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Title

Research on Creativity

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Synonyms

Creativity research; empirical aesthetics; empirical studies of the arts; empirical studies of creativity

Main Text

Key Concepts and Definition of Terms

Defining Research

Research can be defined as an objective, systematic investigation for the purpose of testing theories, establishing facts, and advancing knowledge. Psychology is often subdivided into experimental psychology, which is research oriented, and clinical psychology, which is practice oriented. Thus psychological research on creativity is primarily, though not entirely, the domain of experimental psychology. Educators, business people, people in the entertainment industry, and others, also study creativity.

Defining Creativity

Creativity is arguably our most uniquely human trait. It enables us to escape the present, reconstruct the past, and fantasize about the future, to visualize something that does not exist and change the world with it. Defining creativity presents difficulties; for example, not all creative works are useful, and not all are aesthetically pleasing. Both usefulness and aesthetic value capture, in some sense, what creativity is about. Nevertheless, psychologists have almost universally converged on the definition originally proposed by Guilford over sixty years ago. Guilford (1950) defined creativity in terms of two criteria: *originality* or novelty, and *appropriateness* or adaptiveness, *i.e.*, relevance to the task at hand. *Surprise* is sometimes added as a third criterion (Boden 2004). Some add *quality* as a separate criterion, while others use the term appropriateness in a way that encompasses quality. Creativity has also been defined as a complex or syndrome, and some define it so broadly as to include novelty-generating processes in the biological world or the universe at large. However, it is the ‘originality and appropriateness’ definition that is encountered most often and that has become standard (Sternberg 1988; Feldman, Csikszentmihalyi and Gardner 1994; Amabile 1996; Runco 2004). While this definition provides a much-needed departure point for discussion about and measurement of creativity, there is likely no one-size-fits-all definition of creativity. For scientific or technological endeavors, appropriateness might be more important, whereas in the

arts, originality might be weighted more heavily. Thus, creativity must be assessed relative to the constraints and affordances of the task.

The Four Ps of Creativity

It is often said that creativity involves four Ps: person, process, product, and place (Rhodes 1961).

Research focused on the creative *person* can take the form of studies that investigate what personality traits are correlated with high creativity, or case studies of particular creative individuals. It can also include *historiometric methods*, which involve obtaining qualitative data on eminent creators (*i.e.*, number of paintings produced throughout their career), transforming it into quantitative data, and performing statistical analyses with the aim of finding general laws or statistical relationships that transcend particulars of person, time, or place.

The second P of creativity concerns the *process* by which ideas come about. Process oriented research can involve testing descriptive models of the stages of the creative process, investigations into what kind of thought processes are contributing to the creative ideation in these different stages, or studies of creative individuals at work. These studies may be observational, involve questionnaires, or neuroscientific methods such as functional magnetic resonance imaging (fMRI).

The third P of creativity, the *product*, can take the form of a physical object (*e.g.*, a painting), or behavioral act (*e.g.*, a dance), or an idea, theory, or plan of action. Western approaches to creativity have tended to focus more on the product than Eastern approaches.

The last of the four Ps of creativity, *place*, concerns the environmental conditions conducive to creativity. Certain individual situations, such as education and training, role models and mentors, and perhaps surprisingly, childhood trauma, are correlated to historical creativity. Economic growth appears to have a stimulating effect on creativity, whereas war has an inhibitory effect.

Historical versus Personal Creativity

Psychologists distinguish between different kinds and degrees of creativity, such as between historical and personal creativity (Boden 2004). When the creative process results in a product that is new to all of humanity and makes an impact on the course of civilization, it is referred to as *historical creativity* (H-Creativity). Historical creativity is also sometimes referred to as *eminent creativity*, because the creator tends to become famous. When the creative process results in a product that is new to the creator, but someone else has come up with it before, or it is not creative enough to impact human civilization, it is referred to as *personal creativity* (P-Creativity). Although personal creativity does not change the world, it can be a source of pleasure and amusement. Clearly there are shades of gray between these extremes.

A concept that is closely related to personal creativity is *everyday creativity*. Everyday creativity manifests in daily life; it comes through in how one prepares a meal, decorates a room, or interprets and shares experiences. Everyday creativity generally begins with an innovative, often unconventional approach to life that involves capitalizing on hidden opportunities, undertaking common tasks in uncommon ways, and finding solutions to challenges as they arise.

Historical and personal and creativity are also sometimes referred to as *Big C* and *Little C creativity*, respectively. Some additionally make the case for *Mini C creativity*, which involves making personally meaningful interpretations of objects and events, and which can form the basis for more substantial creative acts (Beghetto and Kaufman 2007). Daily life involves thinking things and doing things that, at least in some small way, have never been thought or done before,

and thus that *everyone* is somewhat creative (Runco 2004).

Creativity versus Discovery and Invention

Creativity is sometimes distinguished from two related concepts: discovery and invention from two related concepts: discovery and invention. *Discovery* involves finding something *already present* and sharing it, *e.g.*, Columbus' discovery of America. It is relatively impersonal because if one person had not discovered it, someone else would have. *Invention* entails unearthing something that was *not present before*, *e.g.*, Alexander Bell's invention of the telephone. Like discovery, it is relatively impersonal. Creativity also involves sharing something that was not present before. Some psychologists additionally require that for something to qualify as creative it must be profoundly personal in the sense that one feels the presence of a unique individual in the work, *e.g.*, Leonardo Da Vinci's art.

Theoretical Background

Early Conceptions

In early times the creative individual was viewed as an “empty vessel” that was filled with inspiration by a divine being. In the first half of the 20th Century there was little research on creativity because it was thought to be too complex and frivolous for scientific investigation. A pioneering exception to this was Wallas' (1926) classification of the creative process into a series of stages. The first of Wallas' stages is *preparation*, which involves obtaining the background knowledge relevant to the problem, its history (if known), and any instructions or past attempts or preconceptions regarding how to solve it. It also involves conscious, focused work on the problem. The second stage is *incubation*—unconscious processing of the problem that continues while one is engaged in other tasks. The preparation and incubation stages may be interleaved, or incubation may be omitted entirely. Wallas proposed that after sufficient preparation and incubation, the creative process is often marked by a sudden moment of *illumination*, or insight, during which the creator glimpses a solution to the problem, which may have had to be worked and reworked to make sense of it. Wallas' final phase is referred to as *verification*. This involves not just fine-tuning the work and making certain that it is correct, as the word implies, but putting it in a form that can be understood and appreciated by others. Empirical investigation of Wallas' theory yielded mixed results. Another shortcoming is that it is merely descriptive; it does not explain how or why the stages occur.

The year 1950 marks a turning point for research in creativity, when it was the subject of Guilford's address to the American Psychological Association. Creativity came to be a subject of interest to many disciplines, and to be approached from many directions.

Cognitive Approaches

Cognitive approaches to creativity focus on the mental processes by which creative outputs are generated. These processes include concept combination, expansion of concepts, imagery, metaphor, and divergent thinking. *Divergent thinking* is often assumed to involve the generation of multiple, often unconventional, possibilities (Guilford 1968; for a review see Runco 2010). Another view is that creative thinking is divergent not in the sense that it generates multiple possibilities, but in the sense that it produces a raw idea that is vague or unfocused and requires processing to become viable.

Some who take a cognitive approach viewed the mind, metaphorically, as a computer (or computer program). They proposed that creativity involves a *heuristic search*, in which rules of

thumb guide the inspection of different states within a particular state space (a set of possible solutions) until a satisfactory solution is found (Newell, Shaw and Simon 1957). In heuristic search, the relevant variables of the problem or situation are defined up front; thus the state space is generally fixed. Examples of heuristics include breaking the problem into sub-problems, and working backward from the goal state to the initial state. It has since been proposed that creativity involves heuristics that guide the search for a new state space itself, rather than just a new possibility within a given state space (Boden 1990; Kaplan and Simon 1990). This involves switching from one representation of the problem to another, sometimes referred to as *restructuring* (Weisberg 1995).

Modifications to Wallas' classic four-stage model of creativity (discussed above) have been proposed. Some incorporate a phase that involves *problem finding* (noticing that something is amiss), problem posing (expressing the problem), problem construction (developing a detailed representation of the problem), or problem definition and redefinition (Amabile 1996; Guilford 1950). Problem finding may involve sensing gaps or disturbing missing elements (Torrance 1963). It may take the form of identification of a 'seed incident' around which the creative project takes shape. Another modification of the four-stage model is the addition of a frustration phase prior to incubation, in which straightforward attempts to solve the problem prove unfruitful. Not all modifications *add* to the four stages; for example, Geneplore is a two-stage model involving *generation* of crudely formed ideas referred to as pre-inventive structures followed by *exploration* of them through elaboration and testing (Finke, Ward and Smith 1999). Defocused attention, by diffusely activating a broad region of memory such that everything seems to be related in some way to everything else, may be conducive to the divergent thought that characterizes idea generation. Focused attention, by activating a narrow region of memory and treating items in memory as distinct chunks that can be readily operated on, may be conducive to the convergent thought that characterizes elaboration.

Psychometric Approaches

Those who take a psychometric approach develop tests of creativity as well as methods for improving creativity.

The most widely known creativity test is the Torrance Test of Creative Thinking (Torrance 1996). It consists of multiple components or sub-tests. Examples include the *Unusual Uses Test* in which participants are asked to think of as many uses for a common object (*e.g.*, a brick) as possible, or the Product Improvement Test, in which participants are asked to list as many ways as they can to change a product to make it more useful or desirable, (*e.g.*, to change a toy monkey so children will have more fun playing with it). Since then other tests of creativity have been proposed. Perhaps the most successful of these is Amabile's (1996) Consensual Assessment Technique, in which a panel of expert judges is asked to rate the creativity of products in their area of expertise, *e.g.*, story writing, poetry, or collage making.

The most well-known technique for improving creativity is *brainstorming*, which takes place in groups, and involves encouraging them to suggest all the ideas they can, no matter how seemingly 'crazy', and discouraging criticism of ideas. Such techniques are used by businesses and organizations to develop successful business strategies, and in business schools to foster entrepreneurship.

Developmental and Personality Approaches

Developmental research focuses on creativity in children and throughout the lifespan. One interesting set of findings to come from this research concerns the relationship between emotions

and creative play during childhood. The extent to which children access affect-laden (emotional) thought is correlated with ratings of associative thinking, cognitive flexibility, and creativity, and the extent to which children engage in fantasy and play (Russ 1993). Moreover, the degree of fantasy and imagination at ages six to seven was related to the divergent thinking ability in high school.

Personality approaches to creativity focus on the personality traits associated with creativity (Feist 1998). Creativity is correlated with independence of judgment, self-confidence, aesthetic orientation, risk-taking, openness to experience, tolerance of ambiguity, impulsivity, lack of conscientiousness, high energy, attraction to and ability to handle complexity, problem sensitivity, flexibility, the ability to analyze, synthesize, evaluate, and reorganize information, engage in divergent thinking. There is also evidence that creative individuals are more prone to anxiety and emotional (affective) disorders. Creative individuals differ with respect to whether they are internally versus externally oriented, person-oriented or task-oriented, and explorers (who tend to come up with ideas) or developers (who excel at turning vague or incomplete ideas into finished products).

Social and Cultural Approaches

Social and cultural approaches examine how family dynamics, group dynamics, and cultural influences affect creativity, and how creativity compares across different cultures.

Maslow believed that creativity is fostered by environments that are supportive and free of evaluation, which he claimed are conducive to self-actualization. However, it is not the case that positive social environments necessarily lead to creativity. For example, highly creative people tend to experience a lack of parental warmth, and are more likely to have experienced the death of a parent at an early age, and raise fewer children, than average.

According to the *systems approach*, creativity occurs through an interaction between (1) the *individual*, *i.e.*, the creator, (2) a *field* which is set of relevant individuals in society, *i.e.*, the people involved in same creative endeavor as the individual, and (3) the *domain*, *i.e.*, the set of relevant ideas in the culture (Csikszentmihalyi 1997; Sawyer 2006). The creative process is thus viewed as highly entwined with the process of persuasion.

Case Studies

In the early days of scientific psychology, experiments in strictly controlled laboratory conditions were encouraged; case studies of individuals, and particularly introspective accounts, were not taken seriously. Recently, researchers have acknowledged the artificiality of many laboratory studies. There is stronger appreciation for taking an *ecological* approach. This involves studying people in their everyday environments engaged in everyday tasks, and treating individual differences not just noise, but as interesting in their own right. Individual differences are particularly important in the study of creativity. Thus, although case studies and introspective accounts are notoriously flawed and will never take the place of more controlled approaches, they have a place in the scholarly effort to achieve a nuanced and multifaceted understanding of the creative process.

Case studies of scientists have led to enhanced appreciation of the importance of problem finding. Einstein, for example, famously claimed that real advance in science is marked by regarding an old problem from a new angle, and the formulation of a problem is often more challenging than its solution. Real-time studies of individual artists and designers have also yielded interesting insights. For example, they have shown that creative ideation involves elaborating on a 'kernel idea', which takes shape through ongoing interaction between artist and

artwork (Feinstein 2006; Locher 2010).

Clinical Approaches

As mentioned previously, there is evidence that creative individuals are more emotionally unstable and prone to affective disorders such as depression and bipolar disorder and have a higher incidence of schizophrenic tendencies than other segments of the population (Andreason 1987; Flaherty 2005; Jamieson 1993). There is also evidence that they are more prone to suicide (Goodwin and Jamieson 1990) and to abuse drugs and alcohol (Ludwig 1995).

Clinical approaches to creativity are not focused exclusively on the negative. Freud's notion of the *preconscious* – a state between conscious and unconscious reality where thoughts are loose and vague but interpretable – is still viewed by many as the source of creativity. Clinical approaches to creativity also investigate how art therapy, music therapy, and dance therapy can help patients open up and express themselves in ways that verbal communication may not. Ironically, the notion of verification, as it has traditionally been construed since it was first proposed by Wallas as the final stage of the creative process, involves making the idea appealing to others takes into account the minds of those who will be exposed to the creative work, while not taking into account the effect of the idea on the mind of the one who creates it. Researchers are now beginning to take this into account.

Biological Approaches

Biological approaches investigate the extent to which there is a genetic basis to creativity, as well as the underlying neural and physiological mechanisms underlying creativity. Twin studies and other sorts of evidence suggest creative abilities are, at least to some extent, genetically inherited (Eysenck 1995). One way to go about investigating the brain mechanisms underlying creativity involves dissecting the brains of people who were particularly creative during their lifetimes. It has been shown that Einstein's brain had (1) a partially absent Sylvian fissure, which may have facilitated communication between different parts of the brain, and (2) a high ratio of glial cells to neurons in both area 9 of prefrontal cortex, which is associated with planning, attention, and memory, and area 39 of the left inferior parietal cortex, which is associated with synthesizing information from other brain regions.

A less dramatic but more common way to investigate the brain mechanisms underlying creativity involves examining brain activity when people engage in creative activities using *electroencephalography* (EEG) or *functional magnetic resonance imaging* (fMRI). Though application of such methods is stymied by the fact that many brain areas are active during creative thought, some interesting findings are emerging (Bristol, Vartanian and Kaufman, in press). There is evidence that different kinds of creativity (deliberate versus spontaneous, and emotional versus cognitive) involve different neural circuits (Dietrich 2004). Creative thought appears to be facilitated by lower levels of noradrenaline and dopamine—catecholamines directly linked to cognitive control, prefrontal functioning, and cortical arousal. EEG experiments show that divergent thinking tasks produce decreased beta range synchrony and increased alpha range synchrony over the frontal cortex, providing further evidence for a loosened cognitive control and lower prefrontal cortical arousal during creative thought. There is also indirect neuroscientific support for the above-mentioned contextual focus hypothesis, *i.e.*, the notion that creativity involves the ability to match where one's mode of thought lies on the spectrum from associative to analytic. Prior to finding the solution to an insight problem there is neural recruitment of the prefrontal and executive memory networks, as well as the so-called 'default network' associated with spontaneous mind wandering. This suggests that mind wandering has a utilitarian function,

and provides neurological support for the notion of expanded receptivity through neural recruitment during divergent thought.

This is further supported by physiological research into creativity, which has revealed evidence of an association between creativity and high *variability* in physiological measures of arousal such as heart rate, spontaneous galvanic skin response, cortical activity, and EEG alpha amplitude (Jausovec and Bakracevic 1995). For example, although creative people tend to have higher *resting* arousal levels, when engaged in creative problem solving they tend to have lower than average arousal levels. These findings in conjunction with the cognitive findings discussed previously suggest that during creative activities, creative individuals are particularly prone to enter a state that is quite different from their normal resting state, a state that has both a physiological aspect (low arousal level) and a cognitive aspect (associative mode of thought).

Biological approaches to creativity also address what is going on at the level of neurons. The vagueness of a ‘half-baked’ idea, and the sense that it holds potential, as well as its capacity to actualize in different ways depending on how one thinks it through, may be side effects of interference. *Interference* refers to the situation wherein a recent memory interferes with the capacity to recall an older memory because they are encoded in overlapping distributions of neurons in the brain. It is generally thought of as detrimental, but it may be beneficial with respect to creativity. When two or more items encoded in overlapping distributions of neural cell assemblies interfere with each other and get evoked simultaneously, a new idea may be the result. The phenomenon of interference leading to creative ideation has been referred to as *creative interference*. The vagueness of the new idea may reflect that it is uncertain how, in the context of each other, the interfering components come together as a realizable whole. The ability to work with an idea in this state is related to the personality trait of tolerance of ambiguity.

Evolutionary Approaches

Comparative and evolutionary approaches address the question of how humans evolved their superlative creative abilities, how these abilities compare with those of other species, and in what sense ideas can be said to evolve.

The earliest preserved signs of human creativity include primitive stone tools approximately two million years ago (Mithen 1998). Since this corresponds with an increase in brain size, it has been suggested that this enabled memories to be encoded in more detail, such that there were more ways in which one experience could evoke a reminding of another. This provided more ways of chaining thoughts and experiences into an integrated understanding of the world, which both enabled and constrained the generation of creative ideas. Computational modeling has provided support for this hypothesis (Gabora and Saberi 2011).

The Middle Upper Paleolithic marks the beginnings of art, science, and religion, and has been referred to as the “big bang of creativity” (Mithen 1998). It has been suggested that this is due to onset of the capacity to spontaneously shift between divergent and convergent modes of thought. Once it was possible to shrink or expand the field of attention and thereby tailor one’s mode of thought to the demands of the current situation, the fruits of one mode of thought could be used as ingredients for the other, resulting in a richer understanding of the world and enhanced potential to creatively change it. Tasks requiring either mode of thought, or both at different stages of the creative process, could be carried out more effectively.

Another evolutionary approach uses societies of artificial agents that invent ideas and imitate neighbors’ ideas to understand how ideas evolve over time. This approach has provided evidence that the evolution of ideas gives rise to many of the phenomena observed in biological evolution, such as (1) an increase in complexity and fitness (usefulness) over time, and (2) an

initial increase in diversity as the space of possibilities is explored followed by a decrease associated with convergence on the fittest possibilities. If even a small fraction of agents are creative, new ideas spread by imitation in waves throughout the society, reaching other creators who puts another spin on them, and over time they evolve. The more creative the creative agents are, the fewer of them there must be in order to maximize the evolution of fitter ideas, suggesting that more creativity is not always better. In collaboration with archaeologists, creativity researchers also trace the process by which one creative idea or technological invention paved the way for another (Dasguptas 1996). They are using evolutionary theories and computational models to aid the process of organizing human-created artifacts into cultural lineages.

Computational Approaches

We saw that computational modeling is particularly useful to those who investigating hypotheses concerning the mechanisms by which humans became creative. Because the onset of such mechanisms left no detectable trace, one begins by establishing which hypotheses are at least computationally feasible. However, researchers studying the evolution of creativity are not the only ones to take a computational approach; indeed efforts to develop computational models of creativity date back to the 1950s and '60s. Herbert Simon developed a computer program called BACON that came up with scientific laws. The nineties and early 2000s witnessed a plethora of computer programs that generate music, art, stories, screensavers, and so forth. Computational models have been used to model incubation and insight (Helie and Sun 2010), concept combination (Thagard and Stewart 2011), and the shifting between two distinct modes of thought in the creative process (Martindale 1995).

Open-Ended Issues

The Relative Contributions of Expertise, Chance, and Intuition

While most psychologists believe that creativity involves a combination of expertise, chance, and intuition, they differ with respect to the degree of emphasis they place on these factors.

Expertise theorists point to evidence that it takes approximately a decade to master a creative domain. Experts are better than beginners at detecting and remembering domain-relevant patterns, and are more adept at generating effective problem representations and, when necessary, revising initial hypotheses. Expertise theorists hypothesize that creativity involves everyday thought processes such as remembering, planning, reasoning, and restructuring. They claim that no special or unconscious thought processes are required for creativity, just familiarity with and skill in a particular domain (Weisberg 2006).

Critics of this view note that entrenchment in established perspectives and approaches may make experts more prone than beginners to psychological phenomena that reinforce familiar perspectives and approaches such as set, functional fixedness, and confirmation bias). Those who emphasize the role of *chance* include advocates of the Darwinian theory of creativity, according to which the creative process, like natural selection, entails blind generation of possibilities followed by selective retention of the most promising of them (Simonton 1999).

Some view creativity as not so much a matter of generating and selecting amongst predefined alternatives but of intuiting an idea and then, by considering the idea from different perspectives or trying it out different ways, taking it from an ill-defined state of potentiality to a well-defined state of actualization (Gabora 2010). Those who study the role of *intuition* and the actualization of potentiality emphasize the association-based structure of memory, and note that creative individuals tend to have *flat associative hierarchies*, meaning they have better access to

remote associates, items that are related to the subject of interest in indirect or unusual ways (Mednick 1962).

The Relative Importance of Process versus Product

While the tradition in the West is to focus almost exclusively on creativity as the process by which a new and useful or entertaining product is generated, Eastern conceptions focus more on creativity as a process that can bring about therapeutic change, *i.e.*, that expresses, transforms, solidifies, or unifies the creator's understanding of and/or relationship to the world. In the extreme, the external creative work can be viewed as a mere byproduct of the internal transformation brought about through engagement in a creative task. In this view the primary value of the creative process is that it enables the creator to express, transform, solidify, or unify the creator's understanding of and/or relationship to the world, while the external product provides a means of tracking or monitoring this internal transformation. This view figures prominently in creative therapies such as art therapy, music therapy, and drama therapy.

Is Creativity Domain Specific or Domain General?

Psychologists who emphasize the role of expertise tend to view creativity as highly *domain-specific*; expertise in one domain is not expected to enhance creativity in another domain. Support for domain-specificity comes from findings that expertise or eminence with respect to one creative endeavor is only rarely associated with expertise or eminence with respect to another (Baer 2010). For example, creative scientists rarely become famous artists or dancers.

Psychologists who emphasize intuition and associative processes tend to view creativity as more *domain-general*, because associative thinking can produce metaphors that connect different domains, and we gain understanding and control over experiences by translating and re-expressing them through the constraints of different domains. This view is supported by studies involving self-report scales, creativity checklists, and other sorts of psychometric or personality data tend to support the view that creativity is domain-general (Plucker 1998). It is also supported by experiments showing that if you recognize someone's creative style in one domain, *e.g.*, creative writing, there is an above-chance probability of recognizing works by that individual in another domain, *e.g.*, art (Gabora, O'Connor and Ranjan, in press).

Most researchers probably believe that the truth lies somewhere between the extremes. A focus on product as opposed to process, and on *talent*, which is treated as one-dimensional, as opposed to *style*, which is multidimensional, may have resulted in exaggeration of the extent to which creativity is domain-specific. Creativity in one domain may help but not guarantee creativity in another; it is neither strongly domain-specific nor domain-general. Although social recognition of achievement in multiple domains may be rare, individuals use multiple creative domains to meaningfully develop, explore, express, and understand themselves and their world. Characteristic stylistic elements of these explorations may be transported from one domain to another since all of an individual's creative outputs are expressions of an individual's particular uniquely structured internal model of the world.

Is there a Dark Side to Creativity?

Although creativity is clearly stimulating and indispensable to cultural and technological advancement, many believe it has a dark side (Cropley, Cropley, Kaufman and Runco 2010). In addition to the evidence that eminent creativity is correlated with proneness to affective disorders, suicide, and substance abuse, discussed above, excessive creativity may result in reinventing the wheel, and absorption in one's own creative ideas may interfere with assimilation

or diffusion of proven effective ideas. Moreover, it is not necessary for everyone to be creative. We can all benefit from the creativity of a few by imitating, admiring, or making use of their creative outputs. Computer modeling suggests that society self-organizes to achieve a balance between relatively creative and uncreative individuals (Leijnen and Gabora 2009). The social discrimination that creative individuals often endure until they have proven themselves may aid in achieving this equilibrium.

The Relationship between Creativity and Intelligence

Early research suggested that creativity and intelligence are correlated up until an IQ of approximately 140, after which point they diverge; thus an individual can be very smart but not terribly creative, or highly creative but not terribly smart. Recent research suggests that the relationship between the two is more complex. Clearly it depends on how the constructs of creativity and intelligence are being measured.

Implications for Theory, Policy, and Practice

Research in creativity has implications for theory, policy, and practice in a number of arenas. A first area of application is clinical. Creative activities such as art making, music making, dance, and drama are increasingly seen to have therapeutic effects that can be effective in both clinical and non-clinical settings. The transformation that occurs on canvas or on the written page is thought to be mirrored by a potentially therapeutic sense of personal transformation and self-discovery that occurs within. Immersion in the creative task has been referred to as a state of *flow* that may share characteristics with deeply spiritual or religious experiences (Csikszentmihalyi 1997).

A second, related area of application is childrearing and education. For example, creative play in childhood facilitates access to affect-laden (emotional) thoughts, which may enhance cognitive flexibility and divergent thinking abilities. Amabile's (1996) work on *intrinsic motivation* showed that rewards for creative work may actually inhibit creativity because focusing on an external reward leads people to neglect the internally rewarding nature of creative acts.

A third area of application is in business settings. For example, psychological work on *brainstorming sessions*, in which people get together as a group and put forward ideas in an open and accepting environment, has shown that it may be more effective when group work is followed immediately by individual work, or when individuals communicate by writing so as to avoid the problem of everyone talking at once.

Conclusion and Future Directions

It is our creativity that perhaps most distinguishes humans from other species and that has completely transformed the planet we live on. Research in creativity is an exciting area that brings together many different fields: neuroscience, education, and business, as well as computational and mathematical modeling. Past and current areas of controversy concern the relative contributions of expertise, chance, and intuition, whether the emphasis should be on process versus product, whether creativity is domain-specific versus domain-general, and the extent to which there is a dark side to creativity. Promising areas for further research in creativity include computational modeling, and work on the neurobiological basis of creativity, as well as environmental influences on creativity.

Cross-References

- Psychology of creativity

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