Can only intelligent people be creative? A Meta-Analysis
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Kyung Hee Kim
Eastern Michigan University

IQ & Creativity are different constructs

- **Guilford (1962)**
  - **Creative individuals possess divergent thinking abilities not measured by traditional IQ tests**
- **Other researchers have shown that creativity test scores, divergent thinking tasks, & creative achievement are independent from IQ** (e.g., Getzels & Jackson, 1958; Gough, 1976; Guilford, 1950; Helson, 1971; Helson & Crutchfield 1970; Herr, Moore, & Hauser, 1965; Rossman & Horn, 1972; Rotter, Langl & & Berger, 1971, Torrance,

…or are they?

- BUT**, other research has shown a relationship between creativity test scores & IQ scores** (e.g., Runco & Albert, 1986; Wallach, 1970)

Threshold Theory

- **Creativity & intelligence are separate constructs;**
- **Below IQ 120**
  - **Correlation between IQ & creative potential**
- **Above IQ 120**
  - **No correlation** (Barron, 1961; Getzels & Jackson, 1962; Guilford, 1967; Guilford & Christensen, 1973; MacKinnon, 1961, 1962, 1967; Simonton, 1994; Walberg, 1988; Walberg & Herbig, 1991; Yamamoto, 1964).

Why are the results inconsistent?

- **Contradictory & inconclusive results** (e.g., Runco & Albert, 1986)
- **Inconsistency may come from**
  - **Different measures of intelligence & creativity**
  - **Demographic differences in samples such as gender, age, & S.E.S.**

Primary Purposes of Synthesis

1) **Conduct a quantitative synthesis of correlations between IQ & creativity test scores**
2) **Compare the correlations between IQ & creativity scores for IQ above 120 with those for IQ below 120 to confirm the threshold theory**
3) **Identify some of the moderating variables (e.g., IQ tests, different levels of IQ scores, creativity tests, creativity test types, creativity subscales, gender, & age)**
4) **Use the correlations to investigate models of the relationships between intelligence & creativity.**

Methods

- *Literature Search*
- *Effect Size Calculations*
- *Moderator Analysis*

Literature Search

- Over 100 studies from 1961 to Summer, 2004
  - Computer searches, personal retrieval using Academic Search Premier, Eric, PsycARTICLES, PsycINFO, & bibliographic searches of each reference
- Keywords: IQ, creativity, intelligence, & threshold theory
- Limitations of data collection
  - Many studies failed to report detailed information
  - Some studies reported IQ & creativity scores with various creative achievements.

Effect Size Calculations

- A quantitative synthesis of the remaining 21 studies
  - Schwarzer's Meta 5.3 statistical software (1991).
  - Fisher's *z* transformation of *r* was used to adjust for the non-normal distribution of *r*.
- Effect size *zr* was weighted by sample size:
  - the weighted mean $zr = \sum(Nj - 3)\, zrj / \sum(Nj - 3)$
  - Zrj: Fisher zr, corresponding to any *r* (Rosenthal, 1991).

Effect Size Calculations

- Each mean *r* was tested using a random effects model of variance
  - Reported values of *r* are back transformations from *Z* (Hunter, Schmidt, Jackson, 1982).
- A correlation coefficient was judged heterogeneous when
  - residual standard deviation exceeded ¾ of the effect size, &
  - sampling error was less than 75% of the observed variance (Schwarzer, 1991).

Effect Size Calculations

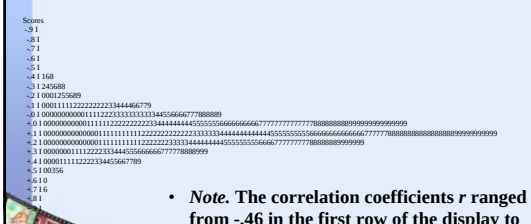
- 447 correlation coefficients were retrieved
  - from 21 studies
  - for 45,880 people
- When using several correlation coefficients per study in analyses of moderators, a conservative statistical criterion ($p < .001$) was used to protect against Type I error (Rosenthal, 1991; Rosenthal & Rubin, 1984).

Moderator Analysis

- Test whether correlation coefficient sizes vary systematically across differing levels of variables that are posited to influence the relationship between intelligence & creativity

Results

Stem-and-Leaf-Display for 447 Correlation Coefficients (r) between IQ & Creativity



- ***Note.*** **The correlation coefficients *r* ranged from -.46 in the first row of the display to +.76 in the last row.**

Threshold as a Moderator

Threshold	N (# of *r*)	Mean *r*	Homogeneity
a. Above IQ 120	65	.201	heterogeneous
b. Below IQ 120	14	.235	heterogeneous
c. Unreported	368	.163	heterogeneous

- ***Note. No statistically significant differences between the groups (p > .001).***
- ***Homogeneity: heterogeneous when p < .001.***
- ***Model for Threshold, QB (2) = 17.625 (p < .001).***

IQ Levels as a Moderator

IQ Level	N (# of *r*)	Mean *r*	Homogeneity
a. IQ < 100	32	.260	homogeneous
b.100<IQ>120	33	.140	heterogeneous
c.120<IQ>135	13	.259	heterogeneous
d. IQ > 135	2	-.215	homogeneous
e. Unreported	367	.162	heterogeneous

- ***Note. No statistically significant differences between different IQ levels (p > .001).***
- ***Homogeneity: heterogeneous when p < .001.***
- ***Model for IQ level, QB (4) = 55.441 (p < .0001).***

IQ Tests as a Moderator

IQ Test	N (# of *r*)	Mean *r*	Homogeneity	Contrast	*p*-value for Contrast
a. TCMT	21	.187	homogeneous		
b. CTMM	114	.191	heterogeneous	CTMM/STEP	*P* < .0001
c. WISC	60	.097	homogeneous		
d. SCAT	40	.084	homogeneous		
e. STEP	100	.096	homogeneous	CTMM/STEP	*P* < .0001
f. PPVT	10	.018	homogeneous		
g. Other	94	.219	heterogeneous		

- ***Note. TCMT = Terman Concept Mastery Test; CTMM = California Test of Mental Maturity; WISC = Wechsler Intelligence Scale for Children; SCAT = School & College Ability Test; STEP = Sequential Tests of Educational Progress; PPVT = Peabody Picture Vocabulary Test; Homogeneity: heterogeneous when p < .001.; Model for IQ tests, QB (6) = 170.193 (p < .0001)***

Creativity Tests as a Moderator

Creativity Test	N (# of *r*)	Mean *r*	Homogeneity	Contrast	*p*-value for Contrast
a. Guilford	64	.250	heterogeneous	Guilford/Wallach-K	*P* < .0001
b. TTCT	18	.218	homogeneous		
c. Wallach-K	319	.116	homogeneous	Guilford/Wallach-K	*P* < .0001
d. Others	46	.242	heterogeneous		

- ***Note. Guilford = Guilford divergent thinking tasks; TTCT = Torrance Tests of Creative Thinking; Wallach-K = Wallach & Kogan Divergent Thinking Tasks***
- ***Homogeneity: heterogeneous when p < .001.***
- ***Model for Creativity tests, QB (3) = 203.079 (p < .0001).***

Types of Creativity Tests

Creativity Test Type	N (# of *r*)	Mean *r*	Homogeneity
a. Verbal	357	.160	heterogeneous
b. Non-Verbal	41	.226	heterogeneous
c. Mixed	46	.235	homogeneous
d. Unreported	3	.068	homogeneous

- *Note: No statistically significant differences between different Creativity Test Types (p > .001).*
- *Homogeneity: heterogeneous when p < .001.*
- *Model for Creativity Test Types, QB (3) = 34.718 (p < .0001).*

Creativity Subscales as a Moderator

Creativity Subscale	N (# of r)	Mean *r*	Homogeneity	Contrast	*p*-value for Contrast
a. Originality	175	.131	heterogeneous	ac, ad	*p* < .0001
b. Fluency	184	.170	heterogeneous	bc	*p* < .0001
c. Figural Redefinition	6	.362	homogeneous	ac, bc	*p* < .0001
d. Flexibility	25	.231	heterogeneous	ad	*p* < .0001
e. General Creativity	57	.206	heterogeneous		

- *Note. Homogeneity: heterogeneous when p < .001.*
- *Model for Creativity Subscales, QB (4) = 88.380 (p < .0001).*

Gender as a Moderator

Gender Group	N (# of *r*)	Mean *r*	Homogeneity
a. Male	186	.149	heterogeneous
b. Female	180	.159	homogeneous
c. Combined	81	.193	heterogeneous

- *Note: No statistically significant differences between male & female groups (p > .001).*
- *Homogeneity: heterogeneous when p < .001.; Model for Gender, QB (2) = 19.163 (p < .0001).*

Age as a Moderator

Age Group	N (# of *r*)	Mean *r*	Homogeneity	Contrast	*p*-value for Contrast
a. Elementary	251	.086	homogeneous	ab, ac, ad	*p* < .0001
b. Middle	27	.210	heterogeneous	ab	*p* < .0001
c. High	105	.261	heterogeneous	ac	*p* < .0001
d. Adult	53	.205	heterogeneous	ad	*p* < .0001
e. Unreported	11	.267	heterogeneous		

- *Note: Homogeneity: heterogeneous when p < .001.; Model for Age, QB (4) = 223.282 (p < .0001).*

Multiple Linear Regression of Effect Size zr on Moderator Variables (Weighted by N)

Moderator	Standardized *β*	z-value	*p* -value
IQ Tests	-.00170	-.53790	*p* = .59064
Creativity Tests	-.01179	-2.33020	*p* < .001
Creativity Subscales	.01647	3.72019	*p* = .01980
Age	.03917	6.19332	*p* < .0001

- *Note: Overall regression effect = 48.96, df = 4, p < .0001 (two-tailed).*

Multiple Linear Regression of Effect Size zr With Threshold (Weighted by N)

Moderator	Standardized *β*	z-value	*p*-value
IQ Tests	.00085	-.26862	*p* = .78822
Creativity Tests	-.01143	-2.26266	*p* < .001
Creativity Subscales	.01638	3.70578	*p* = .02366
Age	.03976	6.29666	*p* < .0001
Threshold	-.00726	-.76628	*p* =.44351

- *Note: Overall regression effect = 49.565, df = 5, p < .0001 (two-tailed).*

Conclusion

Relationship between IQ & Creativity

- Small & positive relationship
  - Mean effect *r*: .174 (95% CI, .165 - .183)
- Heterogeneous Correlation coefficients
- Threshold theory was not supported
- No statistically significant differences among the 4 IQ levels
- IQ > 135: *r* = -.215

Statistically Significant Moderators

- Variance in the magnitude of the correlation coefficients was significantly explained by
  - Different creativity tests (p <.001)
  - Age (p <.0001)
- Weighted multiple linear regression: determines moderators' independent effects for explaining variation.

A Game-like Activity or a Test?

- The mean weighted correlation coefficients between IQ tests &
  - Wallach-Kogan divergent thinking measure scores (*r* = .116)
  - Guilford Test scores (*r* = .250)
- Possibly because
  - Wallach-Kogan divergent thinking measures were administered as a game-like activity
  - Guilford Tests were administered as tests

A Game-like Activity or a Test?

- IQ test scores are independent from creativity test scores
  - When the creativity tests are assessed in a game like, non-evaluative context (Wallach & Kogan, 1965; e.g., Cropley & Maslany 1969; Iscoe & Pierce-Jones, 1964; Kogan & Pankove, 1972; Pankove & Kogan, 1968; Wallach & Wing, 1969; Ward, 1968).
- Torrance (1966) also recommended the creation of
  - A game-like, thinking, or problem-solving atmosphere, &
  - Even suggested a warm-up activity.

Age Differences

- IQ scores were more associated with creativity scores for older groups than within the younger group (K-5)
- Same tests may measure different processes when administered to subjects of differing ages (Ward, 1968)
- Creativity tests may also measure different constructs among various ages
  - Supported by previous studies: latent structure of the TTCT was more invariant across gender than across grade groups (Kim, 2004; Kim, Cramond, & Bandalos, 2004, in press)
- Relationships among younger children may be smaller due to less educational influence over their cognitive functions.

Implications

- **Negligible relationships between creativity & IQ scores**
  - **Even students with low IQ scores can be creative**
  - **Teachers should be aware of characteristics of creative students & potential of each child**

Limitations

- **For the 368 of the 447 correlation coefficients, the subjects' IQ scores were unreported or unable to be used.**
- **For future studies, more studies that have reported IQ scores are needed.**