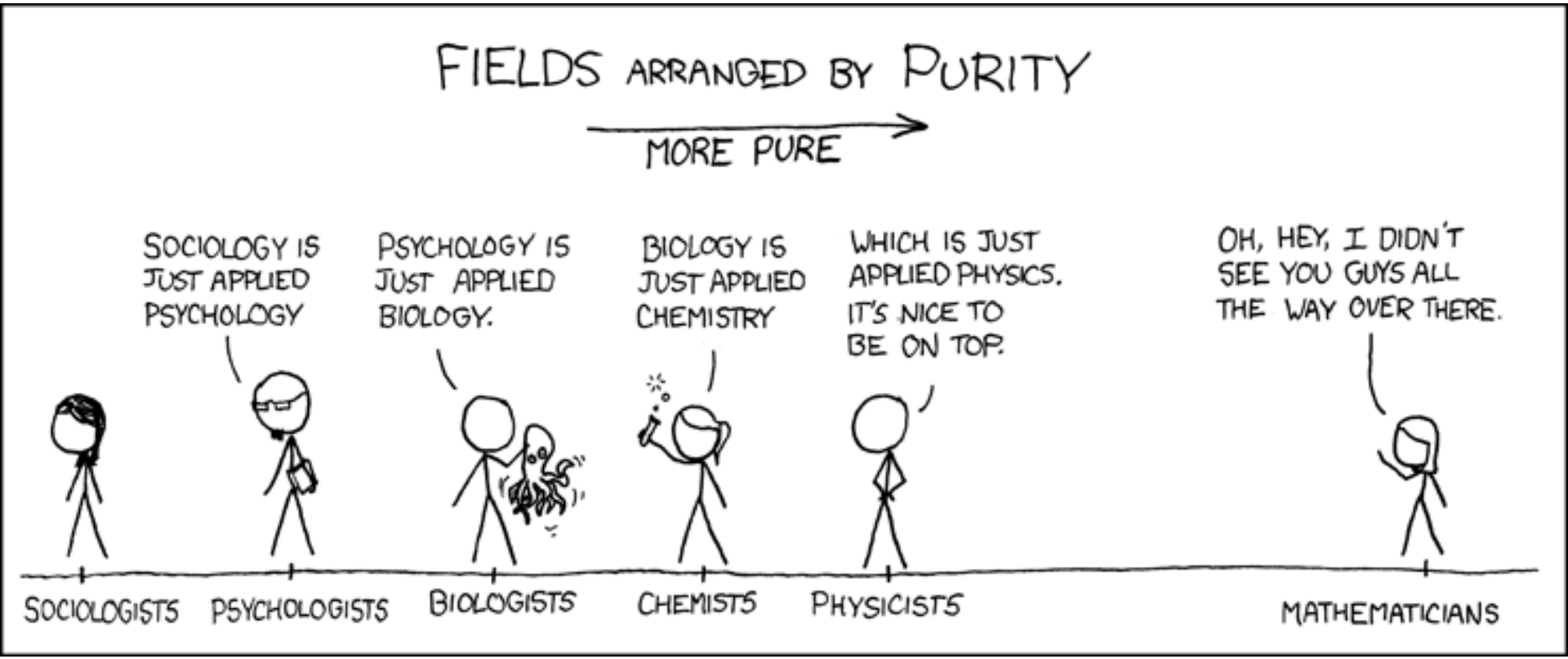

FIELDS ARRANGED BY PURITY
MORE PURE
SOCIOLOGY IS JUST APPLIED PSYCHOLOGY
PSYCHOLOGY IS JUST APPLIED BIOLOGY.
BIOLOGY IS JUST APPLIED CHEMISTRY
WHICH IS JUST APPLIED PHYSICS. IT'S NICE TO BE ON TOP.
OH, HEY, I DIDN'T SEE YOU GUYS ALL THE WAY OVER THERE.
SOCIOLOGISTS
PSYCHOLOGISTS
BIOLOGISTS
CHEMISTS
PHYSICISTS
MATHEMATICIANS

Varieties of Creativity

Types and Levels

Three Arguments

- First, creativity is a
  - heterogeneous rather than homogeneous phenomenon
  - that can be partly captured by a single dimension
  - along which we can place the principal domains of creative activity

Three Arguments

- Second, this single dimension is correlated with psychological traits and experiences of creators who practice in a given domain; these variables are
  - dispositional (e.g., personality)
  - developmental (e.g., education)

Three Arguments

- Third, an individual's magnitude of creativity in a chosen domain corresponds at least in part with the fit between his/her dispositional traits and developmental experiences and those that are typical of that domain

First Argument: Hierarchy of the Sciences

- Classic concept: Auguste Comte
  - astronomy
  - physics
  - chemistry
  - biology
  - sociology

First Argument: Hierarchy of the Sciences

- Contemporary concepts:
  - physical, biological, and social sciences
  - “exact” versus “non-exact” sciences
  - “hard” versus “soft” sciences
  - “paradigmatic” versus “pre-paradigmatic” sciences
  - “natural” versus “human” sciences
  - sciences, humanities, and the arts

First Argument: Hierarchy of the Sciences

- Empirical Research
  - D. K. Simonton (2004). Psychology's status as a scientific discipline: Its empirical placement within an implicit hierarchy of the sciences. *Review of General Psychology*, *8*, 59-67.

Simonton (2004)

- Two classes of measures:
  - Primary:
    - strong logical or empirical connection with the scientific status of a discipline
    - available for physics, chemistry, psychology, and sociology at the minimum
  - Secondary:
    - also connection with scientific status, but
    - not available for one or more of the four core disciplines for the comparison

Primary Measures

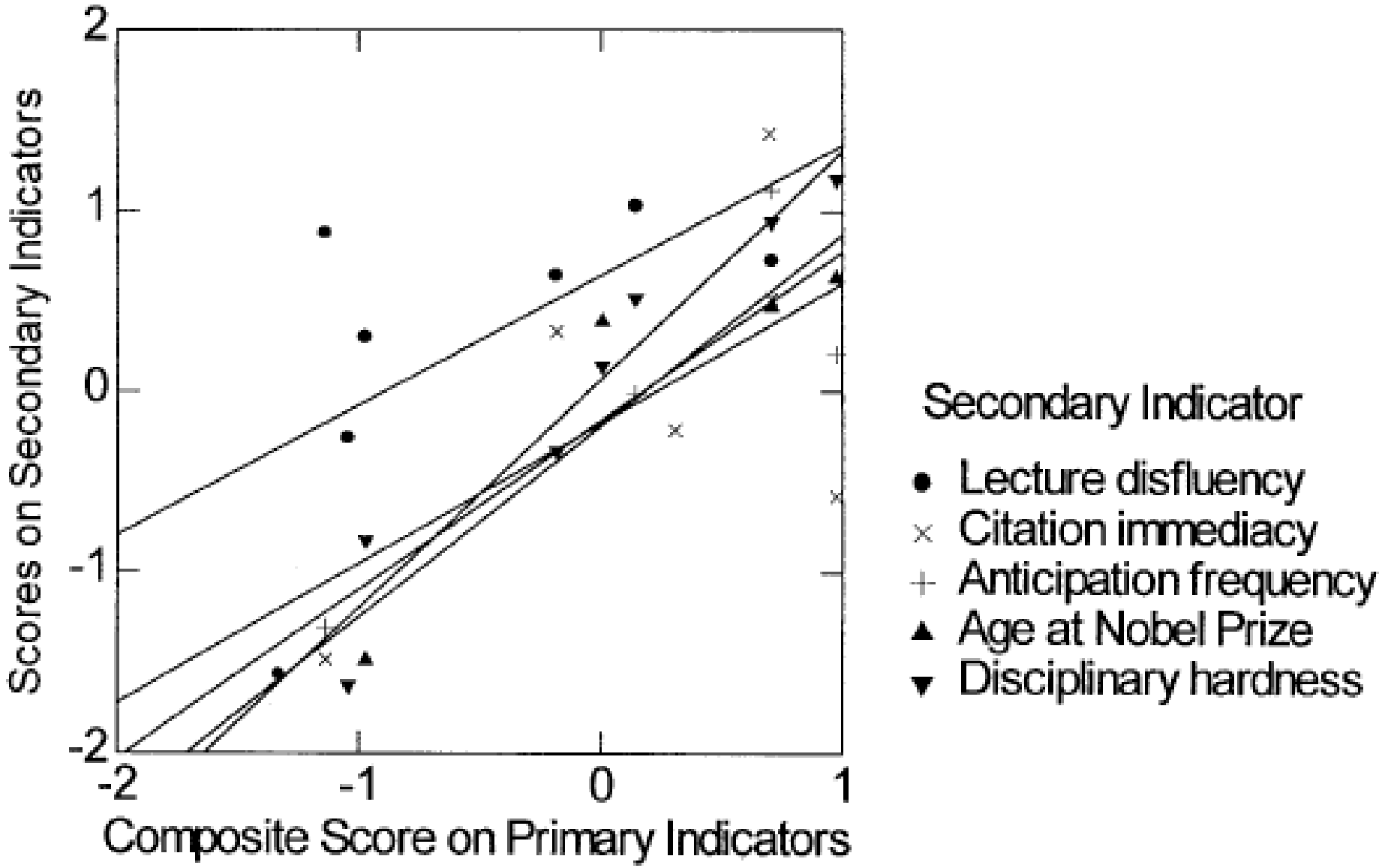
- Positive indicators:
  - Citation concentration (Cole, 1983)
  - Early impact rate (Cole, 1983)
  - Obsolescence rate (McDowell, 1982)
  - Peer evaluation consensus (Cole, 1983)
  - Graph prominence (Cleveland, 1984)
- Negative indicators:
  - Consultation rate (Suls & Fletcher, 1983)
  - Theories-to-laws ratio (Roeckelein, 1997)

Secondary Measures

- Positive indicators:
  - Citation immediacy (Cole, 1983)
  - Anticipation frequency (Hagstrom, 1974)
  - Rated disciplinary hardness (Smith et al., 2000)
- Negative indicators:
  - Age at receipt of Nobel prize (Stephan & Leven, 1993; see also Manniche & Falk, 1957)
  - Lecture disfluency (Schachter, Christenfeld, Ravina, & Bilous, 1991)

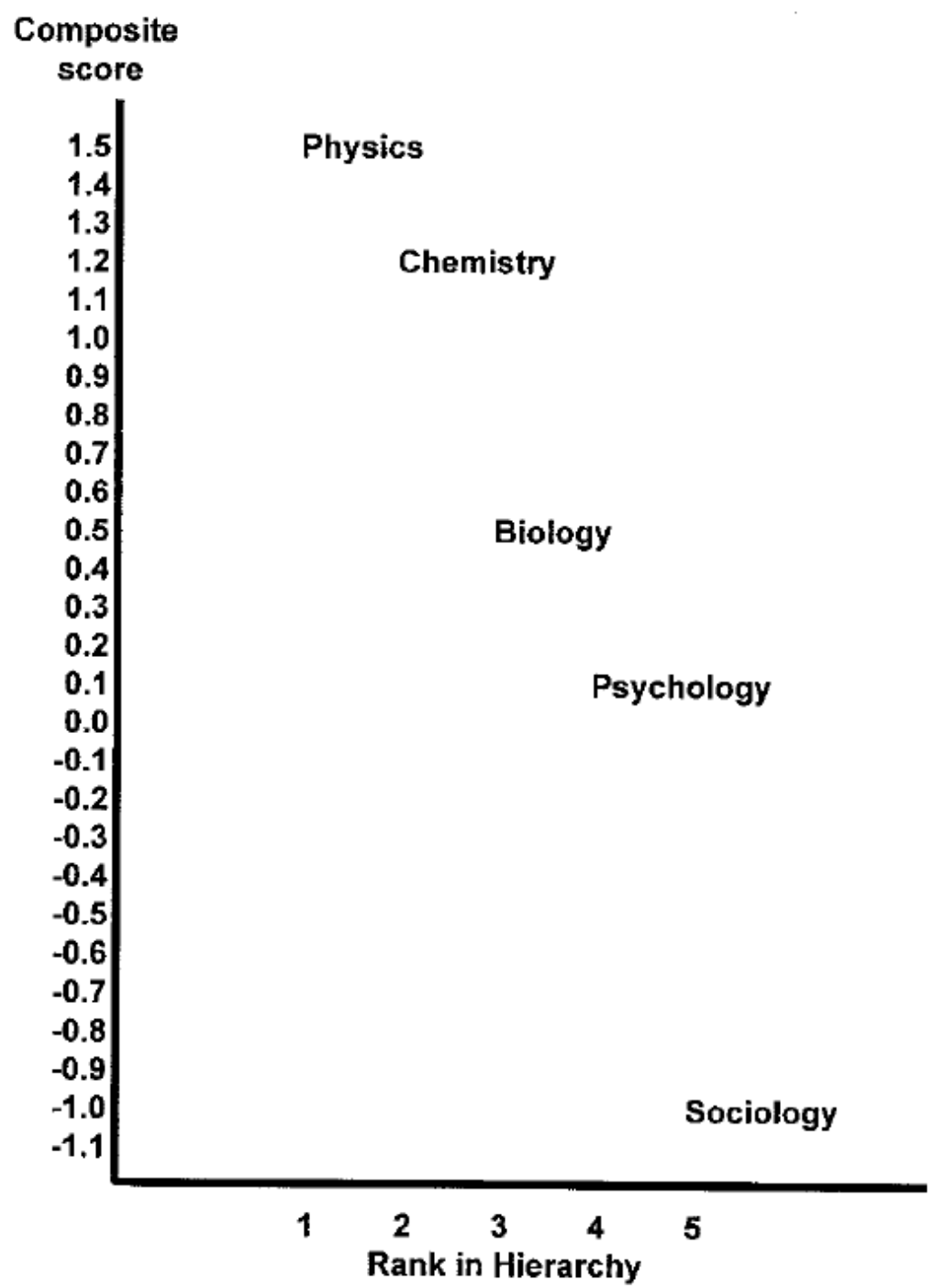
Data Analyses

- Principal components analysis: disciplinary scores on the seven primary measures can be explained in terms of a single latent variable
- Correlation analysis: the forgoing principal component correlates highly with each of the five secondary measures


Scores on Secondary Indicators
2
1
0
-1
-2
-2
-1
0
1
Composite Score on Primary Indicators
Secondary Indicator
Lecture disfluency
Citation immediacy
Anticipation frequency
Age at Nobel Prize
Disciplinary hardness

Data Analyses

- Hence, it's possible to provide an objective arrangement of five principal scientific disciplines along a Comte-like scale, namely …


Composite score
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1.0
-1.1
Physics
Chemistry
Biology
Psychology
Sociology
1
2
3
4
5
Rank in Hierarchy

Former hierarchical arrangement consistent with scientists own perceptions,

e.g. …

Prpić (2008)	Natural scientists *N* = 310	Social scientists *N* = 167
Objectivity as the property of the research process	69.0%	54.8%
Objectivity as the researcher's impartiality and nonsubjectivity	33.6%	54.7%
Objectivity as attainable and attained	76.2%	52.5%
Objectivity as its complete realization doubtful	20.4%	30.3%
Objectivity as impossible or nonexistent	3.4%	17.2%

Two Elaborations

- One: This hierarchy can be *extrapolated* beyond scientific disciplines:
  - Scientific versus artistic creativity
  - Formal versus expressive artistic creativity (Apollonian versus Dionysian; Classical versus Romantic; linear versus painterly; etc.)

Two Elaborations

- Illustrations using criteria used in constructing scientific hierarchy:
  - Obsolescence rate: psychology/sociology > history > English
  - Lecture disfluency: psychology/sociology < political science < art history < English (cf. philosophy)

Two Elaborations

- Two: This hierarchy can be *interpolated* within scientific disciplines:
  - Paradigmatic disciplines in “normal” versus “crisis” stages (e.g., classical physics in middle 19th versus early 20th century)
  - Non-paradigmatic disciplines with contrasting theoretical/methodological orientations (e.g., the two psychologies)

Illustration:
Coan (1979) / Simonton (2000)

- Objectivistic versus Subjectivistic
- Quantitative versus Qualitative
- Elementaristic versus Holistic
- Impersonal versus Personal
- Static versus Dynamic
- Exogenist versus Endogenist

Illustration: Coan (1979) / Simonton (2000)

- Factor analysis reveals that the six bipolar dimensions can be consolidated into a single bipolar dimension
  - “Hard,” “tough-minded,” “natural-science” psychology versus
  - “Soft,” “tender-minded,” “human-science” psychology
- Moreover, evidence that two psychologies are distinct (see also Kimble, 1984):

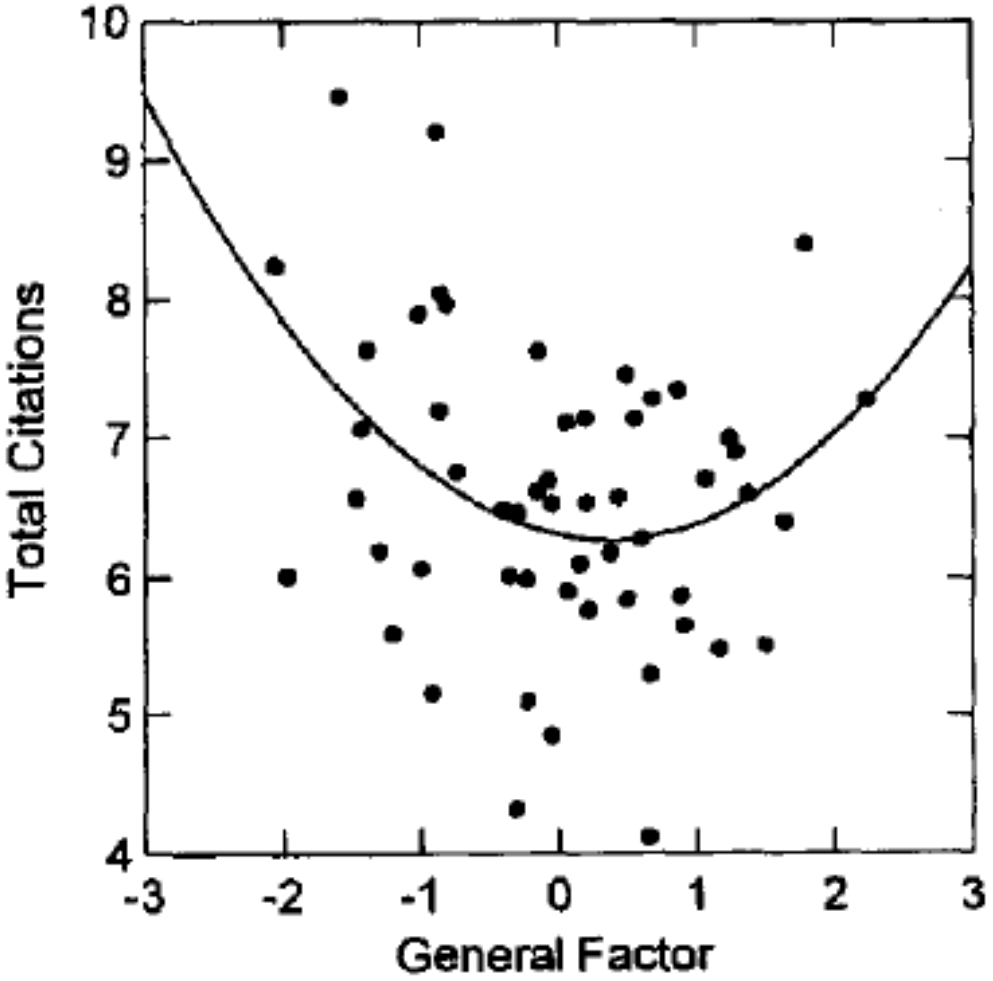


Figure 1. Scatterplot of the relation between the general factor and total citations for 54 eminent psychologists (see Appendix for raw scores). Also shown is the best-fitting quadratic function defining the curvilinear backward-J curve describing the association between the two variables.

Second Argument

- Could creators working in different disciplines display dispositional traits and developmental experiences that correspond to the chosen domain's placement along the single dimension?
- That is, to what extent does the dimension have a psychological basis?

What Determines Preferences Regarding

- Objectivity versus Subjectivity
- Consensus versus Dissent
- Exactness versus Vagueness
- Constraint versus Freedom
- Formality versus Informality
- Rationality versus Emotion
- Logic versus Intuition

Potential Answers:
Review the Relevant Literature on

- Dispositional Traits
- Developmental Experiences

Caveats to Literature Review

- Evidence often scattered and piecemeal; all we possess right now are the “puzzle pieces”
- Empirical results are focused more on scientific than artistic creativity; the former often deemed more important than the latter even though the latter is often seen as more “creative” than the former

Disposition – Science to Art

- Psychopathology/emotional instability (Ludwig, 1998; cf. Jamison, 1989; Ludwig, 1992, 1995; Post, 1994; Raskin, 1936):

Magnification	Professional Categories				
x 1	SCIENCES		<		ARTS
x 2	NATURAL SCIENCES		<		SOCIAL SCIENCES
x 2	FORMAL ARTS	<	PERFORMING ARTS	<	EXPRESSIVE ARTS
x 3	NONFICTION	<	FICTION	<	POETRY
x 4	FORMAL STYLE	<	SYMBOLIC STYLE	<	EMOTIVE STYLE

N.B.: Psychoticism and reduced latent inhibition

Disposition – Science to Art

- Convergent versus Divergent Thinking (Hudson, 1966; English school children; also Smithers & Child, 1974):
  - Scientific “converger”
  - Artistic “diverger”

Disposition – Science to Science

- 16 PF (Chambers, 1964; see also Cattell & Drevdahl, 1955)
  - Chemists < Psychologists on Factor M:
  - The latter more bohemian, introverted, unconventional, imaginative, and creative in thought and behavior
  - Or, more toward the artistic end of the spectrum

Disposition – Science to Science

- TAT (Roe, 1953):
  - Physical scientists (chemists + physicists)
  - less emotional, more factual, less rebellious, less verbal
  - than Social scientists (psychologists + anthropologists)

Disposition – Within a Science

- Mechanistic versus Organismic behavioral scientists (Johnson, Germer, Efran, & Overton, 1988)
  - former are orderly, stable, conventional, conforming, objective, realistic, interpersonally passive, dependent, and reactive
  - the latter are fluid, changing, creative, nonconforming, participative, imaginative, active, purposive, autonomous, individualistic, and environmentally integrated

Disposition – Within a Science

- Integrative complexity of APA presidential addresses (Suedfeld, 1985) :
- Natural-science oriented < human-science oriented

Development – Science to Art

- Family background of Nobel laureates (Berry, 1981; omitting peace and physiology or medicine):
  - Father academic professional: physics 28%, chemistry 17%, literature 6%
  - Father lost by age 16: physics 2%, chemistry 11%, literature 17%
  - 30% of latter “lost at least one parent through death or desertion or experienced the father’s bankruptcy or impoverishment” whereas “the physicists, in particular, seem to have remarkably uneventful lives” (p. 387; cf. Raskin, 1936)

Development – Science to Art

- For 300+ 20th century eminent (Simonton, 1986):
  - fiction and nonfiction authors tend to come from unhappy home environments, whereas better home conditions produce scientists and philosophers
  - scientists have the most formal education, artist and performers the least, with poets least likely to have any special school experiences

Development – Science to Art

- Birth order:
  - Firstborns are more likely to become eminent scientists (Galton, 1874; Roe, 1953; Simonton, 2008; Terry, 1989),
  - but laterborns more likely to become eminent writers (Bliss, 1970),
  - yet classical composers are more prone to be firstborns (Schubert, Wagner, & Schubert, 1977)

Development – Science to Art

- Scientifically versus Artistically Creative Adolescents (Schaefer & Anastasi, 1968): family backgrounds
  - CrS < CrA diversity (foreign, mobility, travels)
  - CrS > CrA conventionality (parental hobbies, interests)

Development – Science to Art

- Formal education
  - Eminent scientists > eminent writers (Raskin, 1936)
- Mentors
  - Eminent scientists < eminent artists (Simonton, 1984, 1992);
  - with eminent psychologists between but closer to scientists in general

Development – Science to Science

- Rebelliousness toward parents: chemists < psychologists (Chambers, 1964; see also Roe, 1953)
- Early interests (Roe, 1953):
  - physical scientists: mechanical/electrical gadgets
  - social scientists: literature/classics (early desire to become creative writers)

Development – Science to Science

- Side note:
  - Although 83% of married eminent scientists enjoyed stable marriages (Post, 1994),
  - Roe (1953) found that 41% of the social scientists experienced divorce, in comparison to 15% of the biologists and 5% of the physical scientists

Development – Within a Science

- Birth order
  - Although firstborns are more likely to become eminent scientists, Sulloway (1996) has offered evidence that revolutionary scientists are more likely to be laterborns, where
  - the latter is a consequence of the positive correlation between openness and ordinal position

Development – Within a Science

- N.B.: According to Sulloway (1996), the forgoing birth-order effect is moderated by other factors, such as
  - pronounced parent-offspring conflict
  - age spacing
  - early parental loss and surrogate parenting
  - gender and race
  - shyness
- Several of these factors also differentiate scientific from artistic creators

Development – Within a Science

- Those psychologists whose mothers where extremely religious are more likely to subscribe to scientifically oriented beliefs, such as behaviorism, quantification, and elementarism (Coan, 1979)

But What Determines Differential Impact Within a Domain of Creativity?

- Some dispositional traits and developmental experiences are orthogonal to placement along the hierarchy and yet predict differential success within any chosen domain within that hierarchy
- To offer just a few examples …

But What Determines Differential Impact Within a Domain of Creativity?

- CPI personality factors: Sci v NonSci correlates ≠ Cr v Lc Sci (Feist, 1998; also see Simonton, 2008b)
- Motivation, drive, determination, persistence, perseverance (Cox, 1926; Duckworth et al., 2007 Matthews et al., 1980)
- Domain-specific expertise acquisition (Ericsson et al., 2006)

But What Determines Differential Impact Within a Domain of Creativity?

- However, other traits/experiences that determine an individual's disciplinary preference may also determine his or her disciplinary impact
- There are three main possibilities:

But What Determines Differential Impact Within a Domain of Creativity?

- First, the most successful creators may be those whose dispositional traits and developmental experiences put them closest to the disciplinary centroid
  - I.e., “domain-typical” creator
  - E.g., disciplinary stasis or stagnation
- The lower-impact creator will be peripheral relative to this centroid

But What Determines Differential Impact Within a Domain of Creativity?

- Second, the most successful creators may be those whose dispositional traits and developmental experiences put them closer to the centroid for disciplines more advanced in the hierarchy
  - I.e., “domain-progressive” creators
  - Cf., behavior geneticists, cognitive neuroscientists, evolutionary biologists

But What Determines Differential Impact Within a Domain of Creativity?

- Third, the most successful creators are those whose dispositional traits and developmental experiences put them closer to the centroid for a discipline lower down in the hierarchy
  - I.e., “domain-regressive” creators
  - E.g., scientific creativity as contingent on “regression” toward artistic creativity

But What Determines Differential Impact Within a Domain of Creativity?

- Empirical data indicate that the third option may apply to the most dispositional and developmental predictors
- That is, the major figures in a given domain are more similar to creators lower down in the disciplinary hierarchy

Dispositional Predictors

- Self-description: Highly productive scientists more original, less conventional, more impulsive, less inhibited, less formal, more subjective (Van Zelst & Kerr, 1954)
- Ludwig (1995): psychological “unease”
- EPQ Psychoticism scores :
  - scientific productivity and impact (Rushton, 1990)
  - artistic creativity and eminence (Götz & Götz, 1979a, 1979b)

Disposition – Within a Science

- Normal versus Revolutionary Science (i.e., paradigm preserving versus paradigm rejecting contributions (Ko & Kim, 2008)
- Psychopathology:
  - None,
  - Personality Disorders,
  - Mood Disorders, and
  - Schizophrenic Disorders
- Eminence

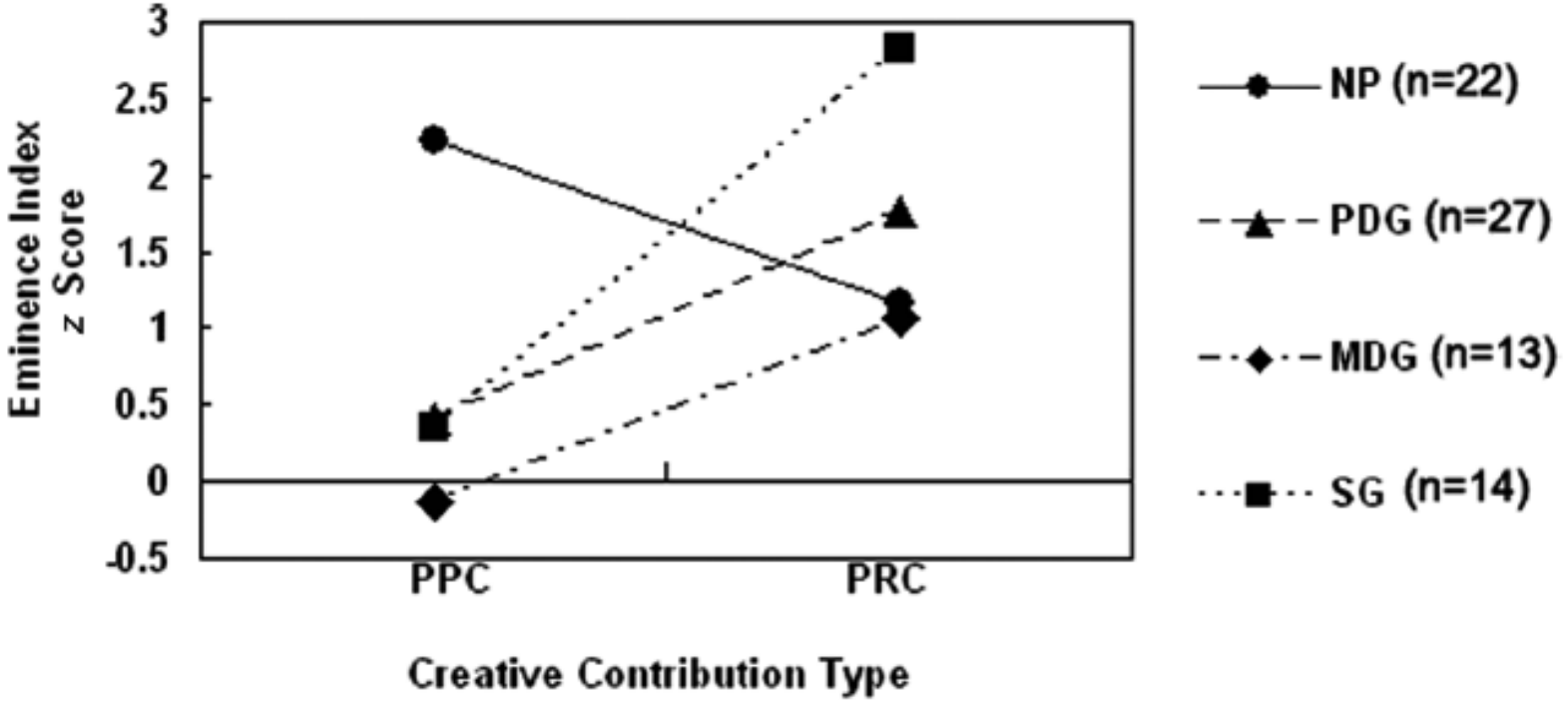


FIGURE 1 Interaction effects between creative contribution type and group. NPG = No Psychopathology Group, PDG = Personality Disorders Group, MDG = Mood Disorders Group, SG = Schizophre-Schizophrenia Group, PPC = paradigm preserving contributions, PRC = paradigm rejecting contributions.

Dispositional Predictors

- Avocational interests and hobbies:
  - Scientific creativity positively associated with involvement in the arts (Root-Bernstein et al., in press):
    - Nobel laureates > RS & NAS > Sigma Xi & US public
- Compare with introspective reports:
  - Max Planck: creative scientists “must have a vivid intuitive imagination, for new ideas are not generated by deduction, but by an artistically creative imagination.”
  - Albert Einstein: “to these elementary laws there leads no logical path, but only intuition, supported by being sympathetically in touch with experience.”

Developmental Predictors

- Domain-typical creator unlikely given Simonton's (1986) *N* = 314 study of biographical typicality and eminence
- What about the other two options?
  - Some indirect support for domain-regressive creator if we can assume that revolutionary scientists more creative than normal scientists
  - But also some inconsistent results (e.g., birth order)

Conclusion

- Three arguments
  - Creativity is heterogeneous, domains of creativity falling along at least one dimension
  - That dimension has a psychological basis in terms of dispositional traits and developmental experiences
  - Creative accomplishment within a domain partly depends on the same dispositional and developmental variables (viz. domain-regressive creators)