this is a mistake. There is reliable variance to originality and flexibility scores, even when fluency scores have been statistically controlled, and even more importantly, originality is more critical for creativity than is productivity. If only one score was to be used, it should be originality and not fluency. The best technique is to look to a profile, with fluency, originality, and flexibility.

It is not just the scores from tests of divergent thinking that determine the reliability and validity. The tasks themselves are also important. In fact, some tests insure that creativity is especially well and realistically sampled. Consider in this regard tasks that assess *problem generation* as well as problem solving. All tests of divergent thinking are open-ended. Unlike tests of convergent thinking, which require that the individual find the one correct or conventional answer, divergent thinking tasks allow multiple answers and ideas. Most of them present a problem, such as "name all of the strong things you can think of" or "list as many uses as you can for a toothbrush." Others are realistic (e.g., "you forgot a hat and the sun just appeared from behind the clouds.... what can you do to avoid sunburn?"). Yet others go beyond problem solving and tap problem generation. This is tied to the problem-finding abilities that are so critical for actual creativity. Often there is more creativity to identifying and defining a problem than there is to solving it! For that reason, some tests of divergent thinking ask the individual to list as many problems as they can (e.g., "list problems faced by a typical student at your school."). Thus, the examiner gets an estimate of both problem-finding and problem-solving originality.

Problem generation tasks were used in one study that had especially impressive predictive validity. This investigation used realistic (presented) divergent thinking problems as well as realistic problem generation tasks in a study of the relationship of each with suicide ideation. The rationale relied on the large literature on psychopathology and creativity (e.g., the "mad genius controversy"); there is a long-standing interest in the relationship of creativity with clinical and subclinical tendencies. Suicide ideation is thought to precede actual suicide attempts. It is especially troubling when it is paired with depression. If that occurs, there is a high likelihood of an actual suicide attempt. The impressive part of this research was that a combination of the divergent thinking tests actually predicted suicide ideation

better than depression! In fact, the association between depression and suicide ideation was determined and then statistically controlled, and still the divergent thinking tests were significantly related to (and predictive of) suicide ideation. Very importantly, it was a statistical interaction that was the accurate predictor of suicide ideation. In particular, suicide ideation was likely among individuals who had both (a) fluency with problem generation (they saw many problems) and (b) low flexibility (a kind of rigidity of thought) when solving problems.

A Technology of Ideation

One attraction of divergent thinking is that it applies to so much of our behavior. Think for a minute how often ideas are involved in our actions! Ideas are involved for all of our mindful behavior (we have an idea, think about it, and perhaps act on it), and depending on how an idea is defined (see this volume, the entry on "► Ideas and Ideation"), they may be involved in everything except reflex. One conclusion of the recent volume, *Divergent Thinking and Creative Ideation* (Runco 2012) was that the divergent thinking research has given us a "technology of ideation." The idea here (pun intended) was that ideation is an important and broadly applicable process and divergent thinking methods provide us with a reliable method for studying ideas. Note that this again implies a separation between ideation and creativity. Creativity sometimes depends on original ideation, but ideation is important outside of creativity.

The breadth of applicability is reinforced by a quick look at all of the populations who have been involved in the divergent thinking research. Virtually all age groups have been studied, for example. Preschool children who cannot yet write can still be assessed by giving them 3D objects and having them talk about what the object could be. They will talk freely and their discourse can be scored for all of the typical indicators, including originality. Older adults have been studied, and interestingly, they have an idiosyncrasy: They seem to suffer, with age, specifically in their flexibility. They rely more and more on routine and habit and their ideas become less and less varied and diverse. One last example of a population which has been studied was that of entrepreneurs. The divergent thinking tests designed for them asked for ideas concerning the strengths, weaknesses, opportunities, and threats to their businesses. This SWOT model is often used in studies of entrepreneurs and was adopted for the divergent thinking tasks in an attempt to insure that the participants in the research – highly successful entrepreneurs – would be engaged in the tasks.

That is an important point and reinforced the argument that tests of divergent thinking are merely estimates of potential. Just because someone does well at one point, on any test or sample of behavior, does not guarantee that they will do the same in the future. Insuring that individuals are engaged in the tasks does help in this regard because those individuals are much more likely to perform at their highest level when motivated. This is actually a benefit of all realistic tests of divergent thinking. There is a drawback, however, in that realistic tests seem to allow individuals to look back on their experience and find ideas by searching long-term memory. As a result, originality scores are often low in realistic tests.

Another way to engage individuals when assessing divergent thinking is to insure that they do not treat the tasks as typical tests. If divergent thinking tasks are presented such that they appear to be tests, examinees focus on convention and correctness. They are not nearly as original as they are if the tasks are called games instead. Originality is much more likely if the tasks have directions which de-emphasize spelling, grades, points, correct answers, or evaluations of any sort. Originality is likely if the tasks are called games and examinees are told to have fun. If divergent thinking tests are not administered in this game-like fashion, the same individuals who do well on traditional tests, like those in school, will be the only ones who do much. Other students may have creative talents, but their originality will not be clear unless they are assured that divergent thinking tasks are not convergent

nor academic tests. If divergent thinking tasks are administered in a game-like fashion, students who do not receive high grades may very well stand out and excel in their ideation.

Conclusions and Future Directions

Additional research is needed to insure that tests of divergent thinking are used most effectively. Research in progress is testing new indices, to go along with originality, flexibility, and fluency, for example. Other work is manipulating the instructions given with these tests, the idea being that results are only valid if respondents and examinees are interested in generating ideas. Of most importance for future research may be techniques that will allow tests of divergent thinking to be used but used such that the information obtained is indicative of creative performances that occur in the natural environment. Too often, tests are only indicative of behavior that can be elicited in controlled settings. What is most important, however, is behavior as it occurs in the natural environment. Headway is being made (e.g., with realistic tests of divergent thinking) toward testing that will predict behavior in the natural environment with great accuracy.

There are other ways, besides divergent thinking tests, to estimate creative potential. Note, however, that tests of divergent thinking capture the most important part of creativity – originality – and do so in a reliable fashion. There is a sizable literature on divergent thinking, which means that plenty of data and results can be found to aid and support interpretations. They are theoretically justified, by the Structure of Intellect model as well as various associative theories. Tests of divergent thinking can be used with a broad range of populations. And they allow the individual to produce something – to create. The creation or product is an idea, but ideas are of enormous value, for world-changing inventions and everyday coping. Divergent thinking tests must be viewed as *estimates* of the *potential* for creative thinking, but they are good estimates, and there are few things that should be invested in as heavily as creative potential.

Cross-References

- ▶ Brainstorming
- ▶ Cognition of Creativity
- ▶ Convergent Versus Divergent Thinking
- ▶ Ideas and Ideation

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Divergent Thinking Tests

▶ Creativity Tests

Divergent Versus Convergent Thinking

Olga M. Razumnikova
Cognitive Physiology Laboratory, State Research Institute of Physiology SB RAMS, Novosibirsk State Technical University, Novosibirsk, Russia

Synonyms

Creativity versus intelligence; Innovation versus critical thinking; Intuitive thinking versus logic thinking; Irrational versus rational thinking

Key Concepts and Definition of Terms

The concept of divergent and convergent thinking was created by J.P. Guilford to term different types of psychological operations while problem solving. **Divergent thinking** is defined as producing a diverse assortment of appropriate

responses to an open-ended question or task in which the product is not completely determined by the information. So, divergent thinking concentrates on generating a large number of alternative responses including original, unexpected, or unusual ideas. Thus, divergent thinking is associated with *creativity*.

Convergent thinking involves finding only the single correct answer, conventional to a well-defined problem. Many facts or ideas are examined while convergent thinking for their logical validity or in which a set of rules is followed. Convergent thinking focuses on reaching a problem solution through the recognition and expression of preestablished criteria. Standard *intelligence* tests are similarly believed to measure convergent thinking.

Divergent Versus Convergent Thinking, Table 1 Differences in characteristics associated with convergent and divergent thinking

Characteristics	Convergent	Divergent
Problem type	Well-defined	Poorly defined
Responses	Single	Multiple
Psychometric index	Intelligence	Creativity
Attention	Focused and local	Defocused and global
Mood	Negative	Positive
Predominating thinking strategy	Analytical and rational	Intuitive and irrational
Specific strategy of response selection	Deductive retrieval	Insight
Brain activation	High-level and localized	Low-level and widespread
Hemisphere dominance	Left	Right
Domain of specific giftedness	Science	Art
Adaptation to constant environment	Mental health	Mental diseases

Theoretical Background and Open-Ended Issues

The differences between convergent and divergent thinking in information processes, psychological operations, and brain activity are presented in Table 1 and in Figs. 1, 2.

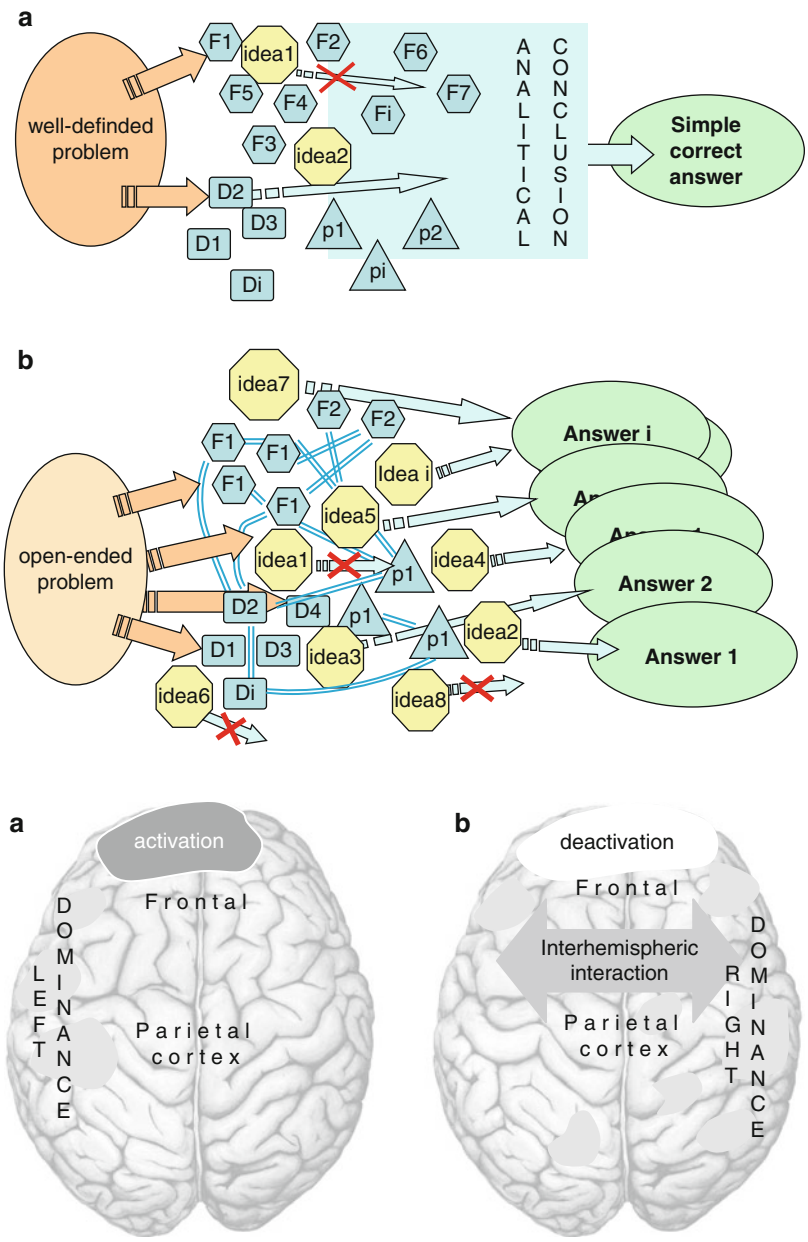
Three basic indices of divergent thinking have been offered of Guilford:

- *Fluency* (total number of the generated ideas)
- *Flexibility* (the number of categories in the ideas)
- *Originality* (the number of unique or unusual ideas)

Effectiveness of divergent thinking suggests a combination of knowledge, good memory, and fluency in associations between sensory and semantic information, as well as richness of ideas, imagination, and fantasy.

The basic index of successful convergent thinking is high speed of the right answer finding. The same condition is due to measurement of mental abilities or well-known *intelligence quotient* (IQ). Intelligence, as measured on many commonly used tests, is often separated into verbal, figural, and numerical, which can be combined to produce a full-scale intelligence score. Also social, emotional, motor, and other components of intelligence are differentiated. Successful convergent thinking required a perceptual exactness in observation, great volume of general and domain-specific knowledge, good memory, analytic-abstract reasoning, and finally fast acceptance of the logical decision.

So, main contrary characteristics of convergent and divergent thinking are a quantity of task solution (simple vs. multiple, respectively), time of answer finding (short vs. long), and concept mapping of idea search (specific vs. widespread associations). However, convergent and divergent thinking have also some **similarity characteristic** in psychological processes while difficult problem solving as it presented in Table 2. These different types of thinking are important components of creative process including the formulation of a problem (dominance of convergent thinking), widespread search of variable ideas of a problem solution (function of divergent thinking), and choice of the final decision based on critical comparison of generated ideas (again convergent thinking phase). So, convergent thinking dominates while domain-relevant knowledge and data are identified and analyzed but divergent thinking – during



Divergent Versus Convergent Thinking, Fig. 1 Scheme of organization of convergent (**a**) versus divergent (**b**) thinking. F1. . .I, D1. . .I, and p1. . .i sign different semantic categories in multiple knowledge structures

Divergent Versus Convergent Thinking, Fig. 2 Model of hemispheric organization of convergent (**a**) versus divergent (**b**) thinking

information transformation and generation of both ideas collection and many possible criteria for reviewing these ideas.

Organization of Divergent Versus Convergent Thinking

Semantic transformations of information and ideas exploring as well as one important source of wit and humor are evidence of divergent thinking. Associational knowledge reflects regularities in experience based on probabilistic linkages among stimuli. Traditionally, *associational knowledge* has been held to give rise to new original thought through variable interconnections of remote concepts (see Fig. 1b). Extensive knowledge provides an information basis for flexible search of different

Divergent Versus Convergent Thinking, Table 2 Similarities in characteristics associated with convergent and divergent thinking

Sensory processes	Careful observation of their environments to gather information through the senses
Memory	Large working memory capacity
	Implicit and explicit memory resources
Knowledge	Effective application of requisite processing operations to relevant domain-specific and general knowledge
Task types	Verbal, figural, numerical, and social
Cognitive structures and abstraction	Using different concept maps and abstract models to understand the world
Emotional regulation	Negative emotions induce increased motivation to task performance, but positive emotion facilitates associative and semantic priming and supports the processing of global perceptual information
Brain activity	Interaction of specific and associative brain areas in line with individual strategies of problem solving
Adaptation to variable environment	Integration of intellectual and creative abilities to introduce change, innovation, or improvement over what exists

and similar features of objects and processes from various semantic categories that contributed to the generation of many new concepts and creative problem solutions. A *heuristic* or *insight* is a strategy that ignores part of the information, with the goal of making creative decisions after incubation period.

On the contrary, convergent thinking is defined as creating of completely determined product. *Linear logic*, schematic knowledge, and mapping operations are contributed to arrive at a firm conclusion based on relevant information. The theory of mental models is widely accepted as the explaining theory in relational reasoning (e.g., Goodwin and Johnson-Laird 2005). In line with this theory, humans construct internal representation of objects and relations in working memory, matching the state of affairs given in the premises. Convergent thinking narrows the available responses with the goal of selecting the single correct response (Fig. 1a) and can inhibit creative though as stops on one most probable idea.

However, as the stage model predicts, sometimes, convergent thinking may be necessary for final selection of original and acceptable problem solution. Two complementary subsystems are required to reach the desirable results: (1) an idea generation subsystem that embeds semantic knowledge and whose dynamics generates ideas as conceptual combinations and (2) a critic, which receives the generated ideas and produces evaluative feedback based on its domain knowledge about the given context.

Involvement of multiple knowledge structures, the capability to memorize which answers and categories have been produced, as well as the accessibility of memory traces in general should be helpful in acquiring both high creativity and intelligence test scores. The large variety of data resulting in an average correlation between divergent thinking and intelligence tests has been found using a meta-analysis of 21 studies and 45,880 participants (Kim 2005). This relationship was moderated by age, gender, specific abilities, personality, and other factors. However, patterns of relationships between these factors and the convergent and divergent thinking organization still should be studied.

So, paradoxical complementary combinations of contrary kind of thinking occur in different phases of novelty production: convergent thinking might dominate in the phases of preparation and verification, but divergent thinking in that of illumination.

Neuronal Mechanisms of Divergent and Convergent Thinking

Understanding of neuronal mechanisms of divergent and convergent thinking may not only improve a performance of different cognitive tasks but also provide new insights into regulation of innovation activity. Possible brain correlates underlying divergent and convergent thinking are found in neuroscientific studies. As example of

convergent thinking, mathematics operations can be tested.

Neuropsychological as well as brain imaging studies converge on the view that *arithmetic processing* is subserved by frontoparietal areas and the basal ganglia (Dehaene et al. 1996). The left angular gyrus, perisylvian language areas, and the basal ganglia are assumed to mediate the retrieval of overlearned arithmetic facts, such as the multiplication tables, from long-term memory. The stronger activation within frontal areas in calculation tasks (Fig. 2a) has been interpreted as reflecting working memory demands, as well as error monitoring and strategic organization. There are evidences that numerical information is represented and processed by regions of the prefrontal and posterior parietal lobes, with the intraparietal sulcus as a key node for the representation of the semantic aspect of numerical quantity. The intraparietal region seems to be associated with an abstract, amodal representation of numbers in as much as it can be activated by numbers presented in various culturally learned symbolic notations. Exact arithmetic depends more on left lateralized, possibly language-related structures, while approximate arithmetic is tied to a quantity representation in bilateral intraparietal areas.

Deductive reasoning as variant of convergent thinking is the attempt to reach secure conclusion from prior beliefs, observations, or suppositions. Some reports have characterized deduction as predominantly left hemispheric, variously recruiting regions in inferior frontal, frontotemporal, and occipito-fronto-temporo-parietal cortices (Goel and Dolan 2004). Core deduction area is the left rostro-lateral prefrontal cortex, a region implicated in tasks involving goals/subgoals.

It can be concluded that the *specific network* involved in skilled arithmetic performance (i.e., convergent thinking) has been established. The inferior parietal sulcus and prefrontal cortex are assumed to mediate a common representation of quantity, and both arithmetic and sentence processing activated large sets of areas strongly lateralized to the *left hemisphere* (Fig. 2a).

On the contrary, divergent thinking and creativity are associated with widespread interconnections between *multiple brain regions* and relative dominance of the *right hemisphere* (Razumnikova 2005; Arden et al. 2010) (see Fig. 2a). A meta-analytic review of the literature to establish how creative thinking relates to hemispheric dominance revealed no difference in predominant right-hemispheric activation for verbal versus figural tasks, holistic versus analytical tasks, and context-dependent versus context-independent tasks (Mihov et al. 2010).

Right-hemisphere dominance in divergent thinking is caused to the facts that the right temporal and parietal cortices may provide a crucial nonlinguistic component needed for the intuitive generation of novel ideas using semantic knowledge in terms of features, concepts, and categories as well as verbal operations, such as the metaphor and humor creation or semantic operations that require a wide net of associations.

Semantic information in the brain is represented at several levels, ranging from combinations of sensorimotor features, through amodal concepts, to semantic categories. Considerable evidence now supports the idea that semantic processing involves several cortical functional networks including the left temporal lobe, the prefrontal cortex, the anterior cingulate cortex, the orbitofrontal cortex, and parts of the occipital cortex. Thus, if great volume of knowledge is necessary for difficult task performance, integration of functions of both hemispheres is required often for a finding of the best decision.

Many investigators have proposed that the ability to generate novel ideas or divergent thinking is associated with increased hemispheric cooperation. In line with this, hypothesis studies of patients with callosal resection have revealed a decrement in complex cognitive ability and EEG coherence studies suggest an association between effectivity of divergent thinking and interhemispheric coupling (Bogen 2000; Razumnikova 2005). Decreased callosal connectivity enhances hemispheric specialization, which benefits the incubation of ideas that are critical phase of creativity, and it is the momentary inhibition of this hemispheric independence that accounts for the illumination (Moore et al. 2009). Alternatively, decreased size of corpus callosum may reflect more specific localization of selective hemispheric processes, thereby facilitating efficient

intrahemispheric functional connectivity. So, the corpus callosum is necessary for transferring earlier integrative aspects of divergent thinking from the right hemisphere to the left one, which would be essential for creative output, that is, verbal and motor answer.

The lateralized processing of the different forms and types of knowledge stored in the right and left hemispheres may be particularly important during different types of divergent thinking (verbal, figural, or social). The right hemisphere is dominated at exploring for new possibilities while the left hemisphere is more likely to result in the application of a previously learnt concept or pattern to a new problem.

An important aspect of cognitive fluency and flexibility is inhibitory control, the ability to dynamically modify or cancel planned actions in response to changes in the sensory environment, or task demands. The control and planed functions are performed in the prefrontal cortex which is deactivated during divergent thinking according to divergent task-induced alpha rhythm synchronization (Fig. 2b). This effect can be interpreted as congruent with idea that *defocused attention* and *inhibitory control decrease* is associated with effective search of original ideas.

Implication for Theory, Policy, and Practice

Successfulness in both divergent and convergent thinking can be considered within the more comprehensive concept of cognitive competence. This concerns the complex achievement forms of problem perception, information processing through learning transfer, and divergent/convergent thought processes in various situations and in different field of activity. There are findings that generally supported the view of convergent scientists and divergent artists. Scientific eminence requires high level not only intellectual but creative abilities and manifests itself in development of solution-relevant hypotheses regarding scientifically unsolved problems, the development of new theories and methods, and original problem solutions. Creativity is generally expressed, for example, in technical areas through original processes, new methods, useful inventions, and valuable products. Analysis of creativity and intelligence scores with regard to extracurricular activities shown that highly creative versus highly intelligent students dominated in art, literature, technology, and social skills whereas in science these scores were equivalent (Perleth and Sierwald 2001).

According to a neural plasticity model, it is expected that environmental interventions in the different form of training in divergent and convergent thinking would improve both creative and intellectual abilities. Schooling and specific intervention programs do affect relative intellectual or creative performance. A well-known tool to enhance divergent thinking in groups is brainstorming. There are many techniques for individual development of ability to generation of original ideas: challenge facts, analogies, random word and picture, and others.

It should also be noted that the magnitude of the thinking score increase would be a function of the underlying differences in neural plasticity. If there are large individual differences in neural plasticity, then even relatively large interventions would not be sufficient to overcome differences in this factor.

Conclusion and Future Directions

So, divergent thinking concentrates on producing a large number of appropriate and adequate alternative responses and often is associated with creativity which involves the generation of varied, original, or unusual ideas in response to an open-ended task. On the contrary, convergent thinking involves finding the single correct answer, and standard intelligence tests are similarly believed to measure convergent thinking.

A major question for further research is a studying individual variability in complex neuronal mechanism of divergent versus convergent thinking depending on sex, age, personality, intelligence, handedness, etc. It is necessary to unify neuroimaging methods and psychometrical testing of different components of thinking designed to

provide greater spatial localization of function in brain. The future of primary creativity research would perhaps be focusing not only on the specialization of the hemispheres but on particular brain areas that are in constant interplay and communication. There is also open-end question on a role of interhemispheric or anterior and posterior cortex interaction in information selection during creative activity. Further research using techniques that can provide information about the nature of white matter connections, such as diffusion tensor imaging, will help to explain the mechanism by which effectivity of divergent thinking relates to size of corpus callosum.

Recently, more and more attention is given to the use of psychological knowledge in the politician and ordinary life. In this connection, studying of functional mechanisms of social creativity or implications of divergent and convergent thinking concepts on work, at home, or in complete adaptation to the world represents a great interest.

Cross-References

- ▶ Cognition of Creativity
- ▶ Convergent Versus Divergent Thinking
- ▶ Creative Brain
- ▶ Creativity and Systems Thinking
- ▶ Divergent Thinking
- ▶ Nature of Creativity
- ▶ Scientific Creativity as Combinatorial Process

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Diversity and Entrepreneurship

Laurice Alexandre-Leclair
Research Network on Innovation, CEDAG Paris Descartes University, Paris, France

Synonyms

Clusters; Cultural diversity; Environment; Ethnic entrepreneurship; Gender; Immigrants; Minority

Every society is composed of social and cultural groups. For researchers, diversity has become increasingly important. Diversity means variety. This variety can be evaluated along the dimensions of race, ethnicity, gender, sexual orientation, socioeconomic status, age, physical abilities, religious beliefs, political beliefs, or other ideologies (Baycan-Levent et al. 2003). Disabilities are sometimes also included among these variables.

According to Hampden-Turner and Chih (2010), diversity includes visible characteristics such as nationality, ethnicity, gender, and age, and also invisible characteristics such as creativity, beliefs, and tastes. These authors state that there is an important connection between fixed diversity and voluntary diversity. In this discussion, the focus is on *fixed diversity*, such as ethnicity and

culture, because these variables are directly linked to entrepreneurship. *Voluntary diversity* is more a strategy of human resources recruitment, adopted by firms in order to improve their image and their reputation amongst their stakeholders and demonstrate that they practice corporate social responsibility.

Diversity is considered by some authors as a factor of competitiveness. Amin and Graham (1997) (in Eraydin et al. 2010) state that cities have never been homogeneous entities; social, cultural, and ethnic forms of diversity have always been key items on the urban research agenda. As a result of processes of globalization, neoliberalization, and economic restructuring, most urban centers in advanced economies have faced significant increases in migration (Eraydin et al. 2010). From an economic perspective, debates about diversity have entered the competitiveness literature (Thrift and Olds 1996; Storper 1997; Florida 2005). Eraydin et al. 2010 cite Fainstein (2005), who argues that "the competitive advantage of cities and thus the most promising approach to attaining economic success, lies in enhancing diversity within the society, economic base, and built environment." Zachary (2000), Florida (2001), and Boodar and Rath (2005) also highlight the positive role of diversity in achieving a competitive economy.

Diversity is a core factor that leads to entrepreneurship. Hampden-Turner and Chih (2010) quote Saxenian (1999), who declares that "immigrants have created a very large proportion of the world's wealth. Moreover, Vecania (1999), quoted by Baykan-Levent (2003), raised the point that for individuals who are unable to adapt to a social system, such as those in ethnic and migrant minority groups, their marginal social position is a driving force to become self-employed. Self-employment in this case is not only a means to earn a living, but it is also a way of obtaining recognition and social acceptance.

Many studies have demonstrated that, despite their investments in human capital, minority workers (including immigrants) are systematically excluded from employment that offers high salaries, job security, and promotion opportunities (Yoon 1997) (in Bogan and Darity 2008). A number of other authors claim the positive relationship between diversity and entrepreneurship. Thuse, the aim of this discussion is to explore diversity and entrepreneurship. As mentioned before, diversity encompasses a wide variety of characteristics. This discussion focuses on ethnicity and culture because these characteristics directly affect entrepreneurship. Culture and entrepreneurship will be discussed first, followed by ethnic entrepreneurship.

Culture and Entrepreneurship

Sowell (1981) has claimed that different economic outcomes across different ethnic groups are due to culture rather than market or institutional discrimination. For instance, the relative success of black West Indians, compared with other black Americans, is attributed to their distinctive cultural values.

In their work, Sobel et al. (2010) present the definition of Lavoie (1991) of culture and entrepreneurship: "It pointed that entrepreneurship necessarily takes place within culture, it is utterly shaped by culture, and it fundamental consists in interpreting and influencing culture. Consequently, the social scientist can understand it only if he is willing to immerse himself in the cultural context in which the entrepreneurial process occurs."

Hofstede (1980, 1993) declares that national cultural values influence the conduct of business in particular countries. Sobel et al. (2010) tried to measure the relation between cultural diversity and entrepreneurial activity using five different measures of entrepreneurship (average business start-up rate, net business creation rate, venture capital per capita, patents per capita, and measure of productive entrepreneurship) in a cross-state analysis. They found that the states with the most diversity in their cultural makeup have higher rates of entrepreneurial activity.

Moreover, Sobel et al. (2010) discuss cultural capital. They state that different geographic areas across the globe are characterized by their own unique cultures. When people migrate from one country to another, they bring some of their

unique cultural capital with them. Because entrepreneurship is about coming up with new and unique combinations of resources, this interchange of ideas may lead to more innovations, new products, and generally a higher rate of entrepreneurial initiatives.

Along the same lines, according to the cultural hypothesis, the inclination of some immigrant and ethnic groups toward entrepreneurship can be explained by their ethno-national attributes (Yoon 1997) (in Bogan and Darity 2008), however, Bogan and Darity (2008) argue that one must take into consideration other factors contributing to the entrepreneurial role of minorities, such as class resources, urban racial segregation patterns, and immigrant disadvantages. The experience of Chinese and Japanese immigrants in the American labor market prior to World War II is a good example of return migration. The immigrants initially were welcomed when they came to fill the labor shortages on sugar plantations, in the mines, and in railroad construction camps on the West Coast. But when labor competition developed during economic depressions, they became the targets of anti-Asian campaigns and institutional discrimination (Yoon 1997) (in Bogan and Darity 2008).

In order to validate these characteristics, Bogan and Darity (2008) took the example of Korean immigrants. For example, Korean immigrants' class resources for their business activities not only include financial capital but also human capital. Korean immigrants with middle class backgrounds possess the knowledge and motives that are required for successful entrepreneurship. College-educated Korean immigrants have advantages in terms of management skills and attitudes over native-born, non-Korean small business owners, who usually have less education (Min 1988b) (quoted by Bogan and Darity 2008).

Korean entrepreneurs have benefitted from discrimination against blacks. The reluctance of corporations to invest in inner-city, minority areas and the retirement of white business owners from these areas created a small business void that was happily filled by Korean immigrants (Min 1988b; Light and Rosenstein 1995) (in Bogan and Darity 2008); a void that black entrepreneurs were unable to fill due to lack of resources, capital, and so on.

Bogan and Darity (2008) note that, for Korean immigrants, their situation as disadvantaged immigrants may be a more significant influence on their business behavior patterns than the cultural influence of their Korean background.

Other factors should be taken into consideration in order to better understand the role of culture in entrepreneurship. For instance, Ibrahim and Galt (2011) highlight the importance of human capital determinants such as schooling, education, and other features that determine productivity (Chiswick 1983). Knocke (2000) (in Ibrahim and Galt 2011) challenged the argument that intrinsic cultural factors are obstacles to labor market integration by showing that integration, segregation, or discrimination against ethnic minorities results from economic needs and structural labor market characteristics.

Ethnic Entrepreneurship

Ethnic entrepreneurialism can only be understood as a multi-dimensional organism existing in an external context that needs to be properly specified.

According to Baycan-Levent et al. (2003), ethnic minorities are gradually becoming a majority in some European cities. The influx of foreign migrants has brought about economic advantages, but it has also caused a multiplicity of social and economic tensions. With a few exceptions, ethnic groups belong, in general, to the lower socio-economic segment of European cities, mainly as a result of their lack of education and skills, which led them toward self-employment. On the other hand, some authors (Bates 1997; Borjas 1999) (in Pecoud 2010) maintain that immigrant entrepreneurship is related to class resources, because entrepreneurship requires financial and human capital and, consequently, self-employment would not modify immigrants' socio-economic conditions.

Ram et al. (2010) note two problems in comparative research about ethnicity and

entrepreneurship. The first is the tendency to focus on a single ethnic group in isolation from the wider small business population, which can accentuate perceived differences (this idea is also proposed by Jones et al. 1992; and Mulholland 1997). They also cite Zimmer and Aldrich (1987, p. 422), who declares that "the comparative study of immigrants and native groups shifts the focus from group differences to group similarities. Studies examining only immigrants may find apparently distinctive characteristics, but in fact many traits are common to all small business owners."

The second problem argued by Ram et al. (2000) is the ignorance of influence of sector on business activity in the frame of ethnic entrepreneurship. When cross-section comparisons are taken into account, inter-communal differences are often less acute than imagined. They give the example of Jones et al. (1994), who confirm that South Asian owners work significantly longer than others; this was found to be largely due to the overwhelming concentration of South Asian firms in labor-intensive sectors like food retailing and confectionery, tobacco, and newsagents.

Consequently, Ram et al. (2000) conducted research on ethnic minority business in the catering sector in the UK, because this sector is one of the niches traditionally occupied by ethnic minorities when they are offering their own unique national foods. According to their findings, the family plays a role in the formation and management of the enterprise across *all* ethnic groups, although it can take different forms. Even though the South Asian business owners, the same as white and African-Caribbean owners, declared that they would not want their children to enter the family business, the researchers noticed that South Asian children found their employment in the family business. This is an example of the importance of family among South Asian groups, but it emerged from economic necessity rather than notions of solidarity (Metcalf et al. 1996).

Pecoud (2010) provides a definition from Zhou (2004, p. 1040): "Ethnic entrepreneurs are often referred to as simultaneously owners and managers of their own businesses whose group membership is tied to a common cultural heritage or origin and is known to out-group members as having such traits; more importantly, they are intrinsically intertwined in particular social structures in which individual behavior, social relations, and economic transactions are constrained."

Ethnicity-based explanations of entrepreneurship coexist with two arguments (Pecoud 2010). The first, mostly developed by British scholars, sees self-employment as the product of the context in which migrants live and work: blocked opportunities, unemployment, and discrimination leave no choice to migrants but business (Barrett et al. 1996) (in Pecoud 2010). Migrants also invest in sectors whose unattractive conditions (long working hours, low return on investments, etc.) put off their previous owners.

Baycan-Levent et al. (2003) present different factors leading ethnic people to self-employment and entrepreneurship: motivations and orientation, labor and capital conditions, customer relationships, and gender and generational differences. We add to this list racial background and contingency factors, which play a role in differentiating and encouraging or discouraging entrepreneurship.

Motivation and Orientation

In addition to the classical motives that push minorities towards entrepreneurship, the existence of ethnic and social networks also plays a major role in motivating immigrants towards entrepreneurship (Delft et al. 2000; Johnson 2000; Kloosterman et al. 1998; Masurel et al. 2002; Ram 1994a, 1994b; Wilson and Portes 1980) (in Baycan-Levent et al. 2003).

Normally, ethnic companies start with a focus on clients from their own ethnic group, with traditional products, services, and communication channels. This internal orientation and the mutual trust within the ethnic network provides a protected market and a ready labor force (Baycan-Levent et al. 2003) and creates a loyalty between the ethnic firm and its clients (Dyer and Ross 2000).

Labor and Capital Conditions

Through their networks of relatives, co-nationals, or co-ethnics, new firms have a privileged and

flexible access to information, capital, and labor (Basu 1998; Kloosterman et al. 1998) (in Baycan-Levent et al. 2003)

Customer Relationship

According to Baycan-Levent et al. (2003), several studies refer to an intra-cluster ethnic loyalty, while highly intensive communication behavior within the ethnic community offers potential competitive advantages for ethnic firms (Donthu and Cherian 1994; Dyer and Ross 2000).

Gender and Generational Differences

Baycan-Levent et al. (2003) emphasize that age and generation can affect the kind of entrepreneurship. The first generations involve more pull factors, whereas the second generation may exhibit more pull factors. First-generation ethnic entrepreneurs are more motivated by discrimination, problems with the transferability of their diplomas, and obtaining status, compared with their second-generation counterparts. In other words, while first-generation immigrants may be more frequently "forced entrepreneurs," second-generation immigrants may act more frequently as "voluntary entrepreneurs" (Baycan-Levent et al. 2003), which supposes that the second generation is free to invest in new markets outside the internal market.

Baycan-Levent et al. (2003) note that this difference also exists for gender difference. Female ethnic entrepreneurs involve more pull factors, their motivation stemming from their education level and work experience and skills, business goals, and management styles and personal value system. Most female ethnic entrepreneurship belongs to services sector; the businesses are small and the owners are relatively young. The social network plays a role also in entrepreneurship. In their study of South Asian people, Ram et al. (2000) noticed that women's work was often not acknowledged, despite its importance to the business.

Racial Background and Entrepreneurship

Researchers examining the success or failure of ethnic entrepreneurs who share the same racial and national backgrounds found that they perform differently in different countries (Ibrahim and Galt 2011). Indeed, some authors make the difference between immigrant entrepreneurship and Black American entrepreneurship. According to Butler (2005) (in Bogan and Darity 2008) and others, the primary difference between black and immigrant entrepreneurs was that black business owners were forced to develop separate enterprises and sell in a restricted marketplace while immigrants were allowed to operate in the economic mainstream. Bogan and Darity (2008) quote the survey of Bearse (1984), who found that foreign-born blacks are more likely to be engaged in entrepreneurship than U.S.-born blacks. The same study's fundamental finding is that the likelihood of black being entrepreneurs is significantly lower than for other groups. Nevertheless, Boyed (1991b) reinforced the view that black immigrants and native blacks share race-related disadvantages.

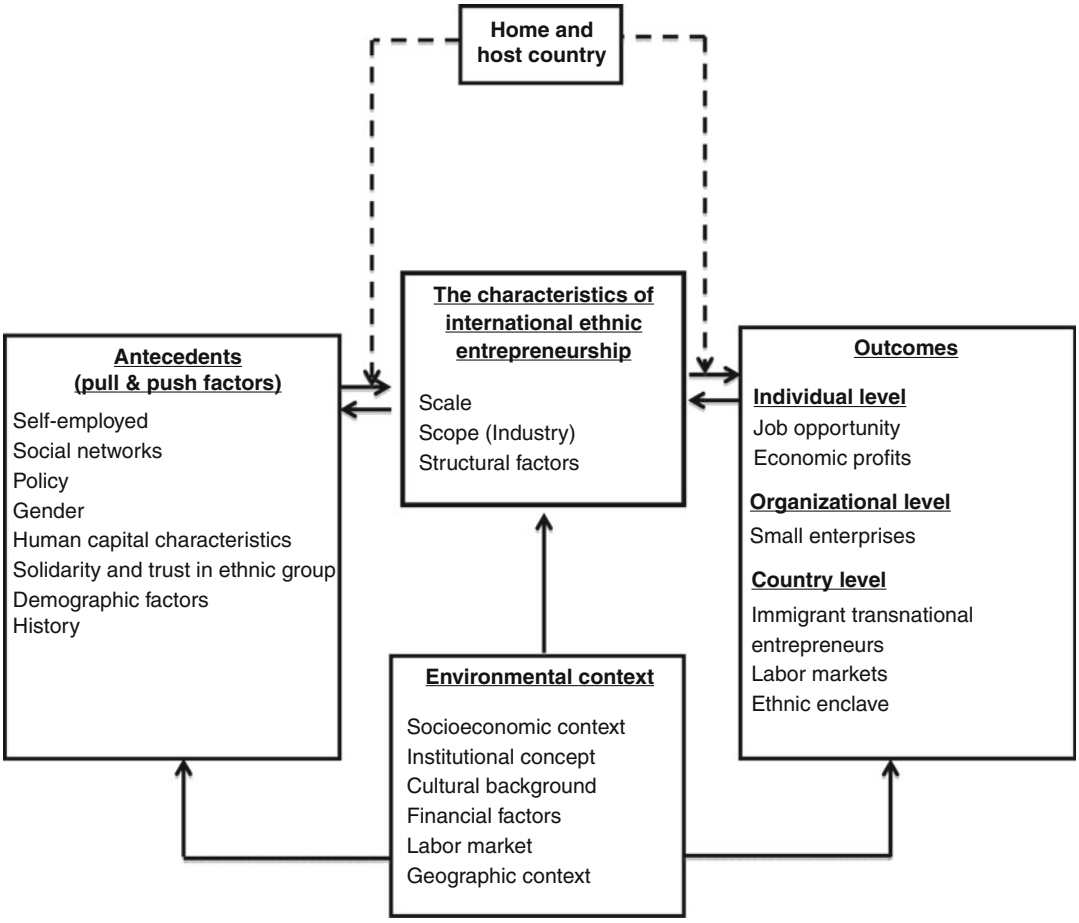
Eraydin et al. 2010 highlight the role of diversity in stimulating innovation. They quote Fainstein (2005), who declares that "forms of social, cultural, ethnic and spatial diversity attract multiple forms of human capital, and undoubtedly encourage cultural and artistic creativity, and technological and scientific innovation."

Contingency Factors

Ibrahim and Galt (2011) quote Evans and Jovannic (1989), who note that there is a link between the financial situation and entrepreneurship for some groups where initial endowments are restricted or where access to funds is difficult and there is likely to be a lower level of entrepreneurial activity and vice versa.

On the other hand, Ibrahim and Galt (2011) highlight the role of institutional arrangements proposed by the institutional economists (North 1990; Williamson 1975, 1985) in reducing transactions costs. These costs may be classified under three headings: search and information costs, bargaining and decision costs, and policing and enforcement costs (Dahlman 1979).

Concerning the relationship between the culture and entrepreneurship, it has been argued that some ethnic groups are endowed with social institutions and cultural norms that foster entrepreneurial talent



Diversity and Entrepreneurship, Fig. 1 Characteristics of international ethnic entrepreneurship (Ilhan et al. 2011)

(Davidsson 1995; Wilson and Portes 1980) (in Ibrahim and Galt 2011). Tight social networks provide flexible and efficient possibilities for the recruitment of personnel, acquisition of capital, and exchange of information based on mutual trust among the members of the network (Werbner 1990).

Furthermore, Eraydin et al. (2005) distinguish between types of social capital. The first, called *bonding capital*, is created via the strong social ties that exist between individuals, family members, close friends, and members of certain ethnic groups. The second is *bridging capital*, which exists between heterogeneous individuals such as friends of friends. A third type is *linking capital*, characterized by connections between individuals, established professional and administrative structures, and local communities (Foord and Ginsburg 2004).

According to Davidson and Honig (2003) (in Ibrahim and Galt 2011), factors in the exogenous environment in which business is conducted, such as the fiscal environment, labor market regulations, administrative complexities, intellectual property rights, and bankruptcy law, will also determine the specific response of ethnic entrepreneurial to establishing a business. Another factor that influences ethnic entrepreneurial decisions in a host country is the propensity for entrepreneurship in the country from which they or their families

emanate. The historic differences between countries in the rate of entrepreneurship will influence the likelihood of individuals becoming entrepreneurs (Sternberg and Wennekers 2005; Wennekers, Uhlaner, and Thurik 2002) (in Ibrahim and Galt 2011).

Conclusion and Future Directions

Diversity is discussed in different literature: economy, management, sociology, anthropology, and so forth. Most authors focus their research on the relationship between culture and/or ethnicity and entrepreneurship, even though diversity involves other factors such as gender, age, and disability. This discussion highlights the fact that the culture of immigrants as much their ethnicity can affect, positively or negatively, self-employment. Many factors lead ethnic people to entrepreneurship: the existence of ethnic and social networks, labor and capital conditions, gender and age, racial background, and contingency factors such as institutional environment, geographic context, and so on. The model of Ilhan et al. (2011) (Fig. 1) summarizes the characteristics of entrepreneurship, taking into account all contingency factors. In this figure, the authors suggest that the environmental context, such as socioeconomic context, institutional concept, cultural background, financial factors, labor market, and geographic context, influence the outcomes on an individual level, organizational level, and country level. The environmental context elements are directly linked to the pull and push factors, such as social network, gender, and demographic factors. On the other hand, pull and push factors may influence the characteristics of international ethnic entrepreneurship, while the scale, the scope of the industry, and the structural factors may influence the outcomes and the pull and push factors.

Gender studies deserve further study because, in certain cultures or ethnic groups, women turn to entrepreneurship in order to be independent and/or to make a living for their family. Furthermore, exploring diversity from the perspective of economic competitiveness could be an interesting complement to studies of immigration and entrepreneurship.

Cross-References

- ▶ Entrepreneurship and Social Inclusion
- ▶ Entrepreneurship in International Context
- ▶ Environmental Determinants of Entrepreneurship
- ▶ Female Entrepreneurship
- ▶ Microfirms
- ▶ National Culture
- ▶ Network and Entrepreneurship
- ▶ Small Business
- ▶ Social Networks and Entrepreneurship

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Diversity Entrepreneurship

- ▶ Female Entrepreneurship

Divestment Spin-Off

► Extrapreneurship

Dotcoms

► Startup

Dreaming

► Imagination

Dynamic Generation

► Imagination