Aging and Creative Productivity

Is There an Age Decrement or Not?

Brief history: Antiquity of topic

- Quételet (1835)
- Beard (1874)
- Lehman (1953)
- Dennis (1966)
- Simonton (1975, 1988, 1997, 2000, 2004)

Central findings:
The typical age curve

Described by fitting an equation derived from a combinatorial model of the creative process

Henri Poincaré (1921):
Ideas rose in crowds; I felt them collide until pairs interlocked, so to speak, making a stable combination.

[These ideas are like] *the hooked atoms of Epicurus* [that collide] *like the molecules of gas in the kinematic theory of gases* [so that] *their mutual impacts may produce new combinations.*

$$p(t) = c(e^{-at} - e^{-bt})$$

where $p(t)$ is productivity at career age t (in years),

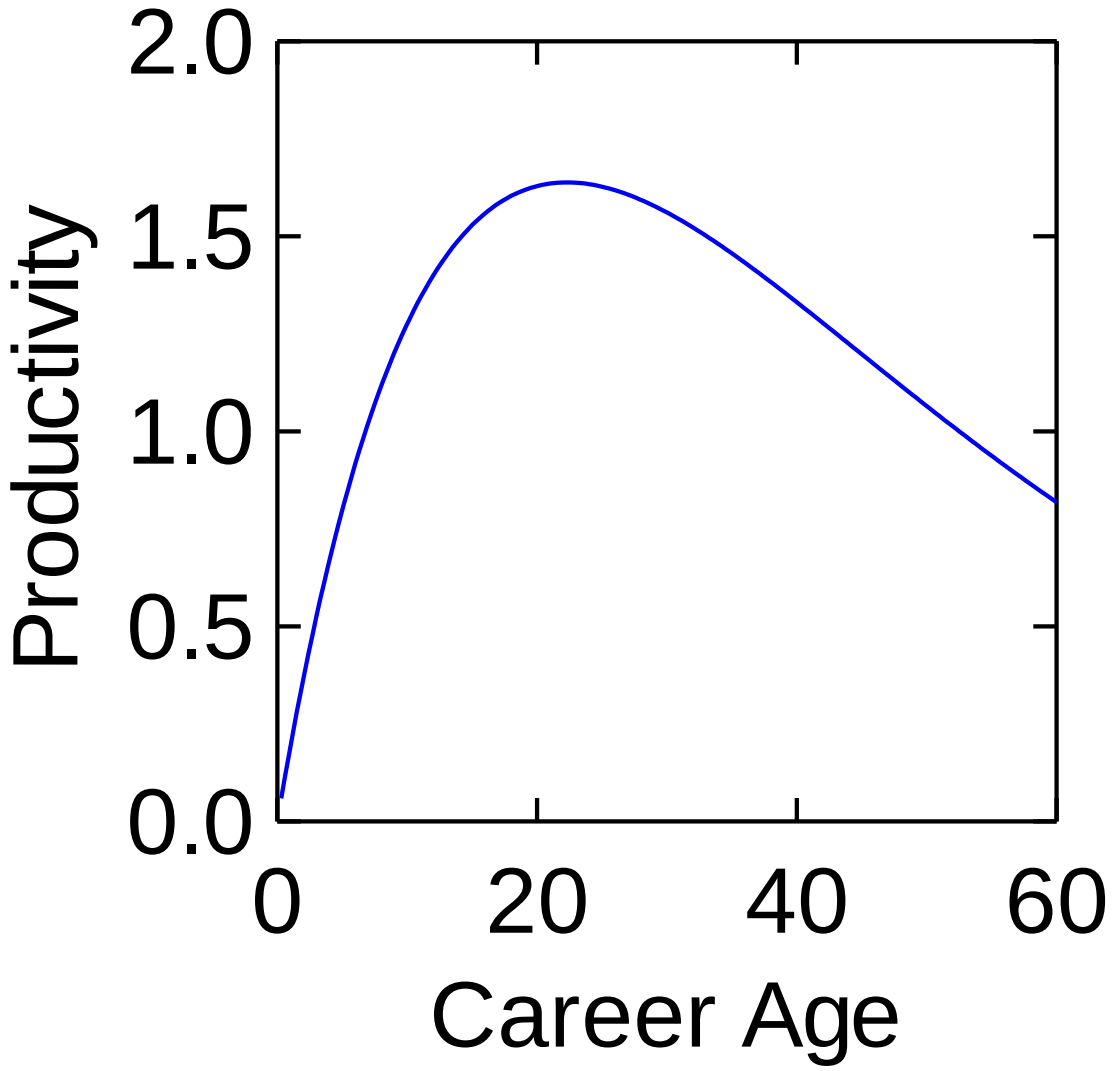
e is the exponential constant (~ 2.718),

a the typical ideation rate for the domain ($0 < a < 1$),

b the typical elaboration rate for the domain ($0 < b < 1$),

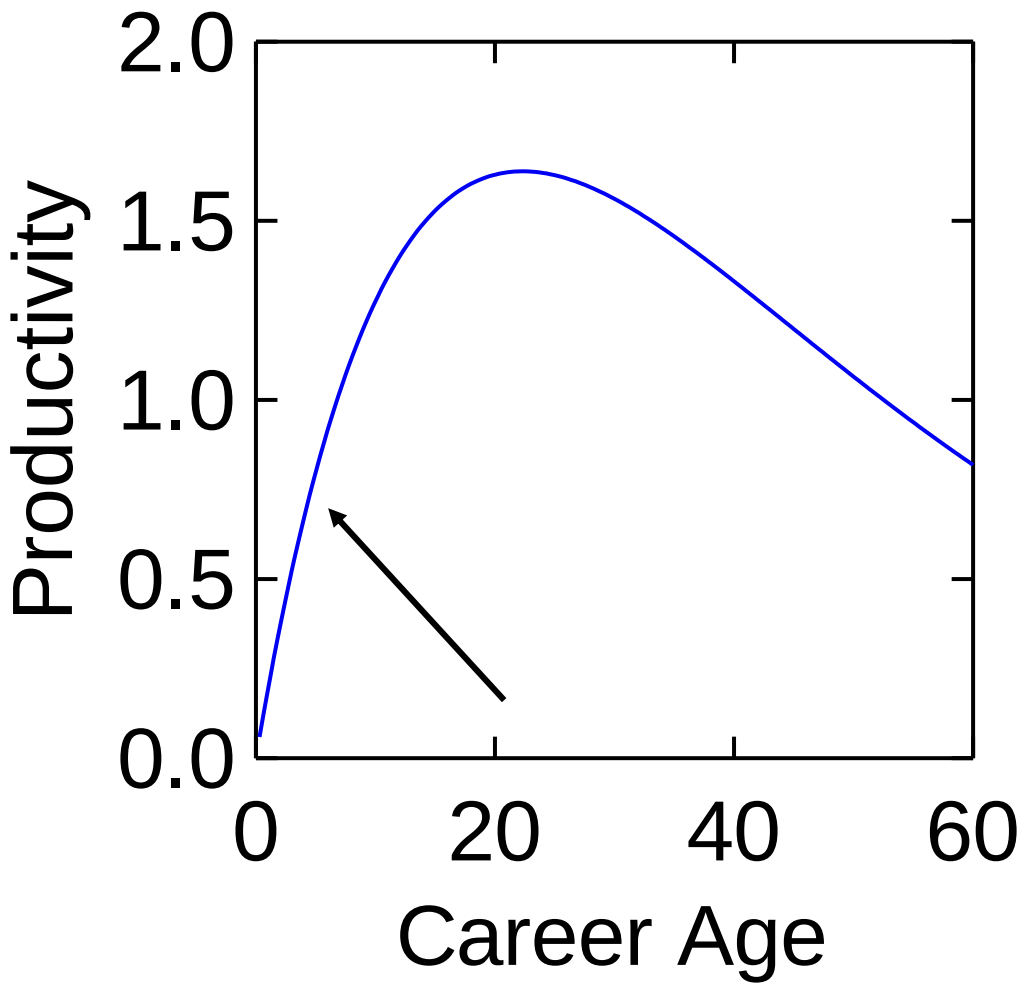
$c = abm/(b - a)$, where m is the individual's *creative potential* (i.e. maximum number of publications in indefinite lifetime).

[N.B.: If $a = b$, then $p(t) = a^2mte^{-at}$]


2.0
1.5
1.0
0.5
0.0
Productivity
0
20
40
60
Career Age

Central findings: The typical age curve

- Rapid ascent (decelerating)


2.0
1.5
1.0
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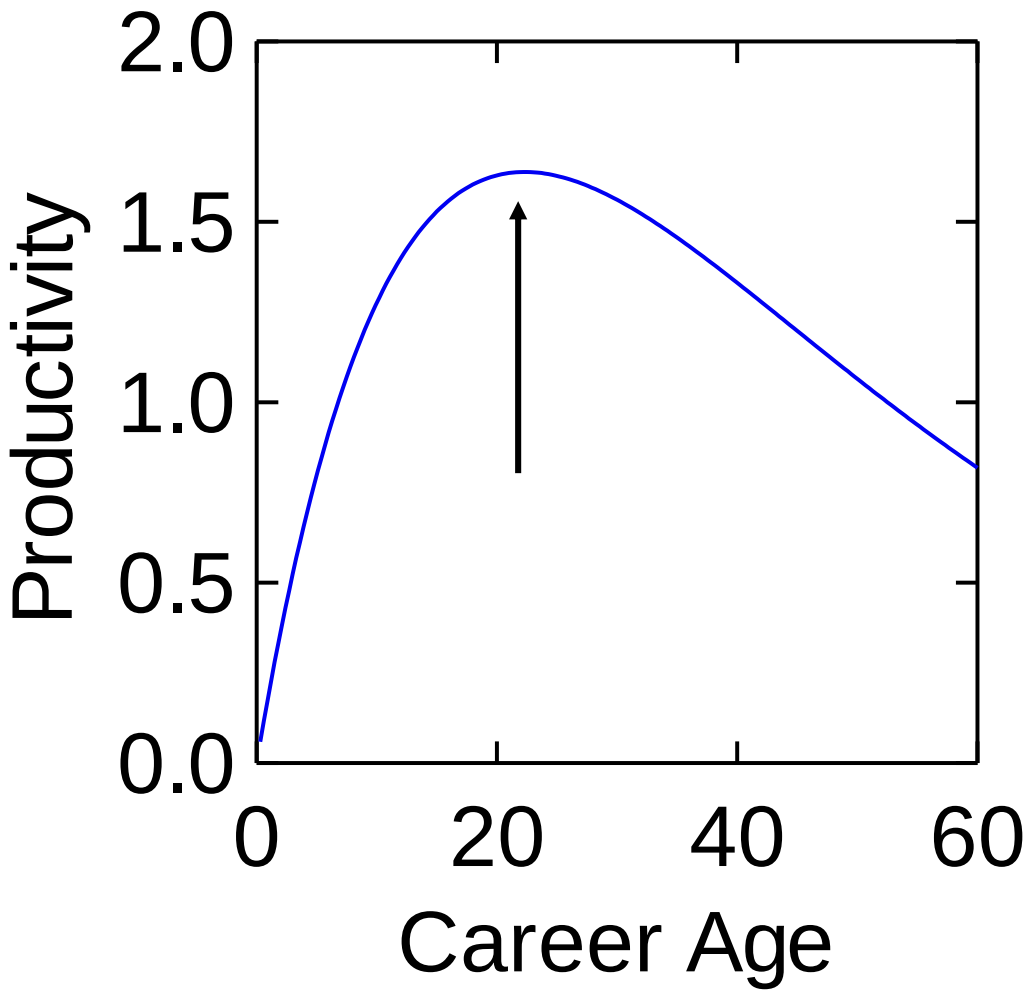
0.0
Productivity
0
20
40
60
Career Age

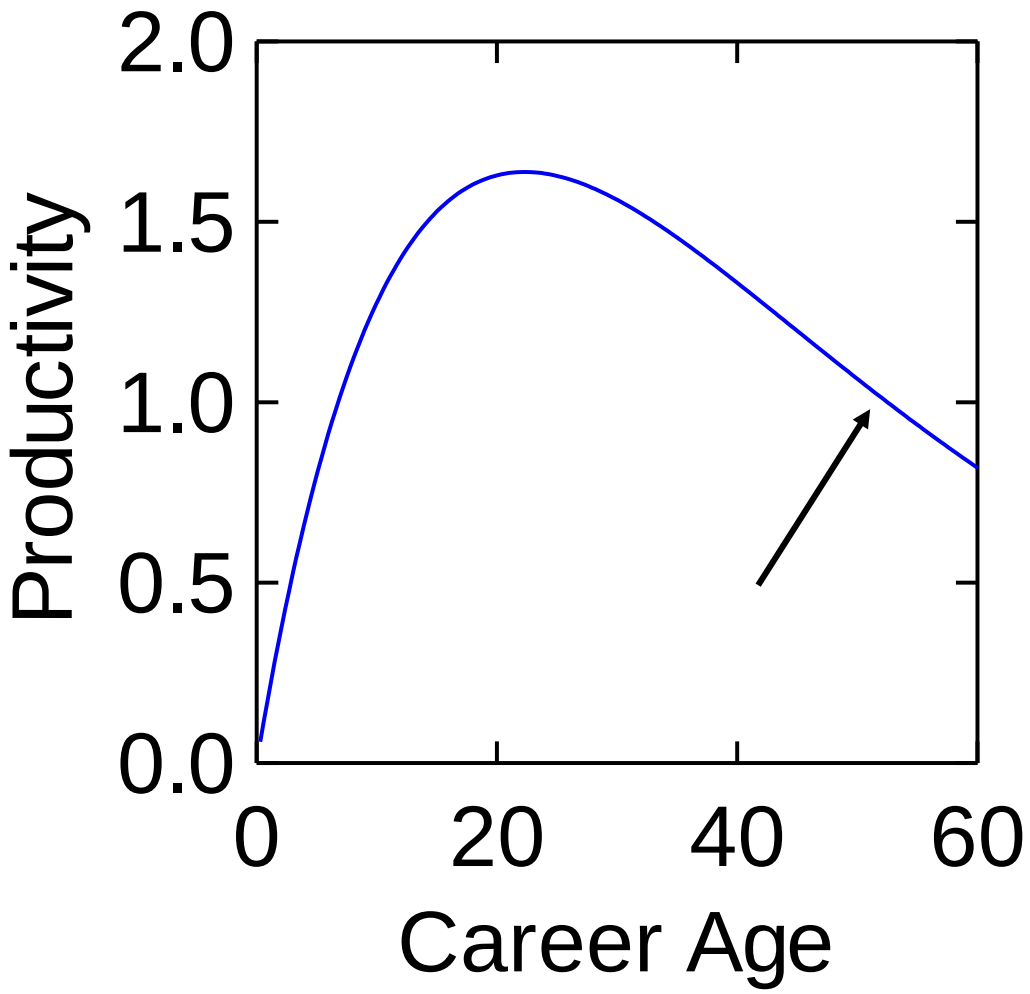
Central findings: The typical age curve

- Rapid ascent (decelerating)
- Single peak


2.0
1.5
1.0
0.5
0.0
Productivity
0
20
40
60
Career Age

Central findings: The typical age curve

- Rapid ascent (decelerating)
- Single peak
- Gradual decline (asymptotic)


2.0
1.5
1.0
0.5
0.0
Productivity
0
20
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60
Career Age

With correlations with published data between .95 and .99.

Criticisms of findings:
Is the age decrement real?

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- Quality but not quantity?

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- Quality but not quantity?
  - But high correlation between two

Criticisms of findings: Is the age decrement real?

- Quality but not quantity?
- Differential competition?

Criticisms of findings: Is the age decrement real?

- Quality but not quantity?
- Differential competition?
  - But survives statistical controls

Criticisms of findings: Is the age decrement real?

- Quality but not quantity?
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- Aggregation error?

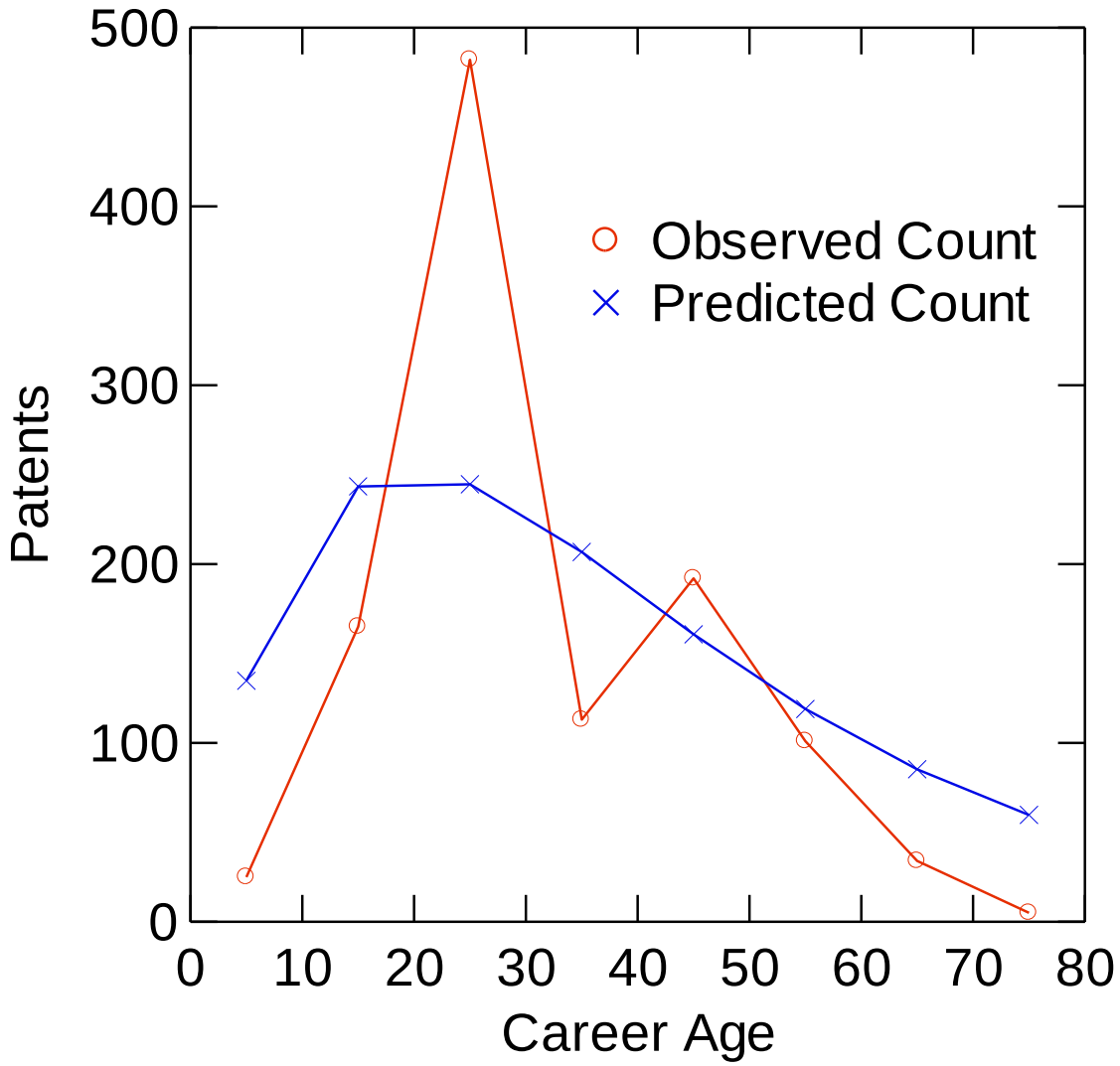
Criticisms of findings: Is the age decrement real?

- Quality but not quantity?
- Differential competition?
- Aggregation error?
  - But persists at individual level

e.g., the career of Thomas Edison

$$C_{Edison}(t) = 2595(e^{-.044t} - e^{-.058t})$$

$$r = .74$$


500
400
300
200
100
0
Patents
0
10
20
30
40
50
60
70
80
Career Age
Observed Count
Predicted Count

However ...

Complicating considerations

Complicating considerations

- Individual differences

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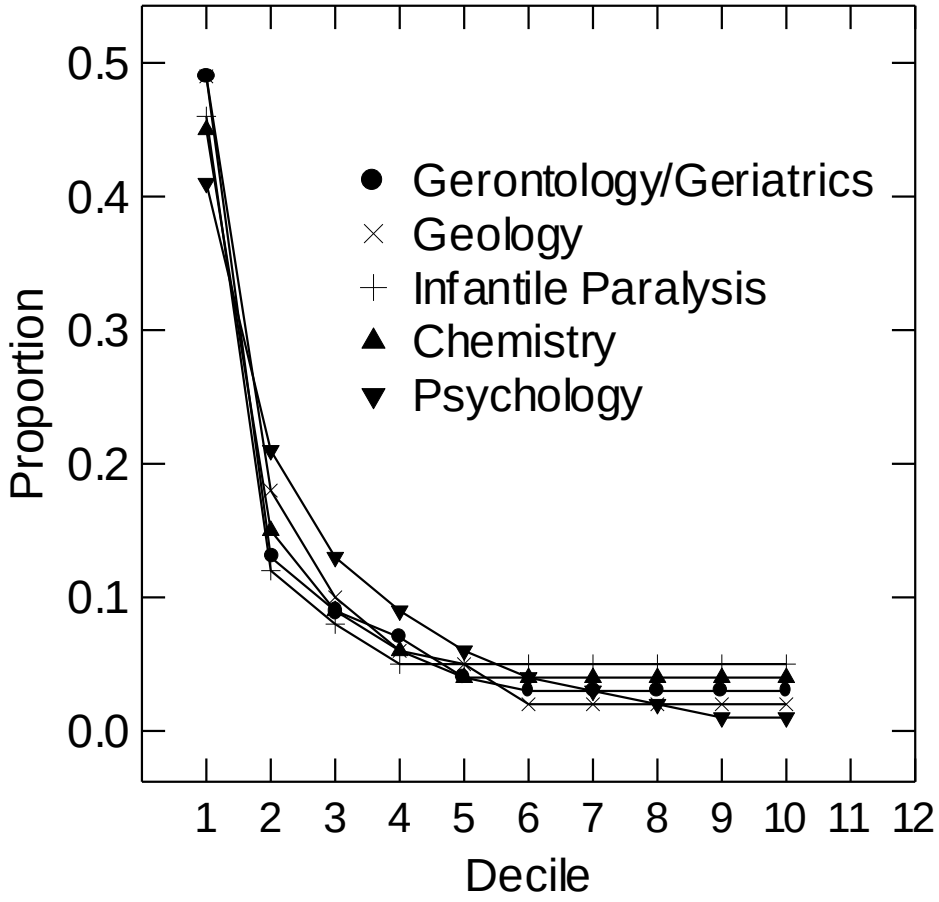
- Individual differences
  - Creative potential (*m* in model)


0.5
0.4
0.3
0.2
0.1
0.0
Proportion
1
2
3
4
5
6
7
8
9
10
11
12
Decile
Gerontology/Geriatrics
Geology
Infantile Paralysis
Chemistry
Psychology

In fact,

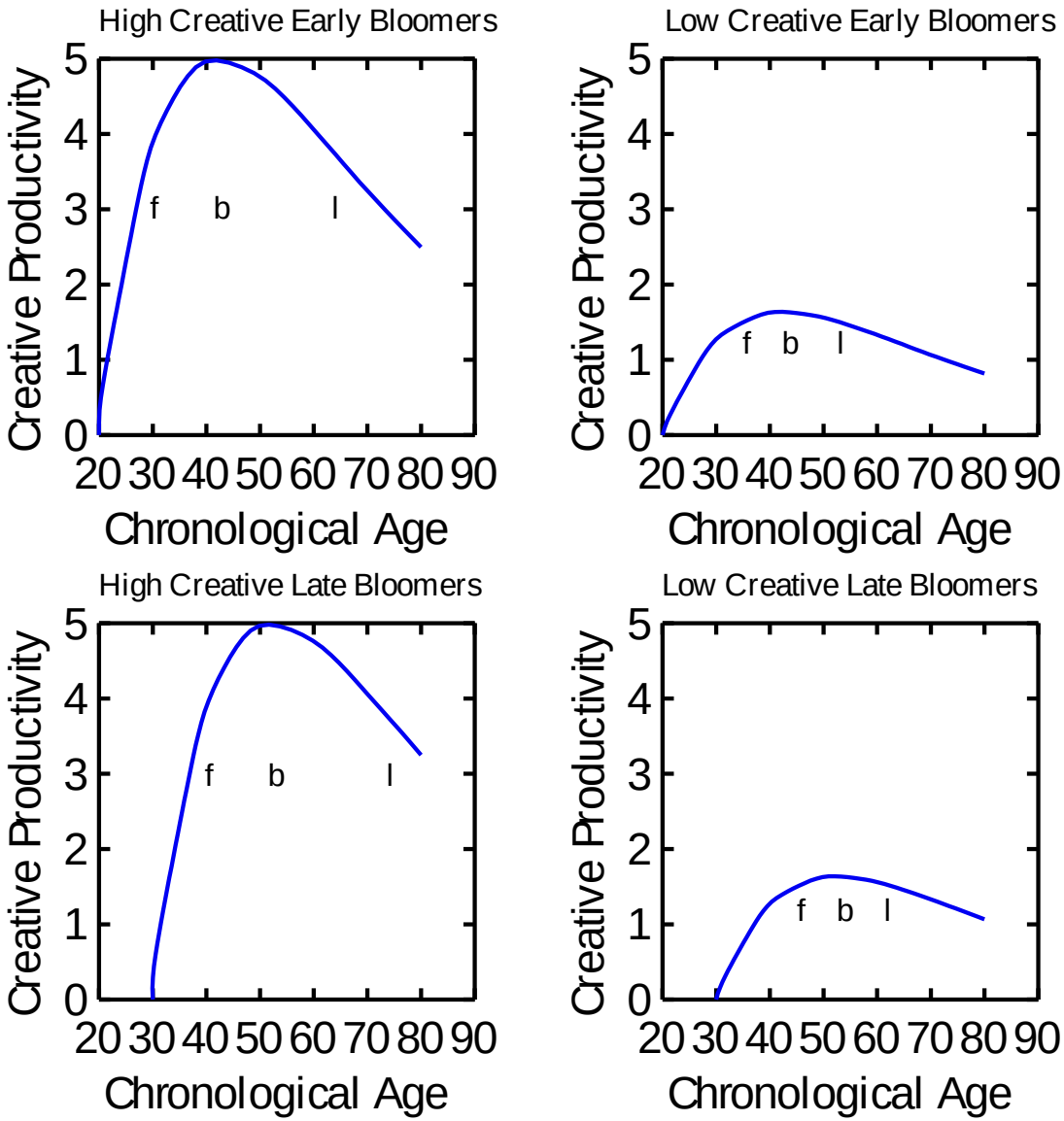
1) cross-sectional variation always appreciably greater than longitudinal variation

2) the lower an individual's productivity the more random the longitudinal distribution becomes

Complicating considerations

- Individual differences
  - Creative potential
  - Age at career onset (i.e., chronological age at $t = 0$ in model)

Hence, arises a two-dimensional typology of career trajectories


High Creative Early Bloomers
Creative Productivity
0
1
2
3
4
5
f
b
l
20 30 40 50 60 70 80 90
Chronological Age
Low Creative Early Bloomers
Creative Productivity
0
1
2
3
4
5
f b l
20 30 40 50 60 70 80 90
Chronological Age
High Creative Late Bloomers
Creative Productivity
0
1
2
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f
b
l
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Chronological Age
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2
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4
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f b l
20 30 40 50 60 70 80 90
Chronological Age

Complicating considerations

- Individual differences
- Quantity-quality relation

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  - The equal-odds rule

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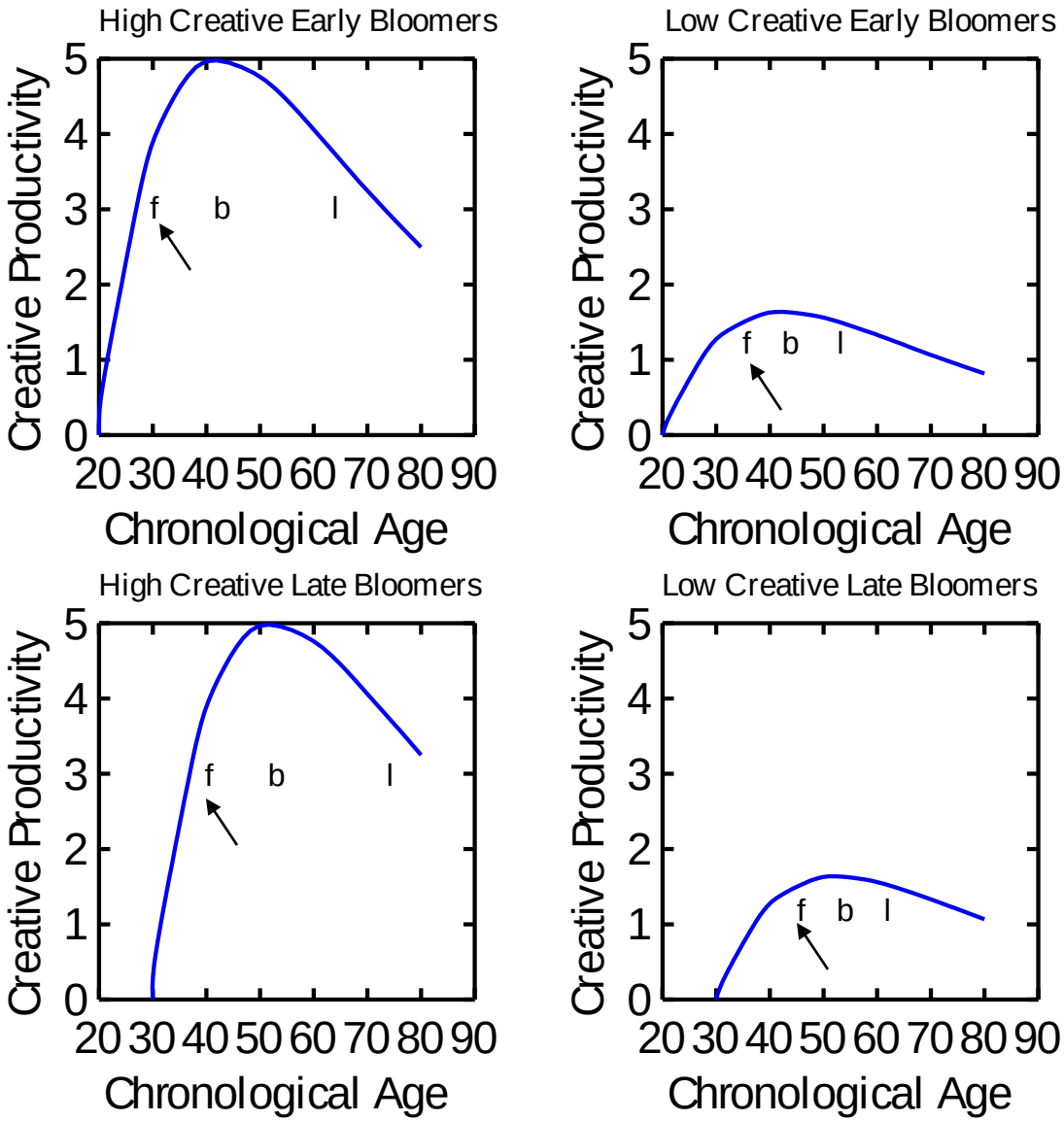
- Individual differences
- Quantity-quality relation
  - The equal-odds rule
  - Career landmarks

Complicating considerations

- Individual differences
- Quantity-quality relation
  - The equal-odds rule
  - Career landmarks:
    - First major contribution (f)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Low Creative Early Bloomers
High Creative Late Bloomers
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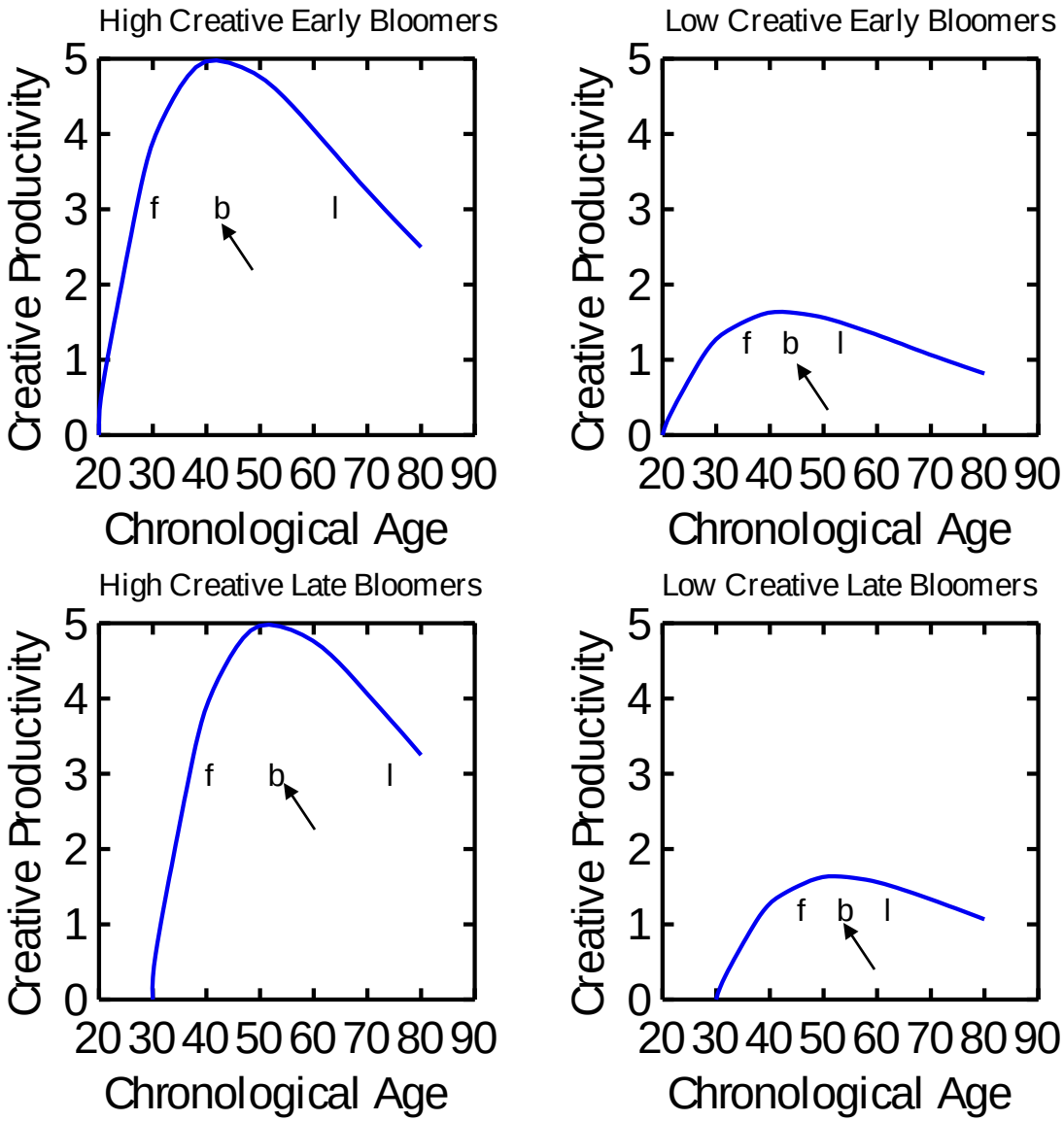
Creative Productivity
Chronological Age
0
1
2
3
4
5
20 30 40 50 60 70 80 90
f
b
l

Complicating considerations

- Individual differences
- Quantity-quality relation
  - The equal-odds rule
  - Career landmarks:
    - First major contribution (f)
    - Single best contribution (b)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Creative Productivity
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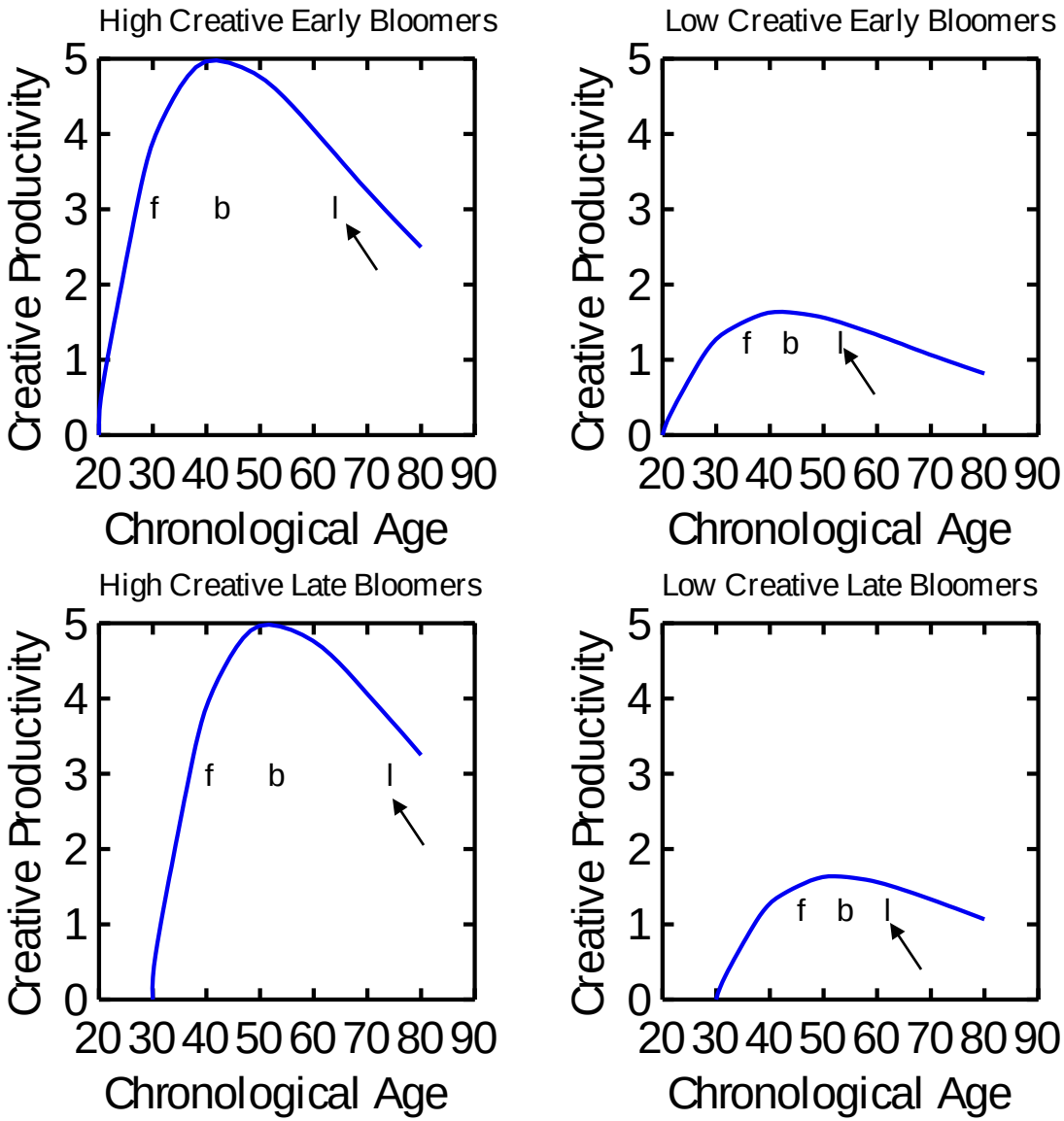
3
4
5
f
b
l
20 30 40 50 60 70 80 90
Chronological Age

Complicating considerations

- Individual differences
- Quantity-quality relation
  - The equal-odds rule
  - Career landmarks:
    - First major contribution (f)
    - Single best contribution (b)
    - Last major contribution(l)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Creative Productivity
0
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b
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Chronological Age
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f
b
l
20 30 40 50 60 70 80 90
Chronological Age

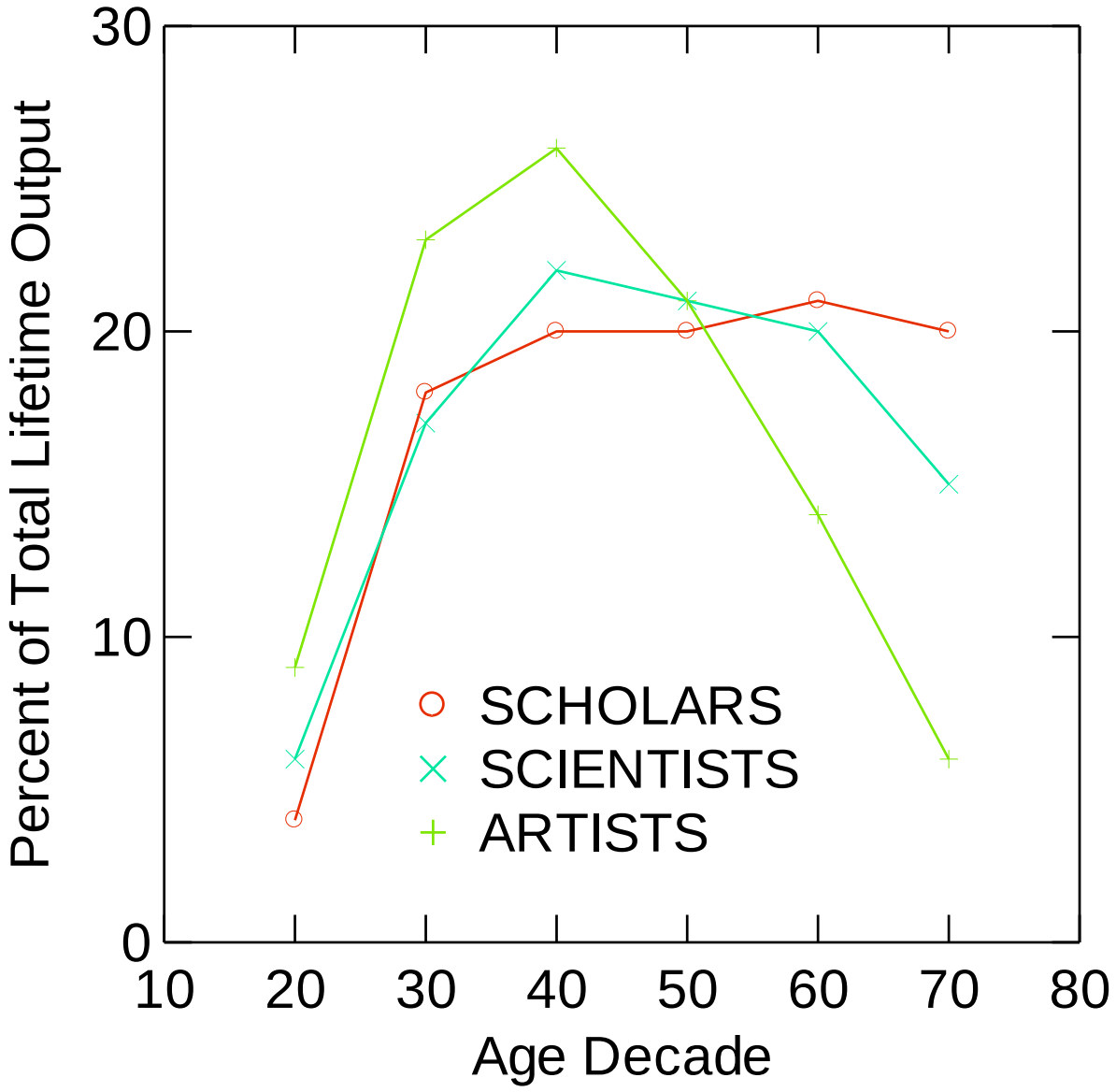
Journalist Alexander Woolcott reporting on G. B. Shaw:
“At 83 Shaw’s mind was perhaps not quite as good as it used to be. It was still better than anyone else’s.”

Complicating considerations

- Individual differences
- Quantity-quality relation
- Inter-domain contrasts (*a* and *b* in model)

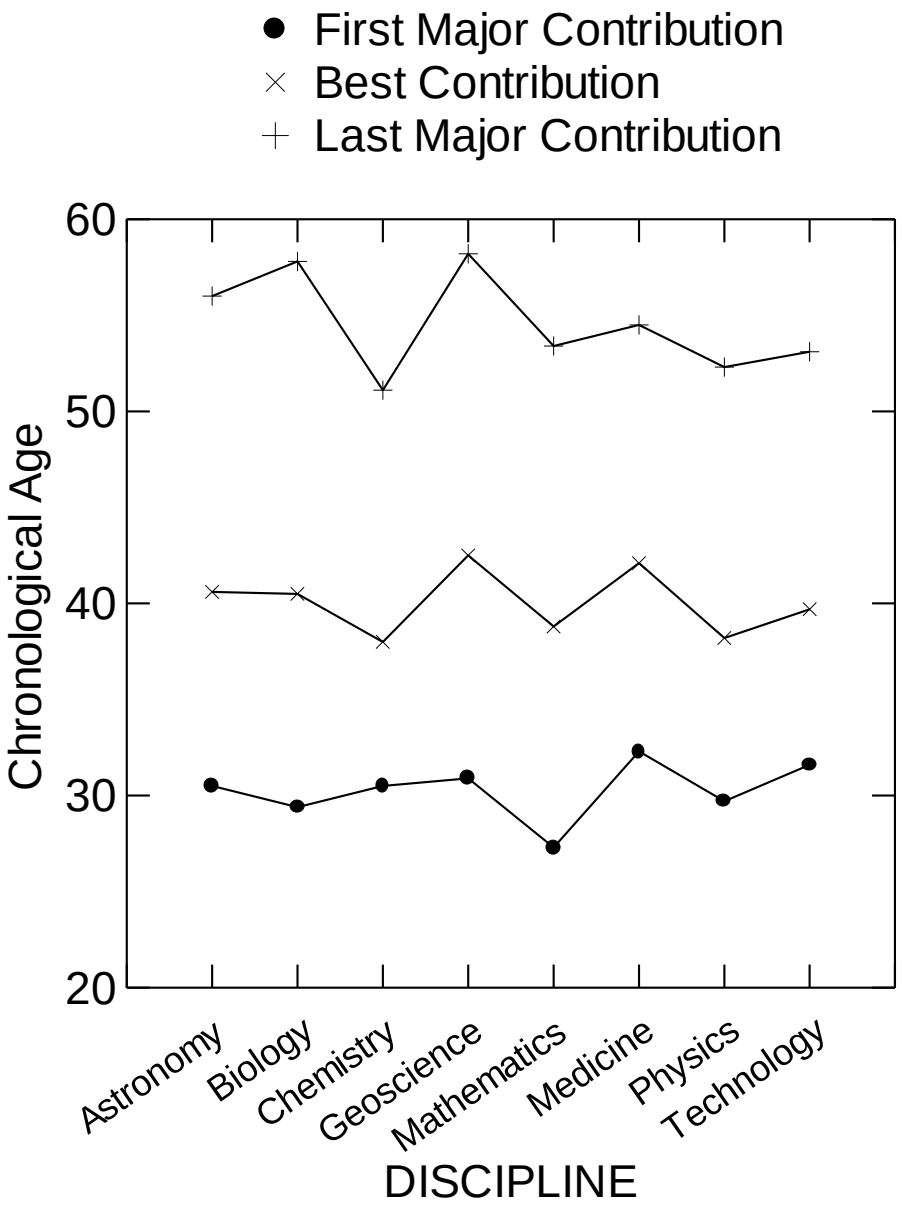
Complicating considerations

- Individual differences
- Quantity-quality relation
- Inter-domain contrasts
  - Differential decrements (0-100%)


Percent of Total Lifetime Output
30
20
10
0
10
20
30
40
50
60
70
80
Age Decade
SCHOLARS
SCIENTISTS
ARTISTS

Complicating considerations

- Individual differences
- Quantity-quality relation
- Inter-domain contrasts
  - Differential peaks and decrements
  - Differential landmark placements


First Major Contribution
Best Contribution
Last Major Contribution
60
50
40
30
20
Chronological Age
Astronomy
Biology
Chemistry
Geoscience
Mathematics
Medicine
Physics
Technology
DISCIPLINE

Complicating considerations

- Individual differences
- Quantity-quality relation
- Inter-domain contrasts
- Impact of extraneous factors

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- Individual differences
- Quantity-quality relation
- Inter-domain contrasts
- Impact of extraneous factors
  - Negative influences

Complicating considerations

- Individual differences
- Quantity-quality relation
- Inter-domain contrasts
- Impact of extraneous factors
  - Negative influences: e.g., war

Complicating considerations

- Individual differences
- Quantity-quality relation
- Inter-domain contrasts
- Impact of extraneous factors
  - Negative influences
  - Positive influences

Complicating considerations

- Individual differences
- Quantity-quality relation
- Inter-domain contrasts
- Impact of extraneous factors
  - Negative influences
  - Positive influences: e.g.,
    - disciplinary networks

Complicating considerations

- Individual differences
- Quantity-quality relation
- Inter-domain contrasts
- Impact of extraneous factors
  - Negative influences
  - Positive influences: e.g.,
    - disciplinary networks
    - cross-fertilization

Hence, the creative productivity within any given career will show major departures from expectation, some positive and some negative

Three Main Conclusions

- Age decrement a highly predictable phenomenon at the aggregate level
- Age decrement far more unpredictable at the individual level
- Age decrement probably less due to aging per se than to other factors both intrinsic and extrinsic to the creative process

Hence, the possibility of late-life creative productivity increments;

e.g.,

Michel-Eugène Chevreul

(1786-1889)

References

- Simonton, D. K. (1984). Creative productivity and age: A mathematical model based on a two-step cognitive process. *Developmental Review*, *4*, 77-111.
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References

- Simonton, D. K. (1991). Career landmarks in science: Individual differences and interdisciplinary contrasts. *Developmental Psychology*, *27*, 119-130.
- Simonton, D. K. (1997). Creative productivity: A predictive and explanatory model of career trajectories and landmarks. *Psychological Review*, *104*, 66-89.
- Simonton, D. K. (2004). *Creativity in science: Chance, logic, genius, and zeitgeist*. Cambridge, England: Cambridge University Press.