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Abstract

The main purpose of this study was to use meta-analysis to investigate the mean effect size of relevant variables associated with creative person, process, product, and environment. Altogether, 2,013 effect sizes from 111 studies were analyzed. The unweighted grand mean effect size of the 111 studies was 0.69, with a standard deviation (SD) of 0.63. Such result was significantly different from 0 at $t(110)=11.52, p<.01$. When the averaged effect size of each study was weighted with the sample size of that study, the weighted grand mean effect size was 0.72. The important findings were: (a) the mean effect sizes associated with problem-solving creativity and verbal creativity were significantly larger than those associated with emotional creativity and nonverbal creativity, (b) variables having a large mean effect size were prestige of honors=awards, working circumstances favorable for creativity, defining problem, and retrieving knowledge, (c) most of the mean effect sizes of the problem solving procedures on the measures of problem solving exceeded the medium (0.5) of Cohen's guidelines. Areas to be further explored are suggested.

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Размер эффекта переменных, связанных с креативностью: мета-анализ

Главная цель данного исследования – использовать мета-анализ для исследования главного размера эффекта релевантных переменных, связанных с творческой личностью, творческим процессом, продуктом и окружающей средой. Всего было проанализировано 2013 размеров эффектов из 111 исследований. Невзвешенный средний размер эффекта по 111 исследованиям был 0.69, стандартное отклонение 0.63. Этот результат значительно отличается от нуля $t(110)=11.52, p<.01$. Когда средний размер эффекта в каждом исследовании был взвешен по отношению к размеру выборки данного исследования, взвешенный средний размер эффекта достиг 0.72. Важные открытия: (а) средние размеры эффекта, связанные с креативностью в решении задач и вербальной креативностью, больше, чем связанные с эмоциональной и невербальной креативностью, (б) переменные с большим размером эффекта предпочтение чести/награды, рабочие обстоятельства, благоприятствующие креативности, определение проблемы и извлечение знания, (в) многие средние размеры эффекта для измеренного решения задач в процедурах решения задач превысили среднее значение коэффициента Коэна. Предлагаются области для дальнейшего исследования.

Данный анализ охватывает два направления исследования креативности:

- 1) определение факторов окружающей среды, подпитывающих или ингибирующих креативность
- 2) поиск связей креативности с индивидуальными факторами, такими как когнитивные способности и/или личность.

В 1998 году Feist провел мета-анализ исследований, сравнивающих ученых и не-ученых, людей искусства и людей не-искусства. Анализ показал, что высококреативные люди более открыты новому опыту, менее добросовестны, больше принимают себя, враждебны и импульсивны. Вопрос в том, можно ли обобщить результаты этого исследования на более широкий круг людей?

Sternberg и Lubart в 1995 предложили шесть источников питающих креативность: интеллект, знания, стиль мышления, личность, мотивация и окружение. Все, кроме последнего относится к характеристике креативной личности.

В настоящем исследовании измерения креативности делятся на следующие виды:

- а) креативность в открытых задачах, включая вербальную и невербальную
- б) креативность в решении задач с существующим правильным ответом
- в) эмоциональная креативность

И сравниваются размеры эффекта различных переменных по отношению к этим трем видам.

Творческая личность (шкалы большой пятерки)

Творческий процесс (определение проблемы, актуализация релевантных знаний, генерирование способов потенциальных решений, генерирование критериев оценки качества решений, выбор способа решения и применение; возможно еще прерывание на инкубационный период)

Творческий продукт (дивергентный и конвергентный, с соответствующими характеристиками – гибкость, применимость и т.д.)

Метод

Выбор исследований для анализа был из The ProQuest Educational Journal, Pro-Quest Dissertation Consortium, и баз данных ERIC с использованием в поиске словосочетаний: creativity and intelligence, creativity and personality, creativity and cognitive ability. Creativity Research Journal and Journal of Creativity Behavior были проверены вручную. Также были добавлены статьи, найденные по ссылкам из имеющихся. Из анализа были исключены исследования, где оценка креативности велась не по тестам или продукту, а по самооценке или оценке преподавателем. Исследования с очень высокими коэффициентами корреляции, или игнорирующие незначимые связи, были также исключены из рассмотрения.

Кодирование переменных

В Table 1 дана классификация коррелятов креативности. В Table 2 – списки категоризации измерений креативности.

Результаты

Вычисление размера эффекта

Размеры эффекта были вычислены по возможности из максимально сырых данных, приведенных в статьях. После усреднения размера эффекта для каждого исследования, средний размер эффекта для 112 исследований оказался 0,68 при стандартном отклонении 0,69, что значимо отлично от 0. Без усреднения, среднее из всех 2013 эффектов было 0,78 при стандартном отклонении 1,16. Анализ остатков показал, что во втором случае не могут быть применены параметрические методы, а только непараметрические. В обоих случаях величина размера эффекта по коэффициенту Коэна находится между средним и большим значением.

Специальный анализ

Данные для подсчетов были разделены на 3 кластера из-за теоретических или психометрических различий исследований.

1. Средние размеры эффекта психопатологических характеристик. Результаты показали, что испытуемые с более высоким баллом по психопатологическим

- характеристикам имеют большие баллы по дивергентной креативности (размер эффекта 0,5), но меньшие по креативности в решении задач (-0,14).
2. Предсказательная сила оценок по вербальной креативности в дальнейшей школьной успеваемости. Средний размер эффекта 0,56.
 3. Средние размеры эффекта работы в области поиска задач (против области решения задач и области применения решений) в соотношении формирования идей/оценочности. Размер эффекта по трем областям оказался 0,89. Для тех, кто работает в области поиска задач, это соотношение сдвинуто в сторону формирования идей, для тех, кто работает в области применения решений – наоборот, в сторону оценки.

Средние размеры эффекта для мер креативности (Table 3)

Среднее от средних размеров эффектов по каждому из 111 исследований оказалось 0,72, т.е. между средним и большим значением. Анализ остатков показал неоднородность данных, и последующий анализ выявил более сильные эффекты для вербальной креативности и решения задач, и более слабые – для невербальной и эмоциональной креативности.

Средние размеры эффектов для переменных, связанных с креативностью

В Table 4 представлены размеры эффектов для различных переменных, связанных с креативностью. Выше среднего оказались эффекты (в порядке убывания):

1. предпочтение чести/награды
2. рабочие обстоятельства, благоприятствующие креативности
3. определение проблемы
4. извлечение знания
5. климат в классе, поощряющий креативность
6. открытость
7. мистицизм
8. эмоциональная чувствительность
9. оценки по тестам личностных черт креативности

Когнитивные способности, такие как IQ или школьная успеваемость, показали размеры небольшой размер эффекта (около 0,3).

Креативность личности

Тесты уровня креативности личности показали средний размер эффекта 0,61, что больше, чем другие личностные тесты (за исключением шкалы «открытость» Большой пятерки 0,71), что также подтвердил тест парных сравнений.

Креативность в процедурах решения задач

В Table 5 отражено влияние компонентов решения задач на креативность в решении задач. Сильные эффекты показали:

1. поиск задачи на беглость решения и составную оценку решения задачи
2. запрос знаний на оригинальность и качество решения

TABLE 1
Classification of Variables Associated With Creativity

A. Variables of creative person

a. *Attained variables*

- School performances: including Grade Point Average; score on standardized achievement test; Accomplishment checklist; Academic achievement based on leaving examination of high school; score on Iowa Tests of Basic Skills Reading (ITBS-R); core knowledge > noncore knowledge curriculum; story writing; oral narrative tasks; classroom performance rating of student teacher; second language acquisition; extracurricular activities; score on California Achievement Test; prior knowledge
- Cognitive ability: including score on the following tests—IQ Tests; WISC-III Vocabulary; Raven’s Cognitive Reasoning Test; The Metaphoric Comprehension; The Lunzer Test; The Wisconsin Card Sorting Test; The Minnesota Engineering Analogies Test; The Terman Concept Mastery Test; Lorge-Thorndike: Verbal and quantitative; The Scholastic Aptitude Test; The Graduate Management Admission Test; The Wechler Intelligence Scale for Children; The Kuhlmann-Anderson Intelligence Test; The Pintner General Ability Test; The General Classification Test; The Arithmetic Reasoning Test; The Armed Force Qualifying Test; The Hidden Patterns Test; The Leveling-Sharpener House Test; The Object Sorting Test
- Capacity for imagery: including visual imagery capacity and predisposition to fantasy
- Humor (word-play; jokes)
- Creative personality: including scores on Adjective Checklist (Creative Personality Scale); How Do You Think (measuring creative personality, interests, attitude, and self-perception); The Barron-Welsh Revised Art Scale (preference for complexity personality trait); personality in terms of a creative attitude; The Torrance Leisure Interest Checklist; The Golann Forced Choice Questionnaire; Panksepp’s Affective Neuroscience Personality Scales; The Förändring och Stabilitet Test (eagerness to solve problems and to explore new things)
- Emotional stability: including high scores of emotional stability and low scores of neuroticism (neuroticism has five subscores, i.e., anxiety, hostility, depression, self-consciousness, impulsiveness, and vulnerability); low anxiety
- Extroversion: including high scores of extroversion (socially outgoing and adept) and low scores of introversion; seeking social support in coping with stressful situations (talking to someone to find out more about the situation); the Myers-Biggs Indicator of Personality Type (extrovert, intuitive, feeling, and perceiving)
- Openness: including openness to experience as opposed to satisfaction with the familiar; nonconformity to school discipline; quest for religious orientation (having an open attitude toward issues of fundamental concern of existence); nonauthoritarianism (not adhering to received custom and authority); non-extrinsic religious orientation (not focusing on external rewards, not accepting the religion as a means to self-serving ends, such as security and social status); non-intrinsic religious orientation (not being true believers)
- Agreeableness: including agreeableness (being compassionate, good-natured, & cooperative) as opposed to hostility (being proud, skeptical, and competitive); nonconfronting coping (attempts to alter the situation without the use of hostile risk-taking activity)
- Conscientiousness: including conscientiousness (being well-organized, disciplined, & achievement-oriented) as opposed to indifference (being easygoing or detaching oneself emotionally from the situation); moral maturity; coping with a stressful situation not by distancing oneself from it, but by addressing it; accepting one’s own part in the responsibility for a stressful situation
- Cognitive styles: high scores of field-independence and low scores of field dependence
- Willingness to take risks
- Inclination for divergent thinking (including preferences for high ideation/low evaluation, high intuition/low reasoning, and high innovation/low adaptation, explorer > assimilator cognitive style; high tolerance of ambiguity)
- Inclination for convergent thinking (including preferences for evaluation, reasoning, and adaptation, intolerance of ambiguity)
- High scores of intrinsic motivation and low scores of extrinsic motivation (extrinsic motivation refers to hoping to acquire external reinforcements, such as a bonus; subjects were told that their tasks would be evaluated); constructive feedback (provision of information about the strength of students’ collage); intrinsic religious motivation
- Prestige of honors: including prestige of honors/awards; national academy membership; professional visibility
- Leadership: including transformation leadership (the leader promotes innovation, motivation, & the expression of different viewpoints of group members); successful leadership on the Nursery School Leadership Observation Schedule
- Nondelinquent
- Psychological androgyny: having high scores on both femininity and masculinity
- Self-efficacy: including self-efficacy (having a faith in one’s own abilities); self-esteem; autonomy; self-determination; self-directing religious coping style (stressing one’s own power to deal with problems without God’s help); internal locus of control (the lower scores for Nowicki-Strickland (1971) Locus of Control Scale are associated with internal orientation, which indicates that life events are largely under internal or personal control instead of external control such as by powerful others or by chance); noncollaborative religious coping style (not viewing both God and the self as active contributors, working together to solve problems but self-directed); non-deferring religious coping style (not placing responsibility for problem solving on God); self-controlling (emphasizing control over one’s own behavior and the situation); making plans to solve problems in coping with stressful situations (deliberate and analytic approaches to solving the problem); not choosing escape-avoidance in coping with stressful situations; high score on self-concept
- Prior traumatic experience: including childhood and adolescent long-term benefits from overcoming hardships
- Mysticism: including general mysticism (emphasizing transcendental experience and having a sense that all things are alive); religious interpretation (emphasizing the holiness or sacredness of an experience)
- Affective sensibility including non-alexithymia (ability to identify and describe one’s own emotional feelings) and empathy (ability to detect and describe the feelings of others)
- Low scores on psychopathological traits: including low score on ego defense mechanisms which include 15 ego defense styles; low negative schizotypy including low scores on social anhedonia and low psychoticism (a high score on social anhedonia delineates social withdrawal and isolation & the inability to experience pleasure from social interaction; a high score on psychoticism measured with the Eysenck (1991) Personality Scales depicts vulnerability to psychosis; psychoticism includes subtraits of aggression, coldness, egocentricity, impersonalness, impulsivity, antisocialness, lack of empathy, creativity, & tough-mindedness)

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TABLE 1
Continued

b. Ascribed variables

Gender (female > male)

Birth order or number of siblings

B. Variables of creative process

Defining problem: including restatement of the problem as many different ways as possible before beginning to solve the problem; going deeper into questions; problem construction (the novel, ill-defined problem must be redefined or restructured); problem representation (identifying goals, procedures, information, & constraints of the problem); Westcott's (1962, 1968) Intuition Scale

Retrieving problem-related knowledge: Including information encoding or acquisition (searching & identifying or retrieving pertinent information, including relevant knowledge, facts, principles, rules, categories, concepts, etc.); technical expertise of drawing

Generating potential solutions: including category selection (selecting a set of categories or concepts to provide a basis of subsequent reorganization)

Generating evaluation criteria for selecting solutions

C. Situational variables

Class climate favorable for creativity: Including competitiveness between peers in achievement; competition > no competition; low friction among students; low cohesiveness between students; satisfaction with class climate; low difficulty of class work; teacher encourages creativity (including self-initiated learning, self-evaluation, manipulate materials, open discussion); instruction condition (heuristically demonstrating the same techniques in a more flexible form > algorithmically providing a rote step-by-step algorithm for building a sample structure); nominal group by brainstorming (exchange of written ideas or using computers) > interactive group brainstorming; anonymous > identified in electronic brainstorming

Quiet working circumstance: Including no alcohol-drinking; work setting with complexity of visual detail, natural view and natural material, less use of manufactured or composite surface materials, and with fewer cool colors used; no limits or informational limits during creative activities > controlling limits; free-play with salt dough before taking creativity test; systematic-relaxation exercises > unsystematic resting or music hearing; playfulness including physical spontaneity, social spontaneity, cognitive spontaneity, and manifest joy

TABLE 2
Variables of Creative Product (Categorization of Measures of Creativity)

A. Ideation with less evaluation

Nonverbal creativity: including figural battery of the Torrance Test of Creativity Thinking; Test for Creative Thinking Drawing Production; Wallach and Kogan (1965) Creativity Test (nonverbal)

Nonverbal fluency: ability to produce a large number of ideas; motor fluency

Nonverbal flexibility: ability to produce a wide variety of ideas; motor flexibility

Nonverbal elaboration: ability to develop or embellish ideas and to produce many details

Nonverbal originality: ability to produce unusual ideas; unusualness; uniqueness

Verbal composite score of creativity: including Torrance (1996b) Test of Creativity Thinking (verbal); total score of two or more components of creativity; creativity test score without mentioning specific component; divergent thinking performance (generating phrases of words starting with given letters, titles for a short story, consequences of not having things, unusual uses for common items, groupings of items on a list, and completions of stem analogies); Wallach and Kogan Creativity Test (verbal); Wallach and Kogan's Uses and Pattern Meaning Test; Purdue Creativity Test; Numeric creativity; Minnesota Test of Creative Thinking (verbal)

Verbal fluency: ability to produce a large number of ideas

Verbal flexibility: ability to produce a wide variety of ideas

Verbal elaboration: ability to develop or embellish ideas and to produce many details

Verbal originality: ability to produce unusual ideas; unusualness; uniqueness

Abstractness of titles

Resistance to premature closure; overcoming fixation

B. Ideation with more evaluation (Problem solving)

Composite score of problem solution; convergent thinking performance (to perform task with analysis, linear reasoning, and evaluation of ideas); Advanced Vocabulary Test II V 5 (a measure of verbal-comprehension problems); Paper Folding Test (a measure of spatial visualization problems); Inference Test RL 3 (a measure of logical reasoning problems); creativity of the product; Wallach and Kogan Creativity Test (problem solving); Remote Association Test; creativity of publications; social problem solving (social creativity); coping abilities (the ability to adapt to environmental demands and to meet personal needs, measured with coping inventory); performance-based assessments (story-telling, collage-making, math problem); scientific creativity; statement of past creative activities; Creative Activities List; Vaughan (1971) Test of Musical Creativity Composite; painting products; divergent production in mathematics; "inventiveness" of the "Berlin Intelligence Structure Test"; New Scientific Uses Test; Scientific Incomplete Sentences Test; Scientific Word Association Test; Real-World Divergent Thinking Test; portfolio of photographs rated by professionals

Fluency of solution (number of nonredundant solutions)

Flexibility of solution (number of categorical shifts made in solutions)

Elaboration of solution (details included in each solution; attractiveness of the product; interest of the product)

Originality of solution (the novelty of the solution); evaluation of originality

Quality of solution: including appropriateness, effectiveness or workability of solution; likeability; technical quality of solution (product); expressivity, repleteness, and composition of drawing

C. Emotional creativity

Emotional creativity (total score as measured by Emotional Creativity Inventory)

Preparedness: understanding and learning from one's own and other's emotions

Novelty: ability to experience unusual emotions

Effectiveness and authenticity: The skill to express emotions adroitly and honestly leading to potential benefit to the individual or group

Preparedness: Understanding and learning from one's own and other's emotions

TABLE 3
Mean Effect Sizes on the Four Categories of Creativity

<i>Categories of Creativity</i>	<i>k</i>	<i>Mean rank</i>	<i>Mean</i>	<i>SD</i>
Nonverbal creativity	161	713	0.45	0.87
Verbal creativity	847	1004	0.79	1.11
Problem solving	787	1011	0.86	1.29
Emotional creativity	131	728	0.34	0.43
Total	1926		0.76	1.15

TABLE 4
Mean Effect Sizes of Variables Associated With Creativity

<i>Variables</i>	<i>k</i>	<i>M</i>	<i>SD</i>
A. Variables of creative person			
<i>a. Attained variables</i>			
School performances	166	0.36	0.44
Cognitive abilities	206	0.31	0.36
Imaginary capacities	9	0.29	0.29
Humor	2	0.48	0.45
Creative personality	38	0.61	0.66
Emotional stability	28	0.26	0.33
Extroversion	24	0.30	0.32
Openness	24	0.71	0.70
Agreeableness	13	0.15	0.21
Conscientiousness	19	0.23	0.33
Cognitive style	4	0.42	0.28
Willingness to take risks	6	0.13	0.64
Inclination for divergent thinking	8	0.43	0.25
Inclination for convergent thinking	7	0.20	0.22
Intrinsic motivation	33	0.30	0.50
Prestige of honors	3	1.39	0.18
Leadership	16	0.56	0.60
Non-delinquent	7	0.49	0.19
Psychological androgyny	10	0.40	0.36
Self-efficacy	46	0.22	0.32
Prior traumatic experiences	24	0.45	0.39
Mysticism	6	0.67	0.31
Affective sensibility	10	0.65	0.83
<i>b. Ascribed variables</i>			
Gender	104	0.14	0.43
Birth order	55	0.31	0.47
Age	154	0.34	0.47
B. Variables of creative process (problem solving process)			
Defining problem	40	0.93	0.83
Retrieving knowledge	8	0.86	0.50
Generating solutions	10	0.49	0.27
Generating evaluation criteria for selecting A solution	5	0.41	0.30
Selecting solutions	23	0.43	0.34
C. Environmental variables			
Class climate favorable for creativity	26	0.71	0.85
Working circumstances favorable for creativity	31	1.13	1.19
Total	1165	0.39	0.54

Note. K = Number of effect size. M = Mean.

TABLE 5
The Mean Effect Size of Components of Problem-Solving Procedures on Problem-Solving Creativity

<i>Problem-Solving Procedure</i>	<i>Products of Problem Solving</i>					<i>Total</i>
	<i>B0</i>	<i>B1</i>	<i>B2</i>	<i>B3</i>	<i>B4</i>	
A1	1.09 (1.00/20)	1.56 (.84/4)	—	0.67 (.33/9)	0.63 (.15/5)	0.93 (.83/40)
A2	—	—	—	0.98 (0.57/5)	0.82 (0.34/2)	0.86 (0.50/8)
A3	—	0.54 (0.00/1)	0.00 (0.00/1)	0.58 (0.23/3)	0.57 (0.28/4)	0.49 (0.27/10)
A4	—	—	0.34 (0.22/2)	0.20 (0.00/1)	0.6 (0.42/2)	0.41 (0.30/5)
A5	—	—	0.05 (0.08/4)	0.43 (0.35/8)	0.43 (0.34/10)	0.56 (0.31/23)
Total	1.09 (1.00/20)	1.36 (0.85/5)	0.12 (0.18/7)	0.63 (0.41/26)	0.60 (0.27/23)	0.71 (0.66/86)

Note. A1 = Defining problem. A2 = Retrieving knowledge. A3 = Generating solutions. A4 = Generating evaluation criteria for selecting solution. A5 = Selecting appropriate solution. B0 = Composite score of the solution to the problem. B1 = Fluency of the solution. B2 = Flexibility of the solution. B3 = Originality of the solution. B4 = Quality of the solution.

Data in the parentheses are SD/number of effect sizes. Missing values () indicate that these areas have been not investigated thus far.