



On Creativity

Towards an Understanding of
Creativity and its Measurements

Ernesto Villalba



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European Commission
Joint Research Centre

Contact information

Address: Ernesto Villalba, JRC, TP 361, Via Fermi, 21027, Ispra (VA), Italy
E-mail: ernesto.villalba@jrc.it
Tel.: +390332785226
Fax: +390332785733

<http://crell.jrc.ec.europa.eu/>
<http://www.jrc.ec.europa.eu>

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[^] The views expressed in this publication are strictly those of the author and they do not necessarily reflect the views of the European Commission.

Creativity is often obvious in young children, but it may be harder to find in older children and adults because their creative potential has been suppressed by a society that encourages intellectual conformity.

R. J. Sternberg*

Creativity now is as important in education as literacy and should be treated with the same status
Sir Ken Robinson♦

* Sternberg, R. J. (2006). The nature of creativity, *Creativity Research Journal*, 18 (1), p. 93.

♦ Robinson, K. (June, 2006). Do schools kill creativity? Talk at the TED: Ideas worth spreading conference. Retrieved August 2008 from:

http://www.ted.com/index.php/talks/ken_robinson_says_schools_kill_creativity.html

Summary

The European Council declared 2009 the year of creativity and innovation. The Communication of March 2008 (European Commission, 2008a, 2) puts it simply: "Europe needs to boost its capacity for creativity and innovation for both social and economic reasons". This paper aims to arrive at a preliminary understanding of research on creativity and the possibilities of constructing a "creativity indicator" using large scale surveys and other existing statistical tools. The paper reviews perspectives on creativity. Despite being a complex entity, difficult to define, there is a degree of consensus on some of the creativity characteristics. Creativity is usually related to the production of something new that also has value. There is also substantial agreement that everybody can be creative to some extent. The second part of the paper presents existing measures of creativity. They are divided into psychological measures related to divergent thinking and personality traits and a "sector" approach to creativity. While the psychological approach is based in the, more or less, traditional psychometric models interested in individual level characteristics, the "sector" approach comes from a different set of disciplines interested in creative aspects of society. The paper concludes by raising questions about the possibility of using existing large scale survey data, such as PISA, to construct a creativity index. It also proposes some necessary steps to implement a large scale assessment on young people's creativity. These include: the development of a working definition of creativity by all interested stakeholders, the development of a framework and a tool for measuring creativity; and, the application of pilot and full-scale surveys.

1. Introduction

The concept of creativity has gained importance in recent years. For example, a vast amount of management literature has been increasingly focusing on how to enhance creativity in the workplace, in order to cope with constant changing environments (see e.g. Nonaka and Takeuchi 1995, Villalba 2008). Another sign of the importance of creativity is the decision of the European Union of making 2009 European Year of Creativity and Innovation. The objective of the year is “to promote creativity for all as a driver for innovation and as a key factor for the development of personal, occupational, entrepreneurial and social competences through lifelong learning” (European Commission 2008a, 5). The year should raise public awareness and promote public debate on creativity; in addition, it should stimulate research into how to develop creativity and innovative attitudes (European Commission 2008b). The Commission will draw in different policy fields such as education and training, enterprise, media, cohesion, rural development and research, to add impact of the Year. In this context and within the overall Lisbon Strategy and its monitoring policies on education and training, the Commission is launching the debate on measuring creativity.

This paper aims at constructing a preliminary understanding of research on creativity and the possibilities of constructing a “creativity indicator” using large scale surveys and

other existing statistical tools. Thus, the paper is mainly focused on exploring measurement possibilities of creativity in an international comparative manner.

The paper aims at answering (at least partially) the following questions:

- Is it possible to measure creativity in a comparative international manner?
- Is it possible to use existing large scale surveys to assess creativity?

It is clear that the phenomenon of creativity is extremely complex. The study of creativity has different perspectives and approaches. This paper review some work on creativity in psychology, mainly through the extensive reviews of Sternberg and Lubart (1999) and Runco (2007). The paper also presents some other perspectives on creativity, not necessarily linked to psychology. Section 2 presents an overview of some definition and main issues in relation to creativity. Section 3 reviews different ways that have been used to approach the measurement of creativity. Section 4 discusses the possibilities of measuring creativity using large scale assessment tools.

2. Towards an understanding of what creativity is

Sternberg and Lubart (1999) present different lines in the study of creativity in psychology. For them creativity research has been marginalized due to the lack of multi-disciplinary approaches and because of problems on providing a sound definition of the phenomena. They refer to Wehner, Csikszentmihalyi and Magyari-Beck (1991, 270) that maintained that the situation in creativity research is similar to the fable of the blind men trying to describe an elephant by touching different parts of the animal, where the one touching the tail says it is like a snail and other touching the flank says it is like a wall.

In a later work, Sternberg (2006a) maintains that there are five commonalities in the research of creativity around the world. First, creativity “involves thinking that aims at producing ideas or products that are relatively novel and that are, in some respect, compelling” (Sternberg 2006a, 2). Second, creativity has some domain-specific and domain-general elements. That is to say, it needs some specific knowledge, but there are certain elements of creativity that cut across different domains. Third, creativity is measurable, at least to some extent. Fourth, it can be developed and promoted. And fifth, “creativity is not highly rewarded in practice, as it is supposed to be in theory” (Ibid.).

Sternberg and Lubart (1999) find the origin of creativity research on spirituality. In this way, research associated with creativity has not had the necessary scientific back-up: “many people seem to believe, as they do about love (see Sternberg 1988a 1988b), that creativity is something just doesn’t lend itself to scientific study, because it is a spiritual process” (Sternberg and Lubart 1999, 5). They also refer to psychodynamic studies on creativity where creativity arises from the tension between the conscious and unconscious drives. Later “pragmatic approaches on creativity” have been mainly concerned with the development of techniques to promote creative thinking in organizations. According to Sternberg and Lubart (1999) these studies are lacking a theory of creativity, since they are mainly practical approaches to enhance creativity. Thus, they do not provide a clear idea of what are the characteristics of creativity.

Studies on cognitive psychology have tried to understand the process of creative thinking. In many instances, this research assumed that creativity is just extraordinary results of ordinary processes (Smith, Ward and Finke 1995), and in this way, there is no real need of studying it as a separate subject. In other cases some authors maintain that creativity is not much different from intelligence (Getzels and Jackson 1962). Spearman (1927, 187) defended that there was no such thing as “creativity power” for him “that which is usually attributed to such special imaginative or inventive operation can be simply resolved into a correlate education combine with mere reproduction”. Later research seems to agree that intelligence and creativity are related, using the threshold theory (Runco and Albert 1986). These theory assumes that there is a “minimum level of intelligence (the lower threshold) below which the person cannot be creative ... They [creativity and intelligence] are related, but only at certain level of ability (Runco 2007, 7).

Other studies in cognitive psychology try to discover the process of creative thinking. Here the debate is between if creative thinking can be or not delineated. Plsek (1997) presents an overview of some prominent models of creativity. Wallas (1926), for example, proposed a creative process that involves: (1) preparation., (2) incubation, (3) illumination and (4) verification. Rossman (1931) extended this model to seven steps: Observation of a need or difficulty, (2) analysis of the need, (3) a survey of all available information, (4) a formulation of all objective solutions, (5) a critical analysis of these solutions for their advantages and disadvantages, (6) the birth of the new idea (the

invention) and (7) experimentation to test out the most promising solution, and the selection and perfection to final embodiment. Plsek (1997) has proposed the “directedcreativity™ cycle”, composed of Observation, analysis, generation, harvesting, enhancement, evaluation, implementation, and living with it. These are grouped within: (1) preparation, (2) imagination, (3) development and (4) action.

Sternberg and Lubart (1999) also refer to psychometric approaches to creativity. They have been mainly focused in developing tests to measure creativity. These will be treated in more detail in the next section. Plucker and Renzulli (1999) differentiate four areas where psychometric methods have been applied in creativity research: creative process, personality and behavioral correlates, characteristics of creative products, and attributes of creative fostering environments. The psychometric approach will be treated in more detailed later on.

Definitions

Sternberg and Lubart (1999, 3) maintains that “Creativity is the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful concerning tasks constrains)”. Runco (2007) present several authors that define creativity as involving the creation of something new and useful (Bailin 1988, Bean 1992, Solomon, Powell and Gardner 1999, Mumford 2003, Andreasen 2005 and Flaherty 2005). Runco (2007, 385) calls these “products definitions” of creativity. He calls these definitions “product bias”. For him, product bias consists on assuming that all creativity requires a tangible product: “It would be more parsimonious to view creative products as inventions and the process leading up to them as creative or innovative” (ibid.).

In the UK, the National Advisory Committee on Creative and Cultural Education (NACCCE) published in 1999 a report where they provided a more elaborated, but similar definition of creativity. They maintain that creativity processes have four characteristics:

1. It is imaginatively, it always involves imagination, since it is the process of generating something original.
2. It is purposeful: it is imagination put into action towards an end.
3. It produces something original in relation to one’s own previous work, to their peer group or to anyone’s previous output in a particular field.

4. And finally, it has value in respect to the objective it was applied for. Creativity involves not only the generation of ideas, but also the evaluation of them, and deciding which one is the most adequate one.

The NACCCE maintain that they understand creativity in a “democratic” way: “one which recognizes the potential for creative achievement in all fields of human activity; and the capacity for such achievements in the many and not the few” (NACCCE 1999, 30). The Department for Culture, Media and Sport (DCMS) in the UK, referred to this definition in their implementation of actions to enhance creativity in schools in 2006 (DCMS 2006).

NACCCE (1999) opposed their view on creativity to two other different views: An “elite”, and a “sector” definition. An “elite” definition involves that creative people are those with “unusual talents”, that are able to make their creative mark without special help and sometimes gain strength from educational failure. This refers to the differentiation usually maintained in the creativity research between eminent-level and non-eminent-level creativity. Richards (1999a) maintains that the former, eminent-level creativity, refers to discoveries that are of particular importance for society (for example, scientific discoveries), while, the later refers to everyday creativity, meaning the capacity of people to adapt to new situations. The later is in line with the “democratic” understanding of creativity defended by NACCCE (1999).

The “sector” definition maintains that creativity is something associated with the arts, and that it does not involve other sectors of production such as science or technology. An extended version of the sector definition could be found in the definition of creativity that KEA European Affairs (2006) propose. In a macro-level approach, they define creativity in a cross-sector and multidisciplinary way, mixing elements of ‘artistic creativity’, ‘economic innovation’ as well as ‘technological innovation’. They consider creativity as “a process of interactions and spill-over effects between different innovative processes” (KEA European Affairs 2006, 41). They differentiate between: Scientific, technological, economic and cultural creativity.

Also from a more macro-level approach, Richard Florida’s popular book “The rise of the creative class” provides a view of what creativity encompasses at a societal level (Florida 2002). He maintains that we live in a “Creative Age”. Florida’s thesis is centered on

three main areas: Technology, Talent and Tolerance (the three T's model). Florida is mainly interested in studying the concentration of "creative individuals" in different regions. For him, these three T's, as he calls them, constitute the main magnets for creative people to establish themselves in a city. It is this creative class the one that has strong influence in making a region prosper economically. He does not provide a specific definition for creativity, but from his description of what are the "main themes" in the body of literature about creativity, one can find a short of definition of creativity (Florida 2002, 30). In his view, creativity is an essential feature of our life. He presents a "democratic" conception of creativity in line with that of NACCCE, where creativity is embodied in different areas of human life. For him, creativity is multidimensional and experiential. Creativity requires "work" to appear and is usually guided by intrinsic rewards. As next section will present, he proposed different ways of measuring these three T's in a composite indicator that he refers to as the "creativity index".

Unresolved issue on defining creativity

There is, thus, certain consensus on some of the creativity characteristics. It seems clear that it is related to the production of something new and with some sort of value. It also seems that there is certain agreement that everybody can be creative to some extent. However, as Mayer (1999, 450) addresses in his review of Sternberg's handbook (Sternberg 1999a): "In spite of agreement on basic definition of creativity, there are several clarifying questions for which *Handbook* authors –reflecting the diversity of the field – have different answers".

As Mayer (1999) noted, studies on creativity can refer to *personal* or *social* creativity. Personal creativity refers to creating something new in respect to the person that creates the product. Creativity that is social refers to something new and useful in respect to the social or cultural environment where it is produced. NACCCE (1999) maintain that creativity involves originality in three possible ways: *Individual*, *relative* or *historic*. *Individual* creativity coincides with Mayer's definition of personal creativity. *Relative* refers to originality in relation to their peer group. Finally, *historic*, refers to original in terms of anyone's previous output in a particular field. Sternberg (1999b) categorizes creative contributions in science into eight different types that differ qualitatively in respect to the context where they are produced. The eight types of contributions can be divided in three major categories: Contributions that (1) accept current paradigms, (2) reject current paradigms and (3) attempt to integrate multiple current paradigms.

In addition, Mayer (1999) maintains that there is a need to clarify if creativity is a property of: (1) *People*, (2) *Product* or (3) *Processes*. He maintains that depending on this assumption, different approaches have been used to study creativity. Runco (2007) adds approaches to creativity related to *place* (Rodhes 1962, Richards 1999b, Runco 2004), *persuasion*, in studying how creative people change the way other people think (Simonton 1990a), and *potential* (Runco 2003) emphasizing research on those that have potential for creativity but are not realizing it.

All these issues have to be addressed in a measurement model for creativity. An understanding of creativity will necessarily require reflection of the issues presented above. This will require a multi-disciplinary approach to creativity, most likely.

The confluence approach

Sternberg and Lubart (1999) conclude that “confluence approaches” would be advisable in creativity research. This line of research put together multiple views on creativity, where different components must converge for creativity to occur. They mention Amabile (1983); Gruber and Davis (1988) and Csikszentmihalyi (1996) as valuable contributions, and their own “investment theory of creativity” (Sternberg and Lubart 1991, 1992, 1995, 1996). The basic idea is that “creative people are the ones who are willing and able to ‘buy low and sell high’ in the realm of ideas” (Sternberg 2006b, 87). According to this theory creativity requires six distinct but interrelated resources: intellectual abilities, knowledge, styles of thinking, personality, motivation and environment.

Sternberg and Lubart (1999) describe a complex system, where these different resources have to have a proper balance. Just as an exemplification of the complexity and the difficulties in creating the right balance, it is noteworthy to present the case of “intellectual abilities”. They emphasize three particularly important intellectual abilities: (a) the synthetic ability of being able to see problems in a new way, (b) the analytic ability to recognize what ideas are worth, and (c) the practical-contextual ability to know how to persuade the others that your ideas are valuable. The three have to occur together, since one without the other will not yield creative results. Analytic ability without the other two will only produce critical but not creative thinking. Synthetic ability without the other two will lack the possibility to carry out the ideas. And the practical-contextual

ability might produce results, but not because the ideas are creative but because they had a powerful way of interpreting. Another example of the complexity can be easily seen in the case of *knowledge*. Sternberg maintains: “On the one hand, one needs to know enough about a field to move it forward [...] On the other hand, knowledge about a field can result in a closed and entrenched perspective” (Sternberg 2006b, 89). The rest of the six resources also require the right balance of attributes.

A “confluence approach” will obviously present tremendous challenges, especially in the case of measurement. Since the interest of the paper is to assess the possibilities of measuring creativity, the following section reviews main approaches of creativity measurement. It expands beyond psychological references and looks into ways of measuring creativity at a societal level, mainly through an extended approach to that proposed by Florida (2002). The review does not claim to be exhaustive, nor comprehensive, but it aims at providing a general overview in the field.

3. Different approaches to measuring creativity

This section is divided into four sub-sections that refer to two different forms of measuring creativity. The first one that includes sections 3.1 and 3.2 relates to psychological study of creativity. In most of the cases the approach consists on developing tests to measure creativity. Haensly and Torrance (1990) identified more than 200 instruments for measuring different aspects of creativity. Houtz and Krug (1995) provide a review of several test developed for the assessment of creativity. They followed Hocevar (1981) classifications into: tests of divergent thinking, attitude and interest inventories, personality inventories, biographical measures, ratings by teachers, peers or supervisors, product judgments, self-reports of creative achievements, and eminence or the study of well-known and establish creative people.

The second form of measuring creativity presented in this section is related to what could be referred as a “sector approach”, and it is explained in 3.3 and 3.4. The “sector approach” looks into specific aspects of a society in relation to creativity. Florida’s is probably the most well known advocate of such an approach. His views to measure the “creative class” serve to extend such an approach to other type of indicators not necessarily considered by him, but that are also related to creativity.

3.1. Divergent thinking

Houtz and Krug (1995) provide a review of several tests developed for the assessment of creativity. Within the category of divergent thinking, Houtz and Krug (1995) present the Torrance Test of Creative Thinking (TTCT) (Torrance 1966, 1974, 1984, 1990, 1998), The Wallach and Kogan Tests (Wallach and Kogan 1965), The Guilford Battery (Guilford 1962, 1971). Divergent thinking requires open-ended questions; as opposed to convergent thinking problems that always has one or very few correct or conventional answers. McCrae (1987) defines divergent thinking as the ability to generate many difference possibilities for solving a problem. A typical item to test divergent thinking would be to ask to name as many objects as they can fall in certain category. It is somehow based on the ideas from associative theories (Mednick 1962) that maintain that original ideas tend to be remote; they come later in the process of thinking about associations. It is important to note, however, that creative thinking is not synonymous of divergent thinking. Creativity involves also sensitivity to problems as well as redefinition abilities, such as transformation of thoughts or freedom from functional fixedness (Kim, 2006, 4).

The most widely used test on creativity is the *Torrance Test of Creative Thinking* (TTCT). It is also the one that has the most extended research on their reliability and validity (Houtz and Krug 1995, Kim 2006). This test has been translated into more than 30 languages and it is used in different places as a tool to assess creative potential. It is based on Guilford (1962) Structure of the Intellect (SOI) battery that included some measures of divergent thinking. Thus, it measures creativity through divergent thinking.

The TTCT was developed in 1966, and it has been re-normed four times: 1974, 1984, 1990 and 1998. There are two forms, TTCT-Verbal and –Figural with two parallel tests each (form A and B). Each test pertain to measure

- Fluency: (The number of ideas) Total n. of relevant responses
- Originality: (The rarity of ideas) N. of statistically infrequent ideas. The score is 0 if the idea is common, and 1 all the other valid responses.
- Elaboration: The number of added ideas
- Flexibility: Number of categories of the relevant responses

In 1990 Torrance deleted the flexibility scale, since it correlated highly with fluency (Herbert et al. 2002), and added two norm-reference measures of creative potential:

Abstractness of titles and resistance to premature closure (Ball and Torrance 1980). Abstractness of titles refers to the “degree beyond labeling... it measures the degree a title moves beyond concrete labeling of pictures drawn” (Kim 2006, 5). Resistance to premature closure pertains to measure the degree of psychological openness.

The test can be administered in around 30 minutes, but the process of scoring requires some training and specific country norms. In 1998 the manual provides norms for the United States and includes both grade-related and age-related norms (Kim 2006). Thus, there is some country specificity in the measurement of creativity. Kim (2006) reported some normative measures in other countries. These norms have usually been developed for research activities.

Heausler and Thomson (1988) refer to four main criticisms regarding the TTCT: First, the response set might influence the results. Thus, different order in the presentation of the items leads to different results (Lissitz and Willhof 1985). Second, some research has shown that “creativity tests administered under different conditions lead to differences in performance” (Hattie 1977, 97). Third, raters of the TTCT might differ considerably in their scores to a similar person. Rosenthal et al. (1983, 39) found that “two raters may agree that a particular student’s performance is better than that of all other students, yet still assigned significantly different scores to describe this performance”. This means as Heausler and Thomson (1988, 464) have pointed out that “these differences might be of practical importance in studies testing mean differences across experimental or other groups”. Finally, a fourth group of criticism refers to the structure of the test. Some studies with factor analysis have shown that the factors found in the TTCT described a task more than underlying constructs (Plass, Michael and Michael 1974, 413).

3.2. Creative personality

Another line of measuring creativity is related to study individual differences and personality attributes. Studies in this line have tried to find characteristics of creative people. They could be divided into psychometric, biographical and historiometric approaches.

In psychometrics approaches, studies attempt “to measure facets of creativity associated with creative people” (Plucker and Renzulli 1999, 42). Tools in this area for studying creativity consist of lists of personality traits, self-report adjectives check-list,

biographical surveys and interest and attitudes measures. A famous check list is the Gough's (1952) Adjective Check Lists (ACL). It consists of 300 descriptor words that a person checks as being self-descriptive. Using this tool, a sample of people that were evaluated as creative by experts is compared to other non-creative sample of people. Domino (1970) identified 59 of those descriptors that formed a Creativity Scale (Houtz and Krug 1995). Other similar tests have been developed and tested with different professionals. Kathena and Torrance (1976) developed the Creative Perception Inventory, composed of the Something About Myself (SAM) and What Kind of Person Are You (WKOPAY) scales. SAM asks people to answer if they have engaged in specific activities with creative potential. It also asks individuals to "agree or disagree with certain self-descriptors, such as 'I am talented in many different ways'" (Houtz and Krug 1995, 279). The WKOPAY ask people to check personality traits that they think characterized them.

Biographical and historiometric approaches are mainly related to the study of creative individuals and their context. Biographical approaches involve case studies of eminent creators "using qualitative research methodologies" (Plucker and Renzulli 1999, 38). Gruber and Wallace (1999) maintain that case study approaches to creativity provide a holistic picture of the creator and his/her environment. They maintain that in a case study method, the investigator has two central roles: a phenomenological one and a critical one. The first requires that the investigator "goes into" the creators mind and tries to reconstruct the meaning of the subject's experience. "In this role, the investigator comes as close as possible to the case" (Gruber and Wallace 1999, 111). The critical role consists on standing "outside" the case to appraise the data, explain and interpret them. It has been used to study eminent products (e.g. Arheim 1962) or people (e.g. Gruber 1974/1981).

Historiometric is also mainly concerned with the study of eminent creators, names that have "gone down in history" as Simonton (1999) puts it. Through a quantitative analysis of the biographical and historical records related to these eminent creators, historiometrics attempt to measure creativity. Simonton (1990b, 3) defines historiometrics as a "scientific discipline in which nomothetic hypotheses about human behavior are tested by applying quantitative analyses to data concerning historical individuals". This definition can be broken down in three components (Simonton 1999, 117): (1) Historimetric approaches look for "nomothetic hypothesis", that is to say "the

goal is the discovery of general laws or statistical relationships that transcend the particular of the historic records” (ibid.). (2) It uses quantitative analyses. The researcher has to transform the usually rich, ambiguous, and qualitative facts of history into more precise, clear numerical measurements. In addition, the researcher should use statistical techniques, mainly multiple regressions, factor analysis and latent-variable models to understand the relationship between different aspects of creativity. (3) The subject of study in the historiometric approach is always a “historical individual”.

Runco (2007) maintains that creative personality encompasses: Autonomy, flexibility, preference for complexity, openness to experience, sensitivity, playfulness, tolerance of ambiguity, risk taking or risk tolerance, intrinsic motivation, psychological androgyny, self-efficacy and wide interest and curiosity. He also noted that creative personality varies from domain to domain, and perhaps, even from person to person: “there is no one creative personality” (Runco 2007, 315). He however, maintains that certain characteristics depend on values, intentions and choice; thus, people have the possibility of trying to enhance their creativity or not. This is in line with what Sternberg affirms (2006b, 93) in his review of creativity research: “Creativity is as much a decision about and an attitude toward life as it is a matter of ability”.

3.3. The creative class

From a rather different perspective, Richard Florida (2002, 2004) has been instrumental for popularizing the concept of creativity. He has created the “creativity index”. He is not specifically interested in measuring creativity per se, but on the factors associated with urban economic growth. Florida’s main thesis is that creativity is the “ultimate economic resource” (Florida 2004, xiii). He maintains that economic success of urban centers is associated with the amount of creative people they can attract. In this way, Florida maintains that creative people are attracted to places that are characterized by a “culture that’s open-minded and diverse” (Florida 2004, xvii). In his view, “places provide ecosystems that harness human creativity and turn into economic value” (Florida 2004, xix). Inspecting the characteristics of these places he presents his 3 T’s model. These stand for: Technology, Talent and Tolerance. Technology is mainly referring to the presence in the region of high-tech companies and their production of patents. Talent is mainly referring to the amount of people in the “creative class”. The Tolerance index is mainly referring to the openness of a place to other ideas and making outsiders welcomed. The measurement used in each of the three T’s are presented in table 1. The

technology index is compounded by the innovation index and the high- tech index. Florida maintains: “Each is a necessary but by itself insufficient condition” (Florida 2004, 249). A place must have all three T’s “to attract creative people, generate innovation and stimulates economic growth” (Ibid.). Florida has created a composite indicator, the creativity index that unifies the three indexes referring to each of the T’s (See table 1).

Table 1: Richard's Florida Creativity Index

Technology	Innovation Index:		Patented innovation per capita (version 2002), Average annual patent growth from 1990 to 1999 (version 2004)
	High-Tech Index	Developed by DeVol et al. (1999)	Metropolitan High-tech industrial output as a % of total U.S. high-tech industrial output % of region's own total economic output that comes from high-tech industries compare to national percentage
Tolerance	Gay index	Developed by Graves et al. (2000)	Fraction of all U.S. gay people who live in a given metropolitan area divided by the fraction of the total U.S.. Population that live in that area
	Bohemian index		Fraction of all artistically creative people (includes authors, designers, musicians, composers, actors, directors, painters, sculptors, artist, printmakers, photographers, dancers. artists, and performers) who live in a given metropolitan area divided by the fraction of the total U.S.. Population that live in that area
	Racial integration index	(In version 2004 only)	Census track ethnicity composition in relation to the composition of the whole MSA (metropolitan Statistical Area)
Talent	Creative class index		Percentage of creative occupations on total employed

Florida and Tinagli (2004) calculated a version of Florida’s creative index in European countries. They used somehow different indicators than the original ones from Florida (2002). In their “European creativity index”, they consider also the three T’s: Talent, Technology and Tolerance. However, they expand each of the indexes, including some extra indicators. For example, the Talent index is compound of creative class, human capital and scientific talent sub-indexes, while in Florida’s first book (Florida 2002) it only encompassed the creative class index. In the Tolerance Index, Florida and Tinagli (2004) do not used the famous “gay index” (Gates et al. 2000, Gates and Ost 2004) but some indexes derived from the World Value survey (Values index and self-expression

index), and an attitude index derived from a survey of the European Monitoring Centre on Racism and Xenophobia (EUMC information and Communication, 2001). The list of indicators used by Florida and Tinagli (2004) is presented in the figure 1.

Index	Sub-Indexes	Description	Source
Talent	Creative Class	Employed in creative occupations as percentage of total employment	ILO (2002) [http://laborsta.ilo.org , data extracted on October 2002]
	Human Capital	Percentage of population 25-64 with a bachelor degree or above	OECD (2001)
	Scientific Talent	Number of researchers in scientific disciplines per thousand workforce	European Commission-Eurostat (2001)
Technology	Innovation Index	Patents applications to the US Patent Office per million population	USPTO as reported by the European Commission, DG Research, In: "Towards a European Research Area. Key Figures 2001".
	Technology Innovation Index	High-Tech Patents per million population (US Patent Office)	USPTO as reported by the European Commission, DG Research, In: "Towards a European Research Area. Key Figures 2001".
	R&D Index	R&D expenditure as percentage of GDP	European Commission-Eurostat (2001)
Tolerance	Attitudes Index	Percentage of population that express tolerant attitudes toward minorities	European Monitoring Centre on Racism and Xenophobia, EUMC and SORA Institute for Social Research Analysis (2001)
	Values Index	Degree to which a country is based on traditional values versus more rational/secular values	World Values Survey, University of Michigan [http://wvs.isr.umich.edu]
	Self Expression Index	Degree to which a country recognizes and accepts self expression values.	World Values Survey, University of Michigan [http://wvs.isr.umich.edu]

Figure 1: Euro-Creativity Index (Florida and Tinagli 2004, 44)

Following Florida's framework, KEA European Affairs (2006) proposed the "EURO CREATIVITY SCOREBOARD" (KEA European Affairs 2006, 211). They propose four sub-indexes: Talent, Cultural, Technology and innovation, and Diversity. The focus is specifically in creative industries, and thus almost all indicators are related to art (see table 2).

Table 2: The Euro-Creativity Scoreboard

⌘ Talent Sub-Index ...
... to measure the level and characteristics of employment in the cultural & creative sector Possible indicators could include: % of workforce employed in the cultural and creative sector.
⌘ Cultural Sub-Index ...
... to measure the availability, participation and production of cultural resources Possible (and non exhaustive) indicators could include: <i>Venues:</i> Number of museums, operas, festivals, cinemas etc. <i>Artists:</i> Number of composers, musicians, dancers, orchestras, ballets, etc. <i>Industry:</i> number of creative companies, production levels, etc. <i>Equipment:</i> Number of TV channels per million inhabitants, radio stations, hardware equipment, Internet connections etc. <i>Education:</i> Number of arts and audiovisual related education institutions, etc. <i>Participation and consumption:</i> Number of people playing an instrument, singing in a choir, reading more than five books a year, cinema attendance, CD albums bought on an annual basis, etc.
⌘ Technology and Innovation Sub-Index ...
... to measure the development of infrastructures and technology penetration, the use of information and communication technologies in cultural institutions and organisations and media activities, the investment in cultural capital, Possible indicators would include: - Broadband penetration, broadband speed, etc. - Investments in intangible assets
⌘ Diversity Sub-Index...
... to measure the variety in cultural products on offer Possible indicators would include: - Market shares of non-national European film or music, etc. - Top 100 hits in music, films, books, etc (including on-line top 100 hits) - Diversity in total sales (including online sales) - Diversity of radio programmes, etc.

Adapted from KEA (2006, 211).

Boschma and Fritz (2007) applied Florida's conception of creative class to study employment growth in 450 regions of eight European countries. They found that creative class had a positive effect on employment growth and that creative class workers seem to be attracted to places characterized by tolerance and openness.

Florida's work is not exempt of criticism. Peck (2005), for example, makes a vivid criticism of Florida's thesis. Malanga (2004) also has severely criticised Florida's for its impact in urban policy. Glaeser (2000) has also raised some concerns about Florida's theories.

3.4. Entrepreneurship and innovation as pointers of creative potential

Florida's views on creativity open up the door to consider other type of measures of creativity far away from the psychological methods and constructs. In particular indicators pointing to innovation and entrepreneurship become possible measures of creativity levels.

The Oslo manual (OECD and EUROSAT 2005, 46) defines innovation as "a new significant improved product (good or service), or process, a new marketing method, or a new organizational method, business practices, workplace organization or external relations". Defined in this way, innovation requires creativity since it implies something new significantly improved. The Oslo manual differentiate between product, process, marketing and organizational innovation. This means that which is "new" does not necessarily have to be a market product, but something that is "significantly" different from what was previously in use. The problem of "relativity" of what is new, as in the case of creativity, is addressed in the case of innovation. For the Oslo manual "the minimum entry level for an innovation is that must be *new to the firm*" (OECD and EUROSAT 2005, 57, emphasis in the original).

Innovation in this definition differs from invention in that it has been introduced into the market, either by using it (an organizational innovation that has been implemented) or by putting it into the market (a new product). In this way, innovation complies with the second characteristic of creativity of "usefulness" or "value". The innovation being implemented is, at least theoretically, a solution to a problem (the lack of certain product in the market, the absence of a marketing strategy, etc.).

Indicators on innovation have been developed in Europe within the context of the Lisbon Strategy. Celikel Esser et al. (2008) present an overview of the innovation metrics used in the European Union in the last 10 years. They identified five tools at a European level: European Trend Chart, the Community Innovation Survey (CIS), the Inno-barometer, the European Innovation Scoreboard (EIS) and the European Service Sector Innovation Scoreboard (SSIS). The European Trend Chart is mainly concerned with policy developments in the European Union. CIS is a statistical survey coordinated by EUROSTAT that collects information on innovation using the methodological basis of the Oslo manual. The Inno-barometer is an opinion poll carried out under the auspices of the European Commission. It explores the opinions of managers in relation to some

innovation issues. EIS is defined by Arundel and Hollanders (2008) as a collection of national and regional indicators relevant to innovation. The EIS “is the range of measures produced to benchmark the EU countries’ innovation performance (Celikel Esser et al. 2008, 16). Table 3 in the ANNEX presents the indicators of the EIS. Finally, the SSIS is a respond to the increasingly importance given in policy to services in general and innovation in service in particular (Hollanders and Arundel 2005). Table 4 in the annex presents the selected indicators used in the SSIS.

In addition, entrepreneurship is another area where the development of indicators is progressing. Indicators of entrepreneurship are not specifically considered by Florida in *The Rise of the Creative Class*. However, in an article for Regional Studies (Lee et al. 2004) the authors linked creativity and entrepreneurship. In their analysis they measure entrepreneurship in the U.S. as firm birth per 1000 people.

In the measurement of entrepreneurship, the OECD and EUROSTAT are collaborating in a project started in 2006: The Entrepreneurship Indicator Program (EIP). EIP defines entrepreneurs as “those persons (business owners) who seek to generate value, through the creation, expansion of economic activity, by identifying and exploiting new products, processes or markets” (Ahmad and Seymour 2008). The definition differs from innovation. While an innovation refers to a new significant improved product or process, entrepreneurship is mainly concern with generation of value from these sources. Value is understood in different ways, and it can be economic or social, although the EIP has mainly focused on economic value. Entrepreneurship, therefore involves also creativity, since it requires the capacity to purposefully exploiting new opportunities. Entrepreneurship requires thus, also one of the common characteristics defined under creativity, the capacity to move one’s ideas forward (persuasion) (Runco 2007).

EIP has developed a framework and proposed a list of indicators related to entrepreneurship. Most of these indicators are pointing to creativity efforts, since they, by definition, are focus on something “new” and with “value”. Interesting enough, Ahmad and Hoffman (2008, 15) point out that “[F]irms do not need to be new to be entrepreneurial. Older firms can demonstrate entrepreneurship too”. In this way, they include high-growth firms based on employment and turn-over as indicators of entrepreneurship, under the assumption that firms that have demonstrated rapid growth are doing something “significantly different” (Ibid.).

Entrepreneurial Performance		
Firms	Employment	Wealth
Employer Enterprise Birth rates	High Growth Firm rates by Employment	High Growth Firm rates by Turnover
Employer Enterprise Death rates	Gazelle rates by Employment	Gazelle rates by Turnover
Business Churn	Business Ownership Start-Up rates	Value-Added by Young or Small Firms
Net Business Population Growth	Business Ownership rates	Productivity Contribution, Young or Small firms
Survival rates at 3 and 5 Years	Employment in 3 and 5 Year Old Firms	Innovation Performance, Young or Small firms
Proportion of 3 and 5 Year Old Firms	Average Firm Size after 3 and 5 Years	Export Performance, Young or Small firms

Figure 2: The OECD/EUROSTAT framework and Indicators for Entrepreneurship (adapted from Ahmad and Hoffman 2008, 17).

They divide the framework into three categories of indicators. Indicators are related to: Firms, employment or wealth. Wealth is a provisional title and it present relatively heterogeneous nature of indicators. The list of the considered indicators is presented in figure 2.

4. Measuring creativity using large international surveys

The previous section has shown that despite having some measures of creativity, it seems clear that understandings of creativity differ depending on the approach chosen to study it. Tests of creativity at individual level require, mainly, either some type of divergent thinking (as opposed to convergent thinking) or some personality traits (that have been associated with creative behavior).

Existing large scale surveys, such as PISA or TIMSS, are mainly convergent thinking tests. This means that in all the items proposed there is only one correct answer. From the description above on creativity, it can be said that trying to measure creativity with items that have been design specifically to test knowledge in one area (mathematics, science or reading) will present several challenges.

First, the differentiation of creative thinking from knowledge proficiency might be difficult to achieve. It could be argue that certain items in the PISA study would require more creativity than others. If it were possible to differentiate between more or less creative items in the PISA test, would it be possible to create a sub-scale of “creativity” using PISA data?

This type of measurement, however, opens another question: how could we say that those items have been correctly answered by the more creative pupil and not by the most knowledgeable? The items have been constructed not to measure creativity (can the students provide an original and adequate answer?) but to measure their proficiency level in one area (can the student provide one adequate answer?). How plausible is to separate the “proficiency” to the “creative” part of solving a problem in PISA?

Another important issue that appears when measuring creativity refers to the conditions of the test. It is interesting to note what Runco (2007, 3) has pointed out:

if schools care about creativity and give children exercises and test for creativity potential, but if those are given in test-like academic atmosphere, the same children who always do well on test will excel, and the children who do moderately or poorly on traditional tests will again do only moderately or poorly.

He noted in this way, while revising evidence from Wallach and Kogan (1965), that in order for test for creativity (using divergent thinking tests) to differ from regular IQ tests, the application of the creativity tests has to be in a “game like” or “permissive environment”. The tests were described as games rather than tests, where no grades would be given. Only in this way, tests on creativity were significantly different than test on intelligence. Thus, one might ask, would the measurement of creativity with large scale survey data differ at all from the regular tests scores?

In addition, how to decide which items require more creativity than others might be complicated. A group of experts could explore items and decide on this issue, but the items selected as “creative”, would have been selected more or less arbitrarily (by a group of experts). Very likely, the resulting scales would have the low reliability, which will make very complicated any interpretation of the results. We will be measuring, not only a small fraction of what apparently (and according to some 30 or 20 experts, if not less) creativity entails, but we will not be able to be sure that we are actually measuring what we are suppose to measure (e.g. creativity in solving mathematical problems). How could we overcome such an obstacle? Can we empirically find evidence that some items are more creative than others?

Literature on creativity presents a rather complicated view of what creativity is. The most plausible approach to creativity is a multidisciplinary approach, in which creative behavior and thinking emerged from the combination of the right variety of elements in a very sophisticated (difficult to replicate) interrelationship (similar to the views of Sternberg and Lubart (1999) or Runco (2007). Thus, can existing international surveys provide a (very small) fraction of what creativity encompassed?

More complicated is to think of creativity as a social construct, in the sense that creative products are determined by the culture the product has been produced. To put an extreme example: “using a lever to move a rock might be judge novel in a Cro-Magnon civilization, but not in a modern one” (Flahery 2005, 147). In this way, creativity would be context dependent and difficult to be compared across countries. What type of creativity could we measure that is comparable across cultures?

Developing a large scale survey on creativity

From the arguments presented above, it seems costly and maybe not very effective to use PISA or other international scale as a measure of creativity. However, the development of an instrument to test creativity in all European Member States could be considered, although, there is little doubt that the process would be extremely challenging and difficult. New methods of assessment with computers allow for simulations and games to assess students capacities. This open up one door to measure complicated constructs such as creativity. Could the emergence of Computer Based Assessment open a door to make the measurement of creativity at an individual level plausible in an international comparative manner?

The first step would necessarily be to agree on a working definition of creativity. The definition would require the participation of as many stake holders as possible, in order to make it relevant to different policy areas. It would have to be adaptable to many different backgrounds and cultures that compound the European Union. An extended review of the literature, more complete than the one presented here would be necessary, as well as involvement of experts in the area.

With this definition in mind, it would be advisable to conduct a feasibility study. This will require some expert group in measurement issues in psychology (and creativity

research specifically) that would assess the possibility of developing a test to measure creativity in an international manner. If the feasibility study yields a positive result, it would provide the “green light” to start the process of developing a tool to measure creativity. The instrument would have to be tested and adapted to the National contexts in the European Union. The tool would have to necessarily be pre-tested in a pilot way, in as many different countries as possible. If the results of these pilot tests are satisfactory, and the tool is good enough, it would be possible to start a full scale process that would provide a picture of creative levels in society.

Such a project would necessarily be a long term project that would require an important amount of investment and political will. The process might be aborted in the way for different reasons. And great difficulties could be expected in the measurement and adaptation of test items to specific cultural aspects. The results of such a project are difficult to predict, as well as the reactions that might cause in the public sphere.

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Annex: Extra tables

Table 3: European Innovation Scoreboard (EIS) indicators, 2007

INPUT – INNOVATION DRIVERS (<i>inidrv</i>)		
1.1	S&E graduates per 1000 population aged 20-29	EUROSTAT
1.2	Population with tertiary education per 100 population aged 25-64	EUROSTAT, OECD
1.3	Broadband penetration rate (number of broadband lines per 100 population)	EUROSTAT
1.4	Participation in life-long learning per 100 population aged 25-64	EUROSTAT
1.5	Youth education attainment level (% of population aged 20-24 having completed at least upper secondary education)	EUROSTAT
INPUT – KNOWLEDGE CREATION (<i>inikc</i>)		
2.1	Public R&D expenditures (% of GDP)	EUROSTAT, OECD
2.2	Business R&D expenditures (% of GDP)	EUROSTAT, OECD
2.3	Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures)	EUROSTAT, OECD
2.4	Share of enterprises receiving public funding for innovation	EUROSTAT (CIS4)
INPUT – INNOVATION & ENTREPRENEURSHIP (<i>inientrep</i>)		
3.1	SMEs innovating in-house (% of all SMEs)	EUROSTAT (CIS3)
3.2	Innovative SMEs co-operating with others (% of all SMEs)	EUROSTAT (CIS4)
3.3	Innovation expenditures (% of total turnover)	EUROSTAT (CIS4)
3.4	Early-stage venture capital (% of GDP)	EUROSTAT
3.5	ICT expenditures (% of GDP)	EUROSTAT
3.6	SMEs using organisational innovation (% of all SMEs)	EUROSTAT (CIS4)
OUTPUT – APPLICATIONS (<i>inoapp</i>)		
4.1	Employment in high-tech services (% of total workforce)	EUROSTAT
4.2	Exports of high technology products as a share of total exports	EUROSTAT
4.3	Sales of new-to-market products (% of total turnover)	EUROSTAT (CIS4)
4.4	Sales of new-to-firm products (% of total turnover)	EUROSTAT (CIS4)
4.5	Employment in medium-high and high-tech manufacturing (% of total workforce)	EUROSTAT
OUTPUT – INTELLECTUAL PROPERTY (<i>inoip</i>)		
5.1	EPO patents per million population	EUROSTAT
5.2	USPTO patents per million population	EUROSTAT, OECD
5.3	Triadic patent families per million population	EUROSTAT, OECD
5.4	New community trademarks per million population	OHIM ¹
5.5	New community designs per million population	OHIM ⁶

¹ Office for Harmonization in the Internal Market (Trade Marks and Designs): <http://oami.eu.int/>

Table 4: European Service Sector Innovation Scoreboard (SSIS) indicators, 2007

HUMAN RESOURCES	
1.1	Share of firms engaged in training for innovation purposes
1.2	Share of firms reporting lack of qualified personnel as an important issue
INNOVATION DEMAND	
2.1	Share of firms reporting uncertain demand for innovative goods/services as an important issue
2.2	Share of firms reporting no need to innovate because no demand for innovation
PUBLIC AND PRIVATE SUPPORT	
3.1	Share of firms that received any public funding for innovations
PRODUCT AND PROCESS INNOVATION	
4.1	Share of firms engaged in intramural R&D
4.2	Expenditures in intramural R&D (% of total innovation expenditure)
4.4	Share of firms engaged in acquisition of machinery, equipment, hardware or software
PRODUCT AND PROCESS OUTPUTS	
5.1	Share of firms with highly important effects in reduced materials and energy per unit output
5.2	Share of firms with highly important effects in improved flexibility of production or service provisions
5.3	Share of firms with highly important effects in improved quality in goods or services
5.4	Share of firms with highly important effects in reduced labor costs per unit output
NON TECHNOLOGICAL INNOVATION	
6.1	Share of firms that introduced organisational and/or marketing innovations
6.2	Share of firms that introduced organisational innovations
6.3	Share of firms that introduced marketing innovations
NON TECHNOLOGICAL INNOVATION OUTPUTS	
7.1	Share of firms with highly important effects in reduced time to respond to customer or supplier needs
7.2	Share of firms with highly important effects in improved quality of goods/services
7.3	Share of firms with highly important effects in reducing costs
COMMERCIALISATION	
8.1	Turnover of new and significantly improved products only new to firm (% of total turnover)
8.2	Share of firms that have new or significantly improved products new to market
INTELLECTUAL PROPERTY	
7.1	Share of firms that applied for a patent
7.2	Share of firms that registered an industrial design
7.3	Share of firms that registered a trademark

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Abstract

This paper aims to arrive at a preliminary understanding of research on creativity and the possibilities of constructing a "creativity indicator" using large scale surveys and other existing statistical tools. The paper reviews perspectives on creativity. Despite being a complex entity, difficult to define, there is a degree of consensus on some of the creativity characteristics. Creativity is usually related to the production of something new that also has value. There is also substantial agreement that everybody can be creative to some extent. The second part of the paper presents existing measures of creativity. They are divided into psychological measures related to divergent thinking and personality traits and a "sector" approach to creativity. While the psychological approach is based in the, more or less, traditional psychometric models interested in individual level characteristics, the "sector" approach comes from a different set of disciplines interested in creative aspects of society. The paper concludes by raising questions about the possibility of using existing large scale survey data, such as PISA, to construct a creativity index. It also proposes some necessary steps to implement a large scale assessment on young people's creativity.

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