

*Psychology of problem-solving and its role in education:
from Sputnik shock to the web*

A problémamegoldás pszichológiája és szerepe a
nevelésben: a szputnyik sokktól a webig

Pléh Csaba

CEU Cognitive Science, Budapest and
Hungarian Academy of Sciences

vispleh@ceu.edu

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Overview Áttekintés

Classic duality : analytic versus holistic Selz *versus* Wertheimer.

Direction and set in problem solving

Images and inner speech

Selection theories

Logical inferential systems

Errors of deduction

Errors of induction Wason

The Sputnik shock and the cognitive revolution

Changes in creativity research

Klasszikus kettősség: elemző és egészes, Selz *versus* Wertheimer.

Irány és beállítódás a feladatmegoldásban. Képek és motyogás a gondolkodásban.

Szelekciós elméletek

Logikai következtetési rendszerek.

Deduktív hibák.

Induktív hibák. A Wason feladat.

A szputnyik sokk és a kognitív forradalom

A kreativitás kutatás változásai

Task 1

Make 4 identical
triangles from 6
matches

6 gyufából csináljon
4 egybevágó
háromszöget

2. Betűszámítan Letter algebra

$$D=5$$

DONALD +
GERALD

ROBERT

Otto Selz (1881-1943)



- Structure
- Direction
- Comparing demands and situation
- Analytic attitude
- Szerkezet
- Irány
- Feltétel és helyzet összevetés
- Analitikus hozzáállás

Max Wertheimer (1880-1943)

Wholes

Insight: reorganization

Visual tasks

Stages

problem

data

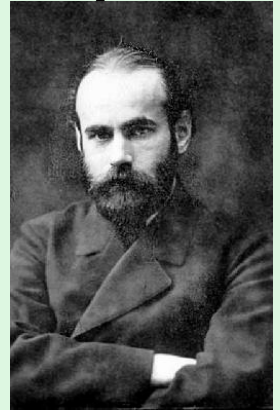
attempts

insight

solution

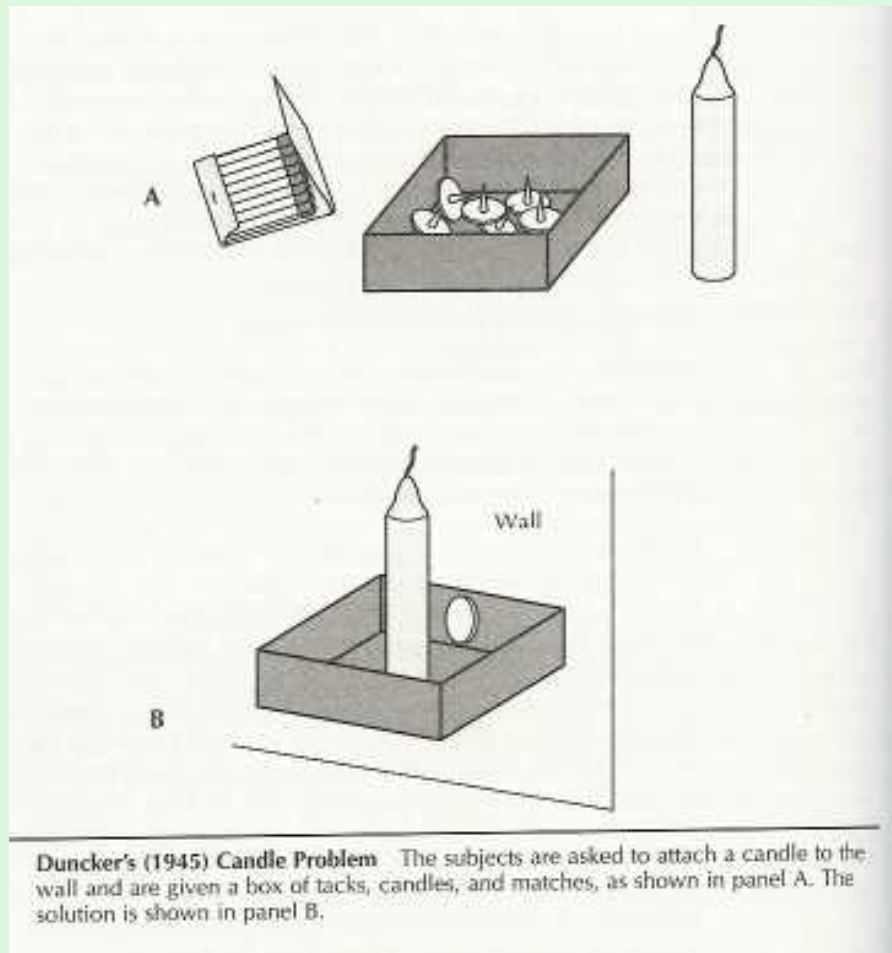
checkp up

- Egészek
- Belátás :
újrászervezés
- Vizuális feladatok
- Szakaszok
 - probléma
 - adatok, próbák
 - belátás, megoldás
 - ellenőrzés



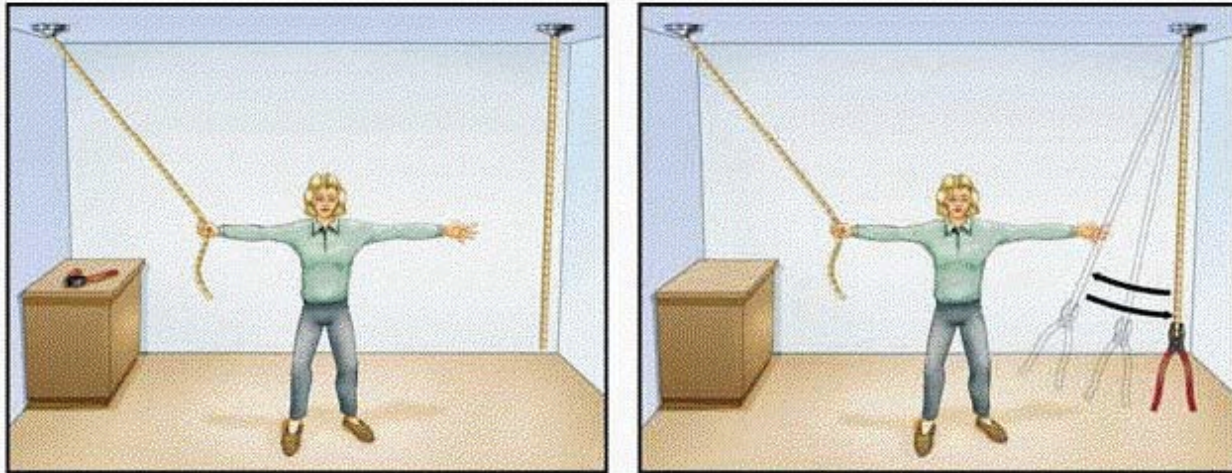
Duncker funkcionális fixáció

Functional fixedness



Maier two ropes két kötél

Functional Fixedness



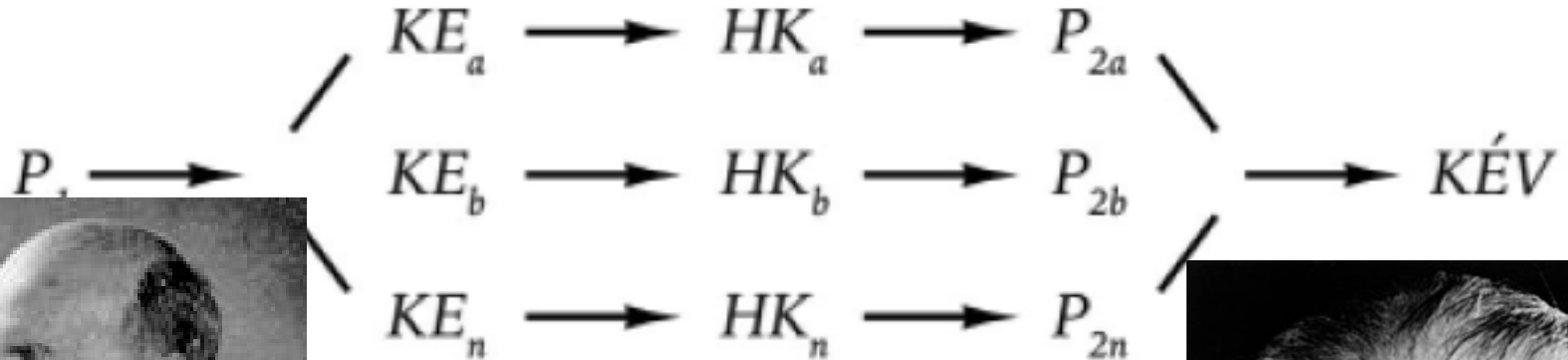
New and Old Új és Régi

- Role of sets
- Repetition: speed up
- Problem redefintion
- Innovation and preservation
- Ein-sicht. Vision and analysis
- Beállítódások szerepe
- Ismétlődés: gyorsítás
- A probléma állandó újrafogalmazása
- Újítás és megőrzés
- Be-látás. Mindig látás v. elemzés?

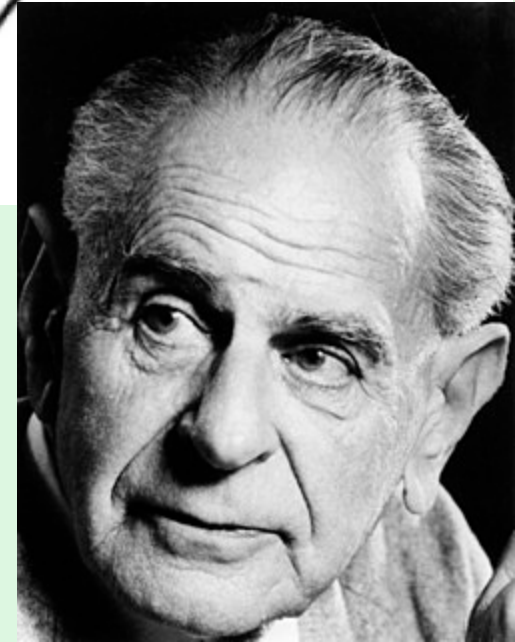
Bühler - Popper on changes. Problem solving is one case

A tudás változásáról:
a problémamegoldás csak egy eset

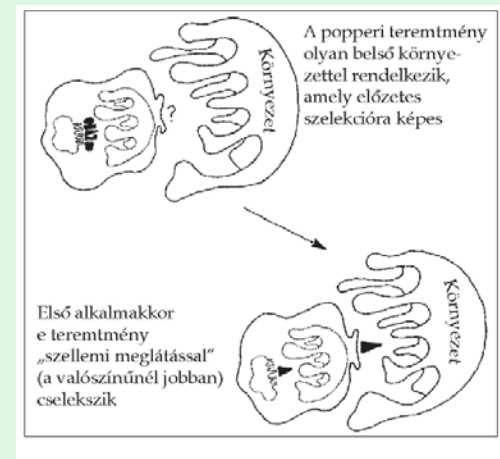
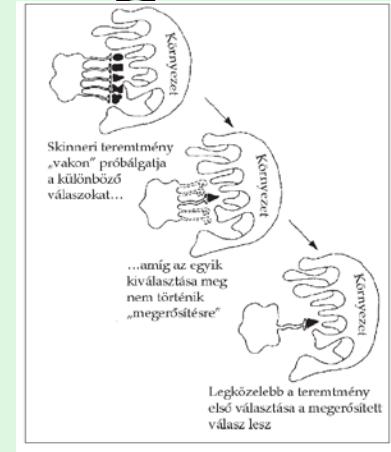
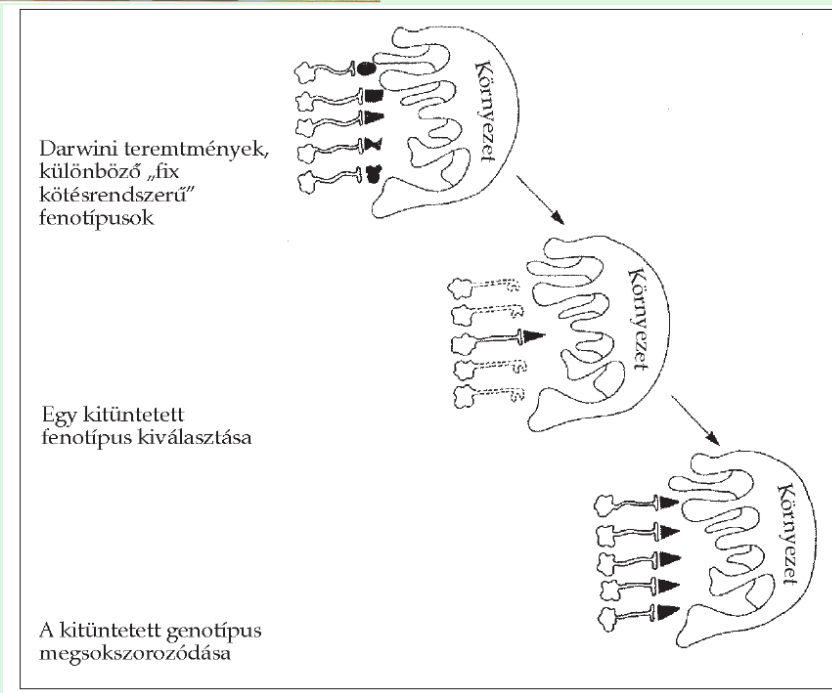
Problem Experimental theory Error elimination Final problem Evaluation
Probléma Kísérleti elmélet Hibakiiktatás Végprobléma Kiértékelő vita



Karl Bühler (1879-1963)
Karl Popper (1902-1994)



Dennett: Selection tower: Darwinian, Skinnerian and Popperian beings



New duality Új kettősség

Kahnemann



- **Gyors. Intuitív**

- Az intuitív rendszer rendkívül gyors. Első megérzés.
- Nem stupid. Perceptuális okság, szemantikai előfeszítés, ismétlési hatások. Evolúciós, bevált. Érzelmi heurisztika
- Nehezen tud nagy adathalmazokat összevetni.
- Meehl: klinikai intuición

- Lassú. Következő

- Nagy adathalmazok.
- Mérlegelő, logikus
- Félrevezethet a mindentudással.
- Meehl: statisztikai predikción.

Small task Kis feladat

- In Moscow, all men are bold.
- Ivan lives in Moscow.
- Thus, Ivan is...
- Északon minden medve fehér.
- Brumi medve északon él.
- Tehát?

A tiszta formális gondolkodás mint különlegesség Lurija 1930

- **Pure formal thought is special**
- Denial based on experience
- Denial based on impossibility
- **Sosem voltam ott**
- **Lehetetlenség**
- **Olyan nincs, hogy mindenki kopasz**



Induction issues Wason 1966



psychologyinaction.org

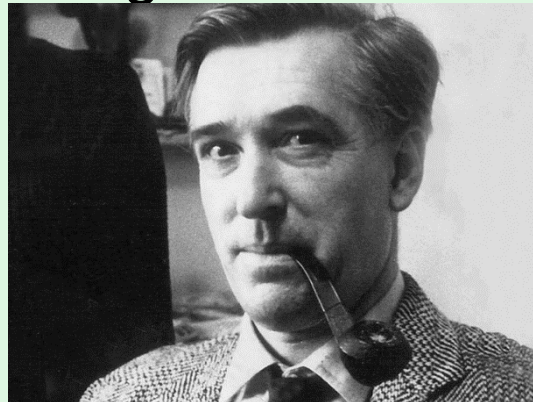
16 25



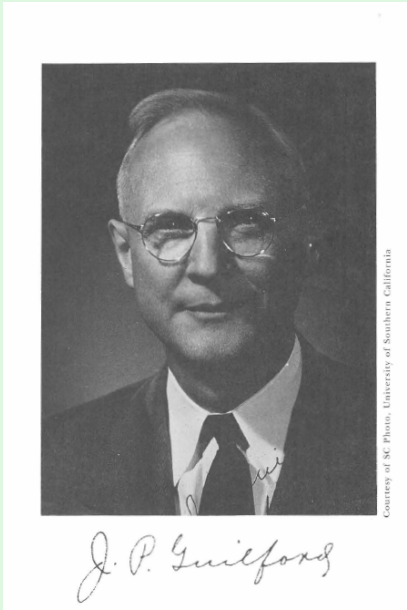
Ha páros, akkor magánhangzó
Melyik kettőt kell megnéznem ?
Ha sört iszik, akkor 18 feletti.
Melyik kettőt kell megnéznem ?

If even, then vowel.

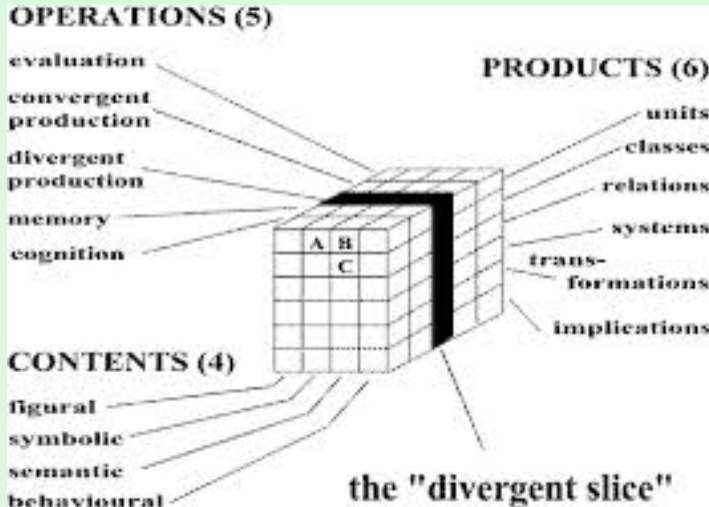
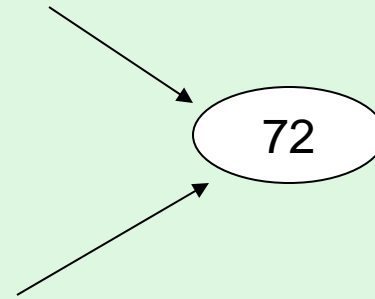
If drinks beer, then over 18.



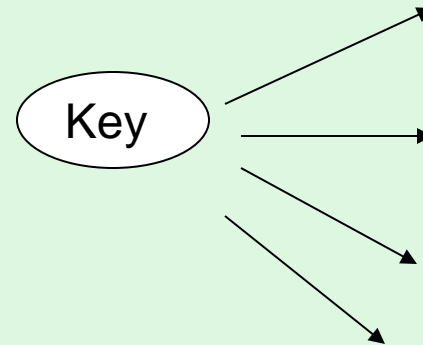
Two types of productive thinking in the 1960s: Convergence and divergence Creativity as disorganization and multiplicity



6 x 12?
convergent



uses of
a key
divergent



Classic vision of the creative person which is later ramified

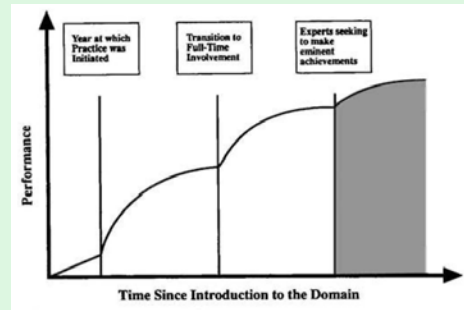
- Divergent
- Open to experience
- MASC and FEMIN
- Independent
- Sensitive

Three great changes of creativity research over half a century

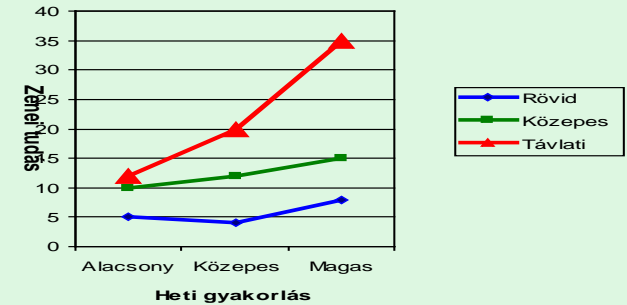
- 60-s
- 2000
- Everbody creative ,Outstanding'
- Divergency Hard work
- Individual creativity Social aspects
- Domain general Domain specific
- Internal factors Life paths

Talent and practice

- The role of great practice :
- Practicing holes; repetition/variation
- 10.000 hours practice
- 10 years for mastery
- Emotions and mentors
- Ericson: stages of expertise formation



McPherson (2001) zenei fejlődés vizsgálata



Refinement of the idea of divergency

Simonton

- SCIENTIST
- Original in their own field
- Domain specific divergence
- Rational imagination
- ARTIST
- More many sided
- General divergence
- Emotional primary process imagination



Two roads to creativity

- **Constrained**

- Conventional
- First born
- Good student
- Single mentor
- Stabil political views

DEVELOPMENT

TENDENCIES

- Logical
- Narrow
- Less trouble

- SCIENTIST
- Paradigm Revolution

INNOVATION

- **Occasional**

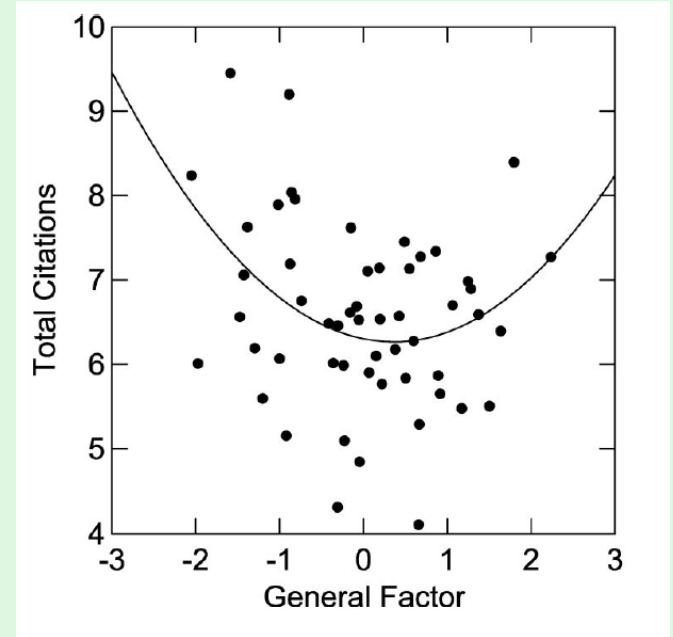
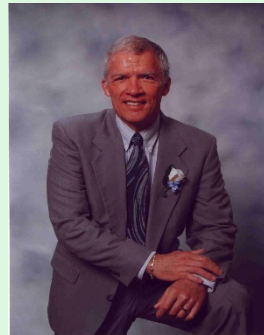
- Multiple, dramatic
- Later born
- Failures
- Many mentors
- Instabil politics

- Intuitive
- Variable
- Many pathologies

- ARTIST
- Formal Expressive

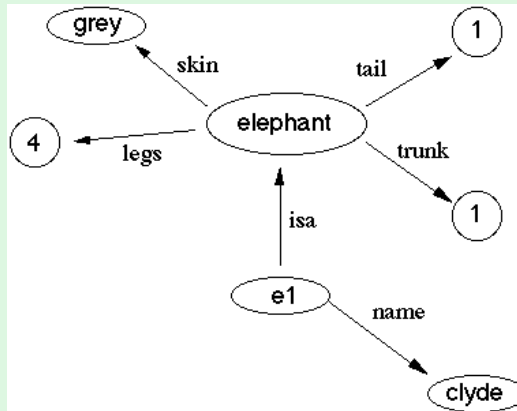
The example of psychology (K. Simonton)

- Objective, quantitative. analytic, impersonal, static
- Subjective, qualitative, personal
- Both influential, only the middle is lukewarm

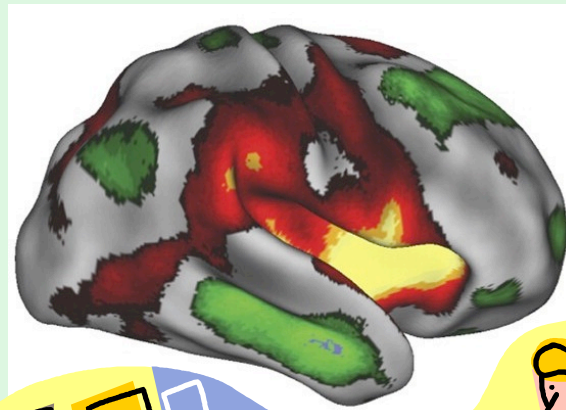


Three senses of networks in psychology and their relations to creativity

THOUGHTS



BRAIN NETWORKS



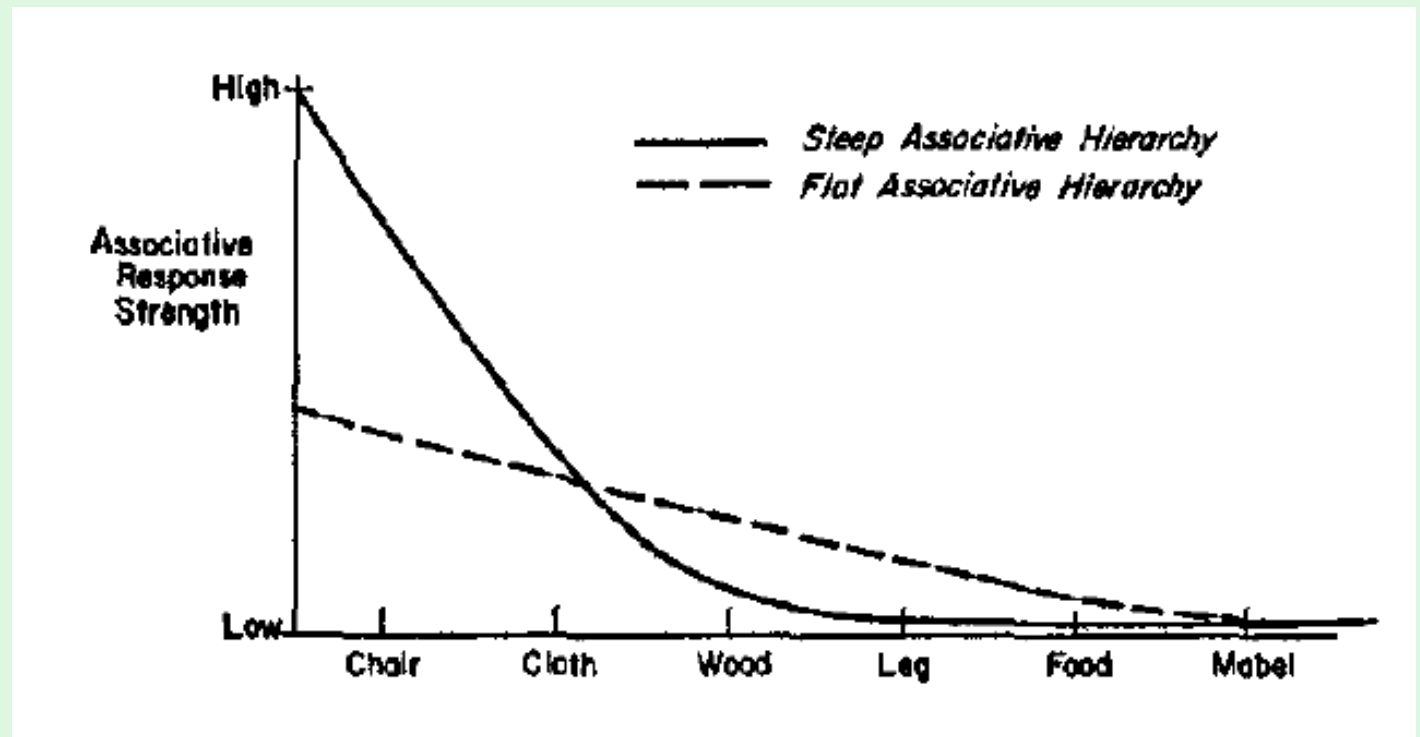
PEOPLE



The cognitive aspect of networks

SEMANTIC HIERARCHIES AND CREATIVITY

Steep and Flat Hierarchies Mednick, 1962



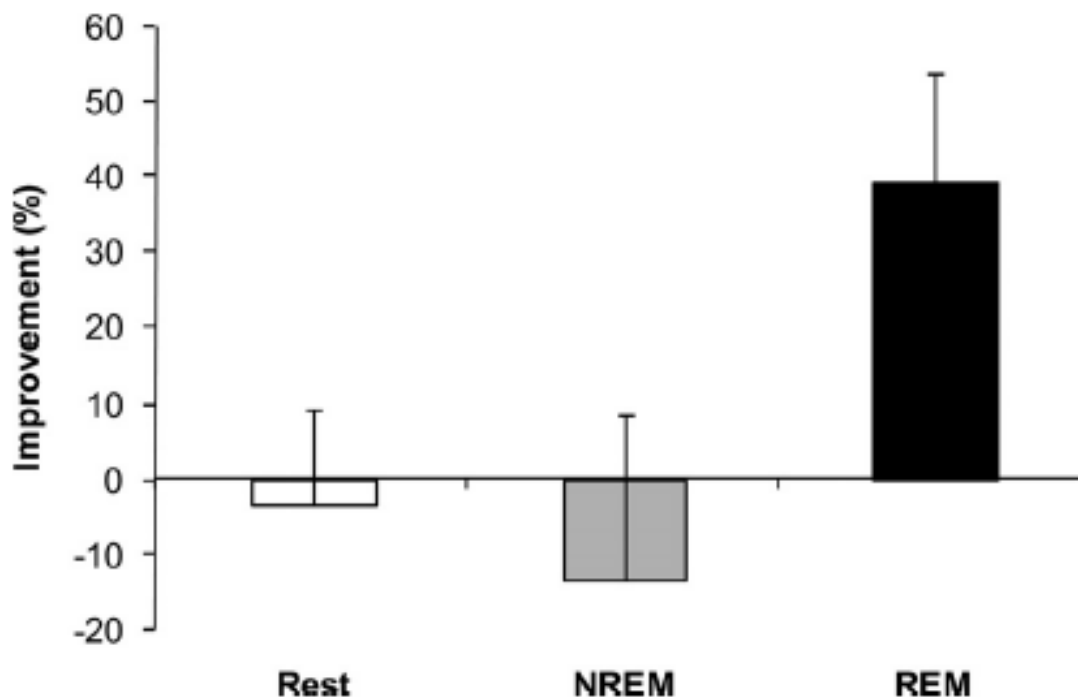
REM sleep in fact helps the novel use of information

Mednick et al 2009

COOKIES, SIXTEEN, HEART: SWEET

ANALOGY PRIME

TALL:SHORT SALTY: S....

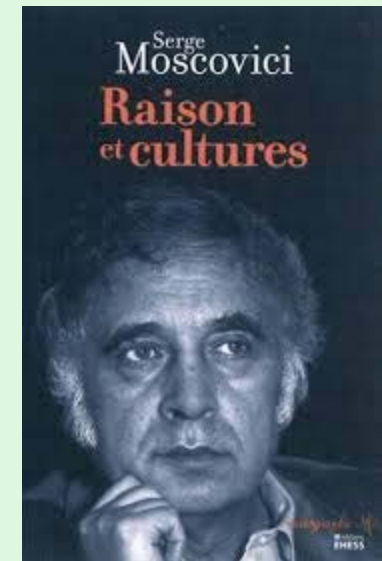
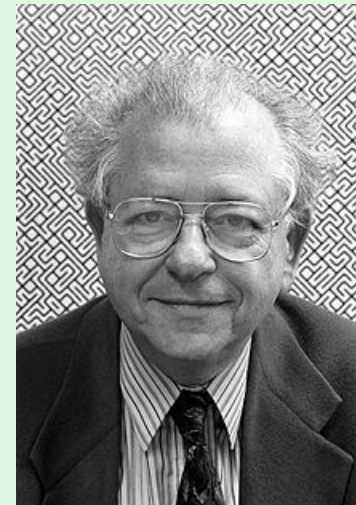


The role of crossing
disciplinary cultures in scientific creativity :
Semantic/categorial transgression

- Helmholtz: physics and experience
- Darwin geomorphology and life:
graduality
- The very idea of NETWORKS
extended
- The imminent danger of reductionism

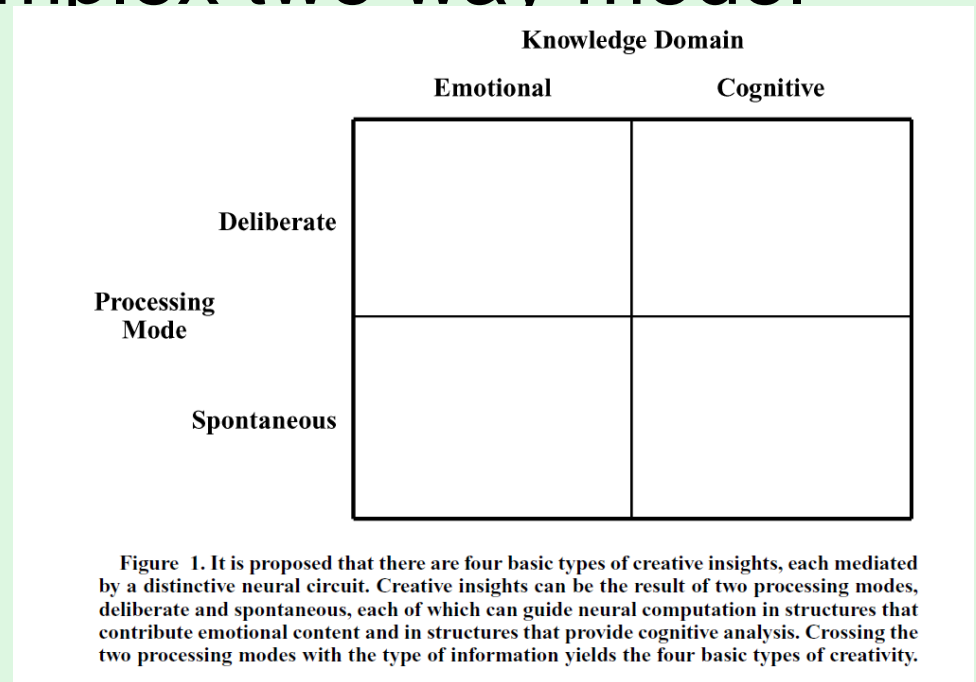
Semantic crossing and multiple group membership

- Bartlett, Koestler: key to innovation is the boundary crossing
- Julesz: scientific bilingualism
- Moscovici 'cognitive polyphasia'.



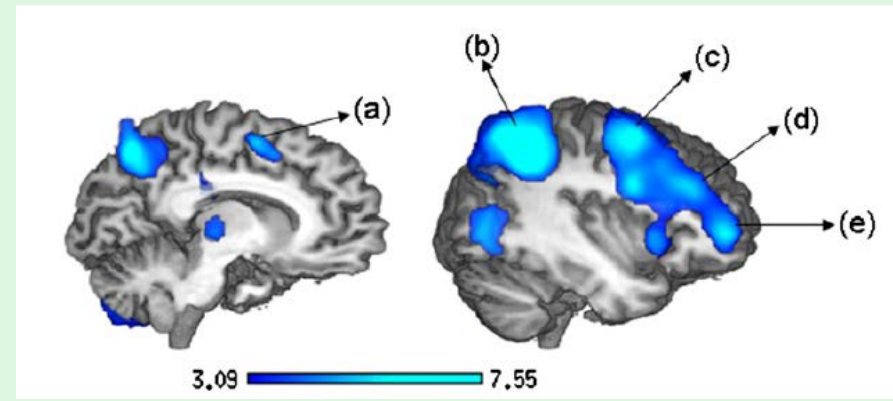
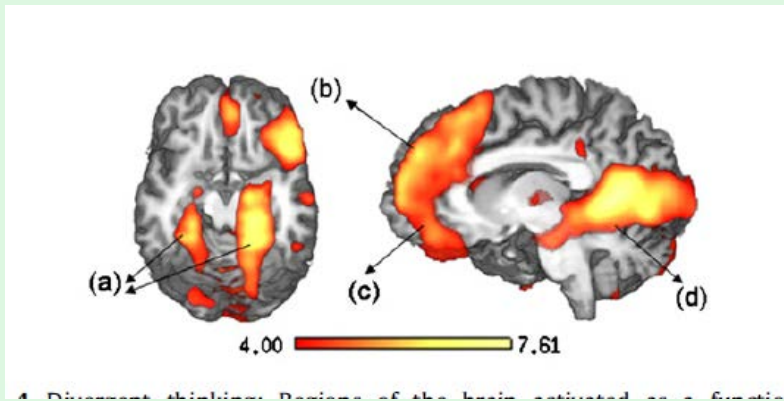
Brain and creativity

- Simple ideas: creativity is right hemisphere function
- Dietrich (2004) complex two way model



Abraham, 2012: divergent and convergent areas in the brain

- Divergent
- Convergent

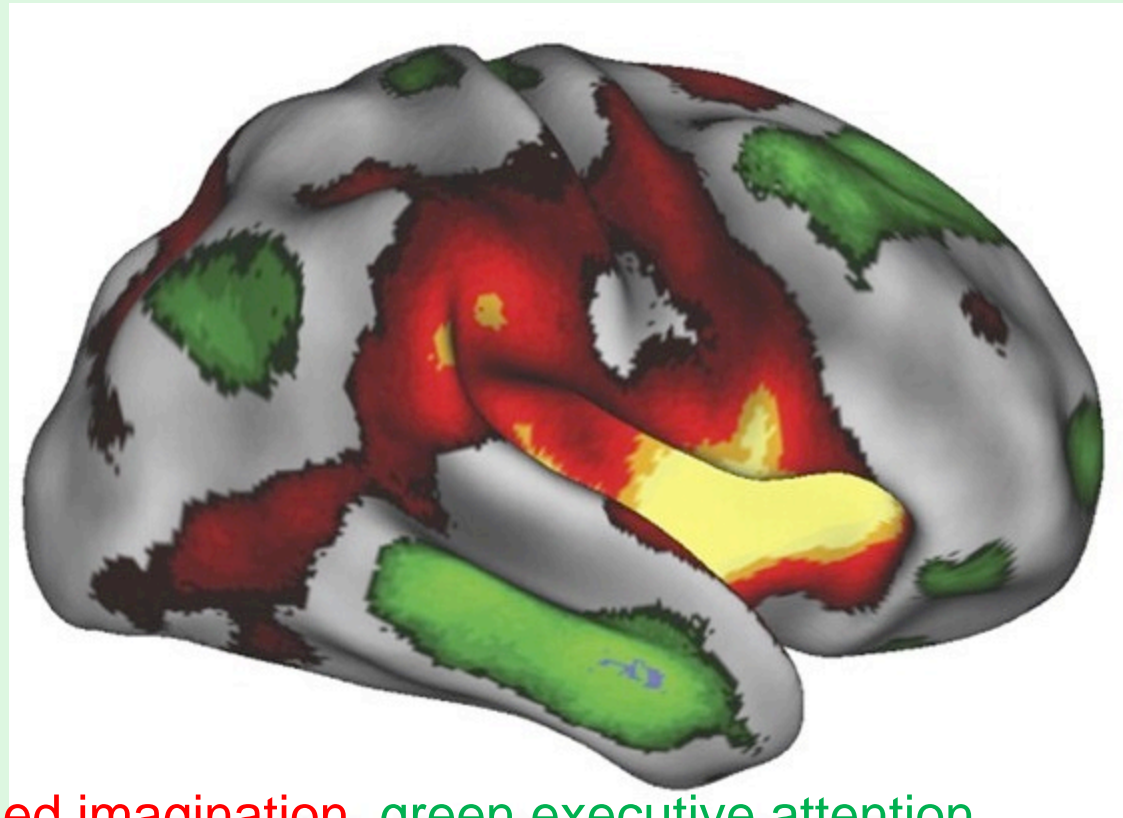


- Hippocampus and amygdala
- Dorsal and ventral medial prefrontal
- Right dorsolateral prefrontal
- Right upper parietal

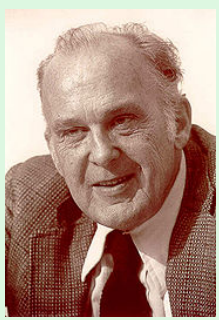
Three brain networks in creativity

- **Network 1: The Executive Attention Network**
- **Network 2: The Imagination Network**
- **Network 3: The Salience Network**

Kaufman, 2013



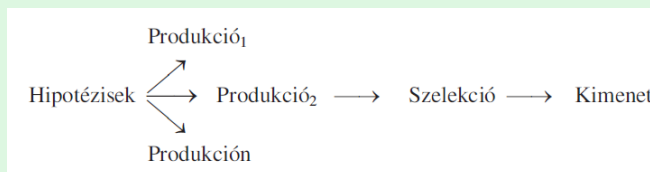
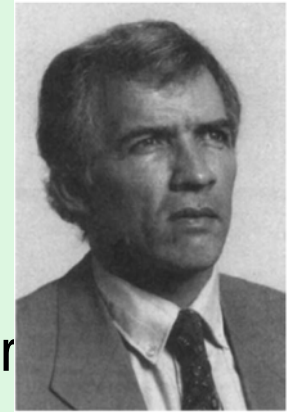
Red imagination, green executive attention



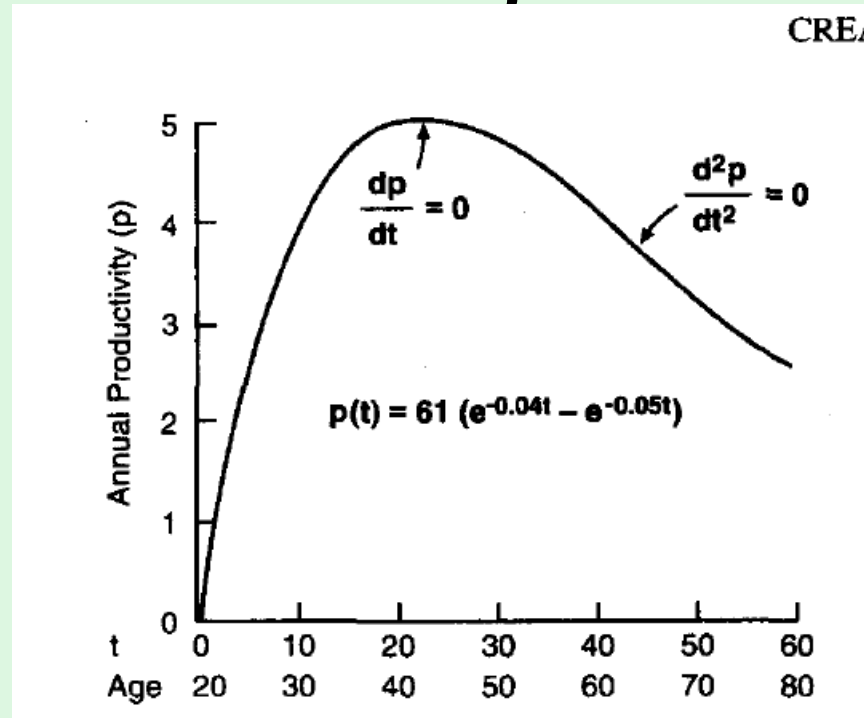
Darwinian model of creativity

Campbell and Simonton

- Creation is a random process
- Two Darwinian aspects
- Creatives liked more ?
- Generation – selection separated
- Idea generation followed by selection
- Idea generation and selection two independent processes
- Stabil hit ratio
- 0.72 correlation of number of papers and citation number to most cited papers

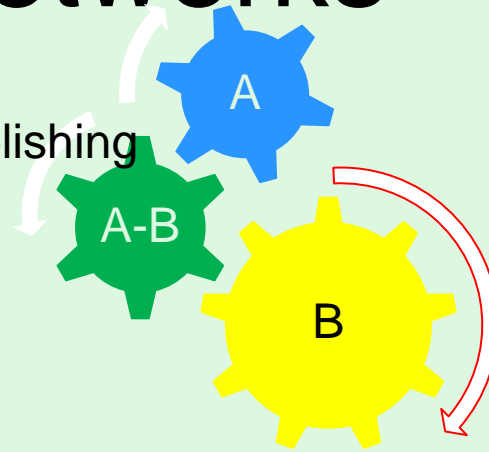


Simonton model. Stable idea generating random process and age

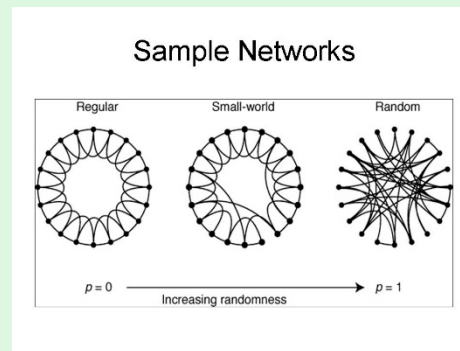


The assumed relations between semantic and Ego-centered networks

Relationship quality
Stable, maintenance, establishing
Openness to experience



Q: Clustering/path length and the small world issue



List of creative relationship ideas Perry-Smith and Shalley, 2003

- Kéri: more support net, more creativity
- More weak ties, more creative
- Central more creative, but external ties needed
- Peripheral with many external ties is best
- External contacts less risky
- Creativity fosters centrality, but after a while centrality inhibits creativity



Cultural elements in a Darwinian process Simonton

- Disintegration of multiethnic empires fosters creativity
- Intellectual multiplicity
- Foreign influence. 20-30 % of excellence in the US is foreign trained
- Family e.g. religious multiplicity also helps

Some advice

- Look actively for external contacts
- Mentors are crucial
- Slightly excentric is good mentor
- Talent and early practice: 10.000 hours needed for excellence