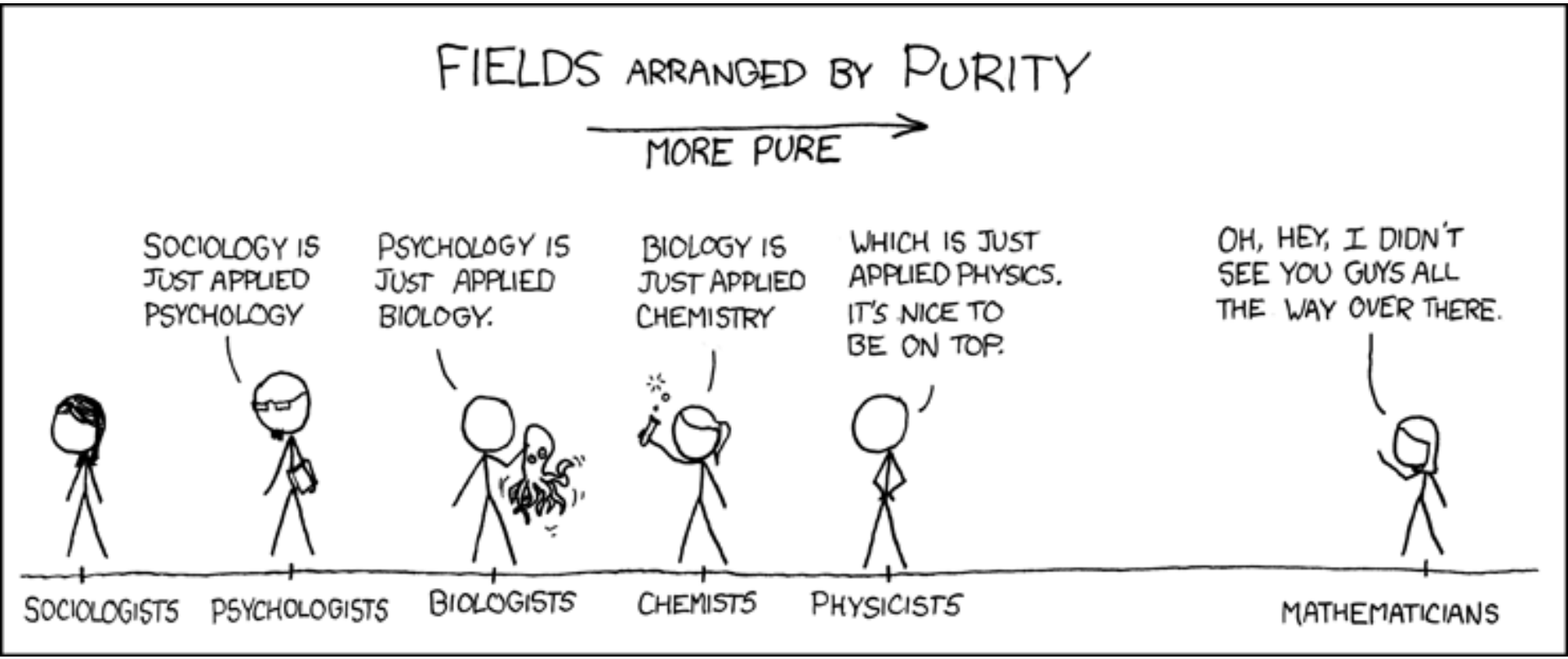

FIELDS ARRANGED BY PURITY
MORE PURE
SOCIOLOGY IS JUST APPLIED PSYCHOLOGY
PSYCHOLOGY IS JUST APPLIED BIOLOGY.
BIOLOGY IS JUST APPLIED CHEMISTRY
WHICH IS JUST APPLIED PHYSICS. IT'S NICE TO BE ON TOP.
OH, HEY, I DIDN'T SEE YOU GUYS ALL THE WAY OVER THERE.
SOCIOLOGISTS
PSYCHOLOGISTS
BIOLOGISTS
CHEMISTS
PHYSICISTS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

# Creative Scientists, Artists, and Psychologists:

Modeling Disposition, Development, and Achievement

# Three Arguments

- *First*, creativity is a
  - heterogeneous rather than homogeneous phenomenon (i.e., some domain-specificity);
  - but a substantial proportion of this heterogeneity can be captured by a single latent factor that extends from the sciences to the arts;
  - that is, along this implicit dimension we can place the principal domains of creative activity, including psychology

# Three Arguments

- *Second*, this single dimension is correlated with psychological traits and experiences of creators who practice in a given domain; that is, these variables are
  - dispositional (e.g., personality), and
  - developmental (e.g., education)
- i.e., the dimension is psychological as well as logical, ontological, or epistemological

# 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 or some other domain along the same dimension

# 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 (Simonton, 2004):
  - Major scientific disciplines can be ordered along a single dimension using a large number of positive and negative indicators of “hardness”

# Simonton (2004)

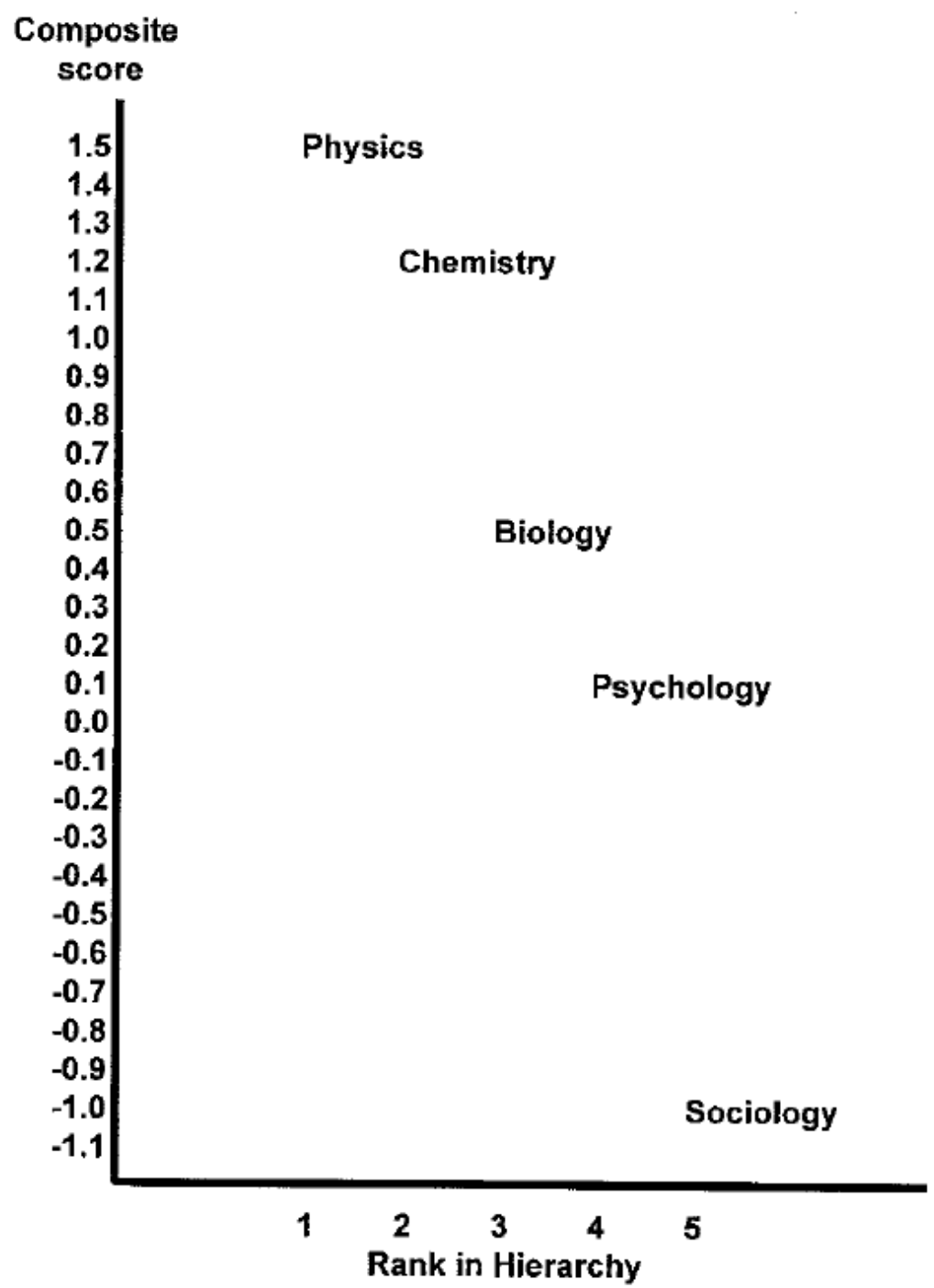
- Positive indicators
  - Peer evaluation consensus (Cole, 1983)
  - Citation concentration (Cole, 1983)
  - Early impact rate (Cole, 1983)
  - Citation immediacy (Cole, 1983)
  - Anticipation frequency (Hagstrom, 1974)
  - Obsolescence rate (McDowell, 1982)
  - Graph prominence (Cleveland, 1984)
  - Rated disciplinary hardness (Smith et al., 2000)

# Simonton (2004)

- Negative indicators:
  - Consultation rate (Suls & Fletcher, 1983)
  - Theories-to-laws ratio (Roeckelein, 1997)
  - Age at receipt of Nobel prize (Stephan & Leven, 1993; see also Manniche & Falk, 1957)
  - Lecture disfluency (Schachter, Christenfeld, Ravina, & Bilous, 1991)

# Simonton (2004)

- Yielding …


Composite score
1.5
1.4
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1.1
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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 of their domains,**

**e.g. …**

| Prpić (2008) | Natural scientists<br>*N* = 310 | Social scientists<br>*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

- Extrapolation beyond Scientific Domains
- Interpolation within Creative Domains

# Two Elaborations

- One - This hierarchy can be *extrapolated* beyond scientific domains:
  - Scientific versus artistic creativity, where
  - creativity in the humanities falls somewhere between that in the sciences and the arts

# Two Elaborations

- Illustrations using criteria previously applied in constructing scientific hierarchy:
  - Obsolescence rate:
    - psychology/sociology > history > English
  - Lecture disfluency:
    - psychology/sociology < political science < art history < English (cf. philosophy)
- See also analytical series developed by Bliss (1935) through Gnoli (2008) and empirical demonstrations like Hemlin (1993)

# Two Elaborations

- Two - This hierarchy can be *interpolated* within creative domains:
  - Paradigmatic sciences in “normal” versus “crisis” stages (e.g., classical physics in middle 19th versus early 20th century)
  - Non-paradigmatic sciences with contrasting theoretical/methodological orientations (e.g., the two psychologies)
  - Formal versus expressive arts (Apollonian versus Dionysian; Classical versus Romantic; linear versus painterly; etc.)

# Illustration: 54 Eminent Psychologists (Simonton, 2000; cf. Coan, 1979)

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

# Illustration:

- 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 these two psychologies are distinct (see also Kimble, 1984):

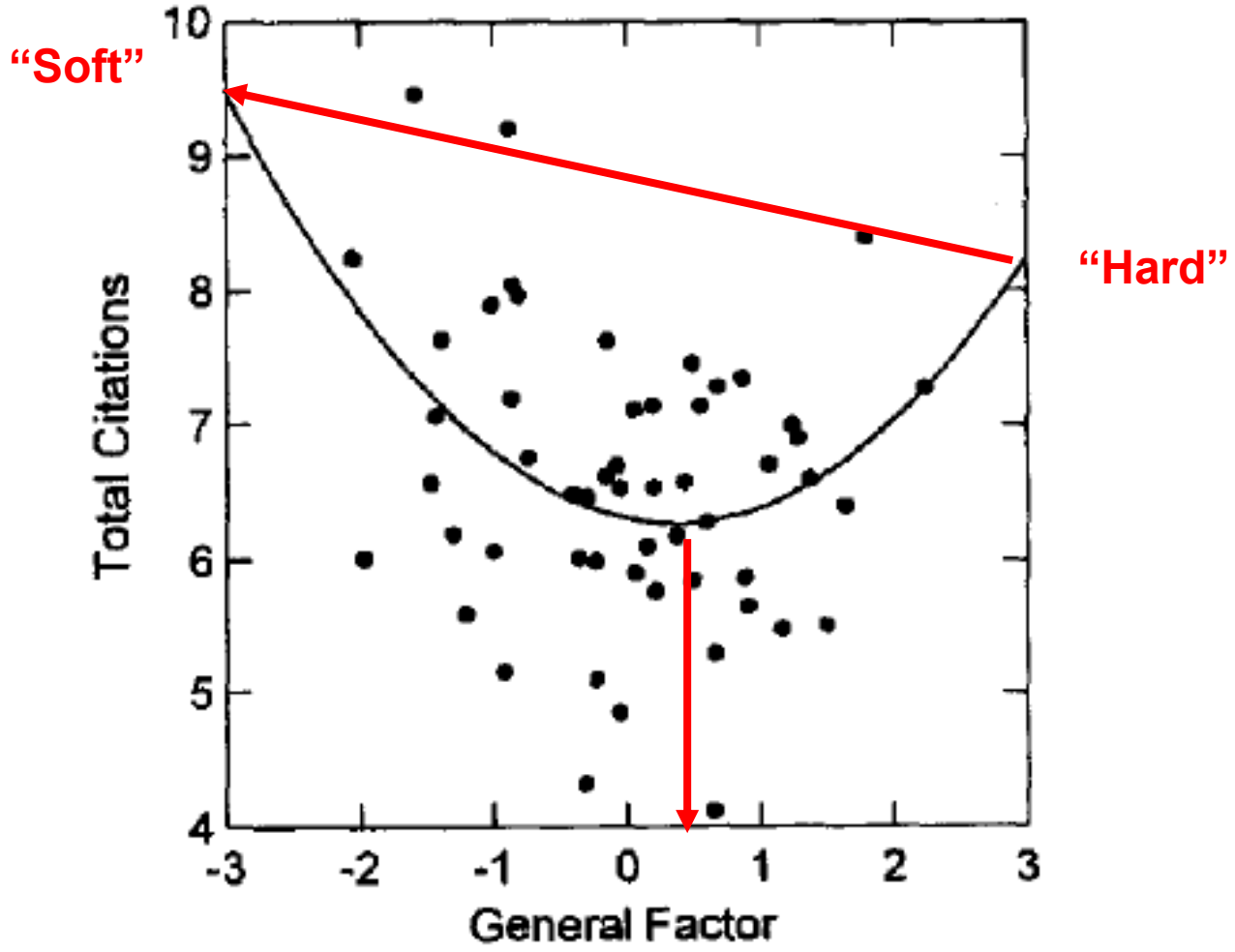



*Figure 1.* Scatterplot of the relation between the general factor and total citations for 54 eminent psychologists (see Appendix for raw scores). Also shown is the best-fitting quadratic function defining the curvilinear backward-J curve describing the association between the two variables.

# Second Argument

- Creators working in different disciplines should display dispositional traits and developmental experiences that correspond to the chosen domain's placement along the single dimension
- That is, at least to some extent the dimension should have a psychological basis because there should be a partial match between discipline and disposition/development

# What Dispositional and Developmental Factors Determine Preferences Regarding

- Consensus versus Dissent?
- Collectivism versus Individualism?
- Constraint versus Freedom?
- Objectivity versus Subjectivity?
- Logic versus Intuition?
- Exactness versus Ambiguity?
- Formality versus Informality?
- Rationality versus Emotion?
- Algorithms versus Heuristics?

# Potential Answers

- Review the relevant literature on
  - Dispositional Traits
  - Developmental Experiences
- Caveat:
  - Fragmentary nature of the evidence
  - No studies to date span the full spectrum of disciplines across all dispositional and developmental variables

# Disposition – Science to Art

- Psychopathology/emotional instability (Ludwig, 1998; cf. Jamison, 1989; Ludwig, 1992, 1995; Post, 1994; Raskin, 1936):
  - "persons in professions that require more logical, objective, and formal forms of expression tend be more emotionally stable than those in professions that require more intuitive, subjective, and emotive forms" (p. 93)
  - because this association holds both across and within domains the result is a fractal pattern of "self-similarity" at various levels of "magnification"
  - historiometric data support this prediction:

# Disposition – Science to Art

| 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 |

But also some psychometric evidence:

←lower psychoticism versus higher psychoticism→

where EPQ psychoticism positively associated with reduced negative priming + reduced latent inhibition

# Disposition – Science to Art

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

# Disposition – Science to Science

- 16 PF (Chambers, 1964; see also Cattell & Drevdahl, 1955)
  - Chemists < Psychologists on Factor M:
  - i.e., psychologists are 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 more *orderly*, *stable*, *conventional*, *conforming*, *objective*, *realistic*, interpersonally passive, dependent, and reactive
  - the latter are more *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 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, artists 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, 1992b);
  - with eminent psychologists between but closer to scientists in general (Simonton, 1992a)

# 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 birth-order effect is moderated by:
  - pronounced parent-offspring conflict
  - age spacing
  - early parental loss and surrogate parenting
  - gender and ethnicity
  - 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)
- i.e., conventional background → hard scientists

# Third Argument: Differential Impact Within a Domain

- 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 …

# Third Argument: Differential Impact Within a Domain

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

# Third Argument: Differential Impact Within a Domain

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

# Third Argument: Differential Impact Within a Domain

- *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., stasis or equilibrium due to optimization of domain-disposition/development relationship
- The lower-impact creator will be peripheral relative to this centroid, either above or below

# Third Argument: Differential Impact Within a Domain

- *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
  - e.g., behavior geneticists, cognitive neuroscientists, and evolutionary psychologists within psychology
  - viz. the “reductionists”

# Third Argument: Differential Impact Within a Domain

- *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
  - cf. old psychoanalytic theory of creativity as “regression in service of the ego” (for evidence, see Martindale, 2007)

# Third Argument: Differential Impact Within a Domain

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

# Dispositional Predictors

- Self-description: Highly productive scientists see themselves as 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)

# Dispositional Predictors

- Reduced latent inhibition correlates with
  - creative achievement in highly intelligent individuals (Carson, Peterson, & Higgins, 2003)
  - openness to experience (Peterson, Smith, & Carson, 2002), a strong correlate of both
    - psychometric creativity (Harris, 2004; McCrae, 1987) and
    - behavioral creativity (Carson, Peterson, & Higgins, 2005)
- Openness related to integrative complexity

# Dispositional Predictors

- Suedfeld (1985): even among APA presidents, integrative complexity correlated with disciplinary eminence (by multiple criteria)
- Feist (1994): 99 full professors of physics, chemistry, or biology (31 of them NAS members)
  - High integrative complexity re: research associated with
    - higher peer ratings in eminence,
    - higher citations
  - High integrative complexity re: teaching
    - fewer works cited

# Dispositional Predictors

- Normal versus Revolutionary Science; i.e., paradigm preserving versus paradigm rejecting contributions (Ko & Kim, 2008)
- Psychopathology (Simonton, 1994, et al.):
  - None,
  - Personality Disorders,
  - Mood Disorders, and
  - Schizophrenic Disorders
- Eminence  (using Murray, 2003)

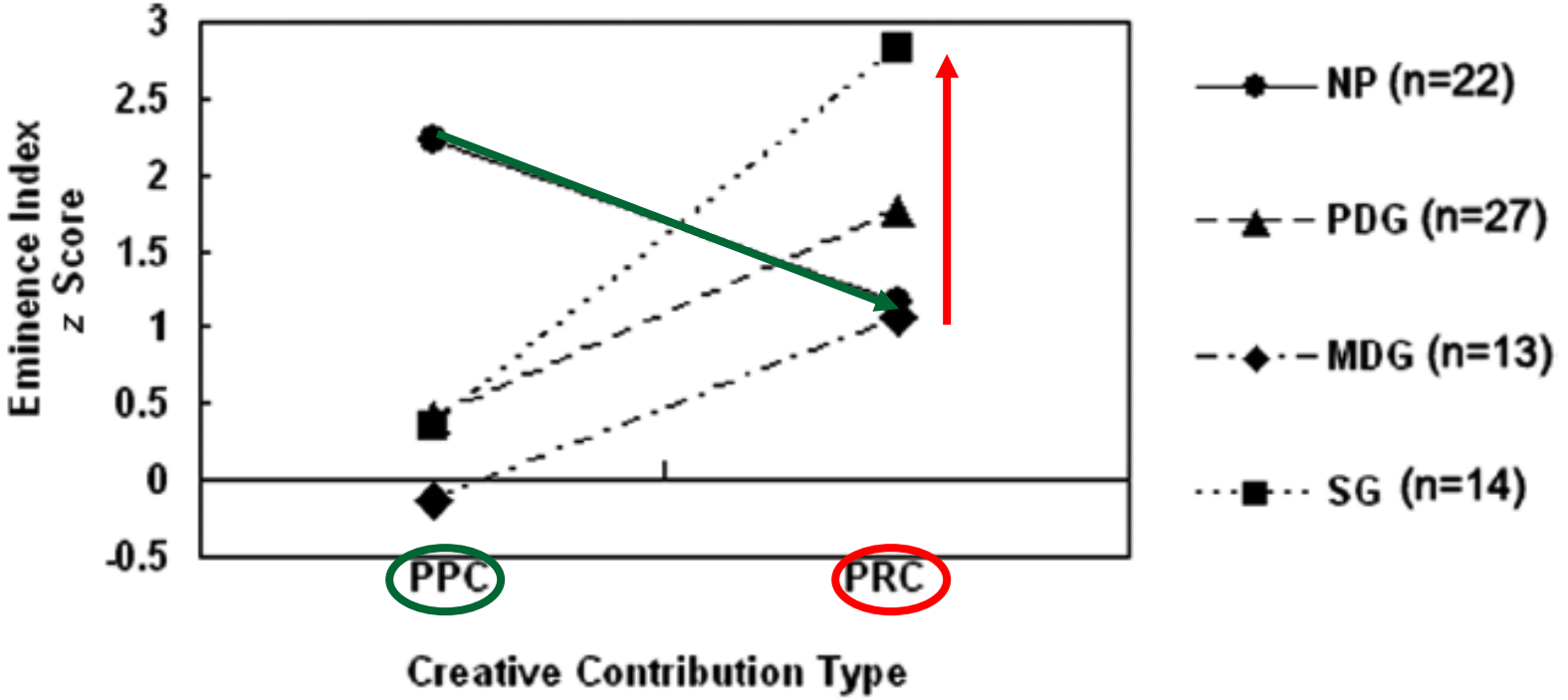



FIGURE 1 Interaction effects between creative contribution type and group. NPG = No Psychopathology Group, PDG = Personality Disorders Group, MDG = Mood Disorders Group, SG = Schizophre-Schizophrenia Group, PPC = paradigm preserving contributions, PRC = paradigm rejecting contributions.

# Dispositional Predictors

- Avocational interests and hobbies:
  - Scientific creativity positively associated with involvement in the arts (Root-Bernstein et al., 2008):
    - Nobel laureates >
    - RS & NAS >
    - Sigma Xi & US public

# Dispositional Predictors

- Compare with introspective reports:
  - Albert Einstein: “to these elementary laws there leads no logical path, but only intuition, supported by being sympathetically in touch with experience.”
  - Max Planck: creative scientists “must have a vivid intuitive imagination, for new ideas are not generated by deduction, but by an artistically creative imagination.”

# Developmental Predictors

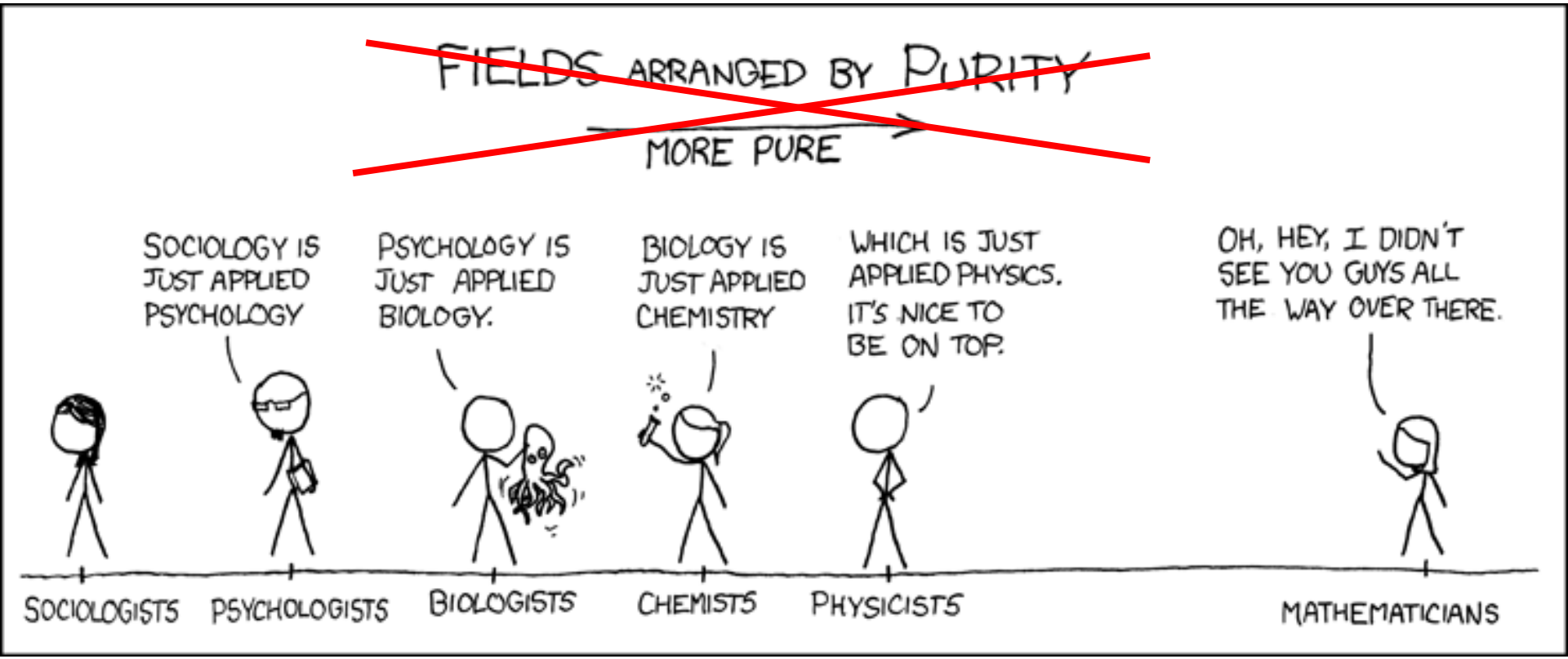
- Domain-typical creator unlikely given Simonton's (1986) *N* = 314 study of biographical typicality and eminence
- What about the other two options?
  - Some indirect support for domain-regressive creator given that revolutionary scientists have higher impact than normal scientists (Ko & Kim, 2008; Sulloway, 2009)
  - But also some inconsistent results and complications (see Sulloway, 2009)
- Hence, "more research needed"

# Conclusion

- Domains of creativity fall along a dimension that has a psychological basis defined by dispositional traits and developmental experiences
- Creative achievement within a domain partly depends on the same dispositional and developmental variables (viz. domain-regressive creators)
- Thus the need to invert and redefine the hierarchy …

# FIELDS ARRANGED BY CREATIVITY

← MORE CREATIVE



# FIELDS ARRANGED BY CREATIVITY

← MORE CREATIVE