



ECONOPHYSICS COLLOQUIUM 2009

Centro Ettore Majorana Erice, (TP) Italy
OCTOBER 25-31 2009

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Outline of the talk

- I. The Peter Principle: *what it says*
- II. Agent Based Simulations: *the principle in action*
- III. Promotion strategies to overcome it
- IV. Conclusions

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The Peter principle revisited: A computational study

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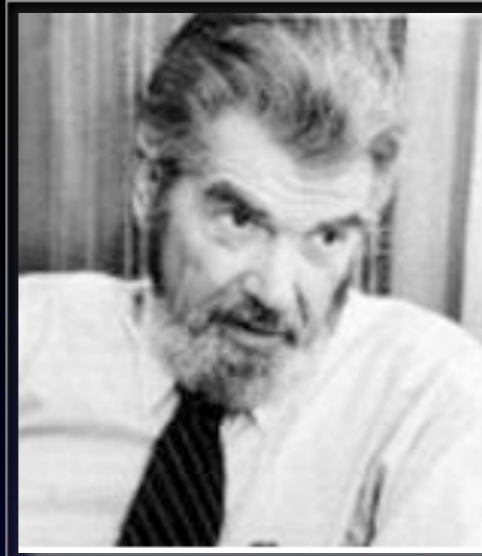
Agent based models

ABSTRACT

In the late sixties the Canadian psychologist Laurence J. Peter advanced an apparently paradoxical principle, named since then after him, which can be summarized as follows: *'Every new member in a hierarchical organization climbs the hierarchy until he/she reaches his/her level of maximum incompetence'*. Despite its apparent unreasonableness, such a principle would realistically act in any organization where the mechanism of promotion rewards the best members and where the competence at their new level in the hierarchical structure does not depend on the competence they had at the previous level, usually because the tasks of the levels are very different to each other. Here we show, by means of agent based simulations, that if the latter two features actually hold in a given model of an organization with a hierarchical structure, then not only is the Peter principle unavoidable, but also it yields in turn a significant reduction of the global efficiency of the organization. Within a game theory-like approach, we explore different promotion strategies and we find, counterintuitively, that in order to avoid such an effect the best ways for improving the efficiency of a given organization are either to promote each time an agent at random or to promote randomly the best and the worst members in terms of competence.

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Lawrence J. Peter



Laurence J. Peter was a Canadian author, educator, psychologist, and management theorist in US.

1919 - Born 16th of September in Vancouver, British Columbia.

1941 - Began his career as a teacher.

1963 - Received the degree of Doctor of Education from Washington State University.

1964 - Peter moved to California, where he became an Associate Professor of Education, Director of the Evelyn Frieden Centre for Prescriptive Teaching and Coordinator of Programs for Emotionally Disturbed Children at the University of Southern California.

1968 - Published the The Peter Principle, in which he states: "In a hierarchy every employee tends to rise to his level of incompetence".

1969-1977 - Co-wrote "The Peter Principle: Why Things Always Go Wrong" 1969, wrote "The Peter Prescription and How to Make Things Go Right" 1972, "The Peter Plan: A Proposal for Survival" 1975, "Peter's Quotations: Ideas for Our Times" 1977.

1990 - Laurence J. Peter died 12th of January.

The Peter Principle

The Peter Principle

In the late sixties Laurence J. Peter advanced an apparently paradoxical principle, named since then after him, which can be summarized as follows:

‘Every new member in a hierarchical organization climbs the hierarchy until he/she reaches his/her level of incompetence’.

It holds that in a hierarchy, members are promoted so long as they work competently. Sooner or later they are promoted to a position at which they are no longer competent (their "level of incompetence"), and there they remain, being unable to earn further promotions.

Peter's Corollary states that "in time, every post tends to be occupied by an employee who is incompetent to carry out his duties" and adds that "work is accomplished by those employees who have not yet reached their level of incompetence".



Is that real ?

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From a personal point of view everyone has good examples:

- A smart researcher who is not able to be a brilliant teacher or a good administrator
- a good worker who is not able to be an efficient manager
- a good soldier who is not able to be a good commander
- and so on...

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Simulations

We verified the validity of the Peter principle by simulating promotions in a hierarchical organization by means of an agent based algorithm

Our schematic organization

We consider here an organization with 160 positions divided into 6 hierarchical levels.

Each level has a different number of members (which decreases, climbing the hierarchy) with a different characteristic responsibility, reported on the left side.

Empty positions are in yellow

Each agent has two parameters:

- age - ranging in the interval [18,60]
- competence - ranging in the interval [1,10]

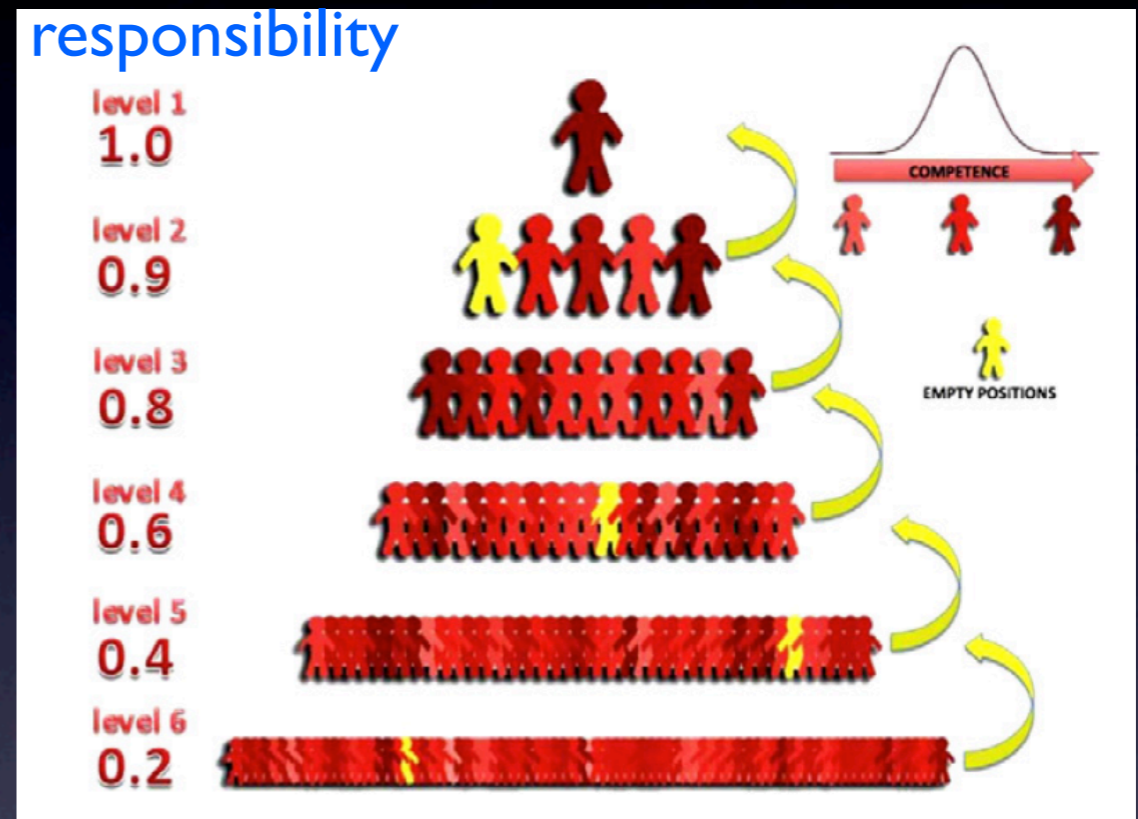
Average age 25 (std dev 5)

Average competence 7 (std dev 2)

The agent color indicates the degree of competence, which at the beginning is normally distributed

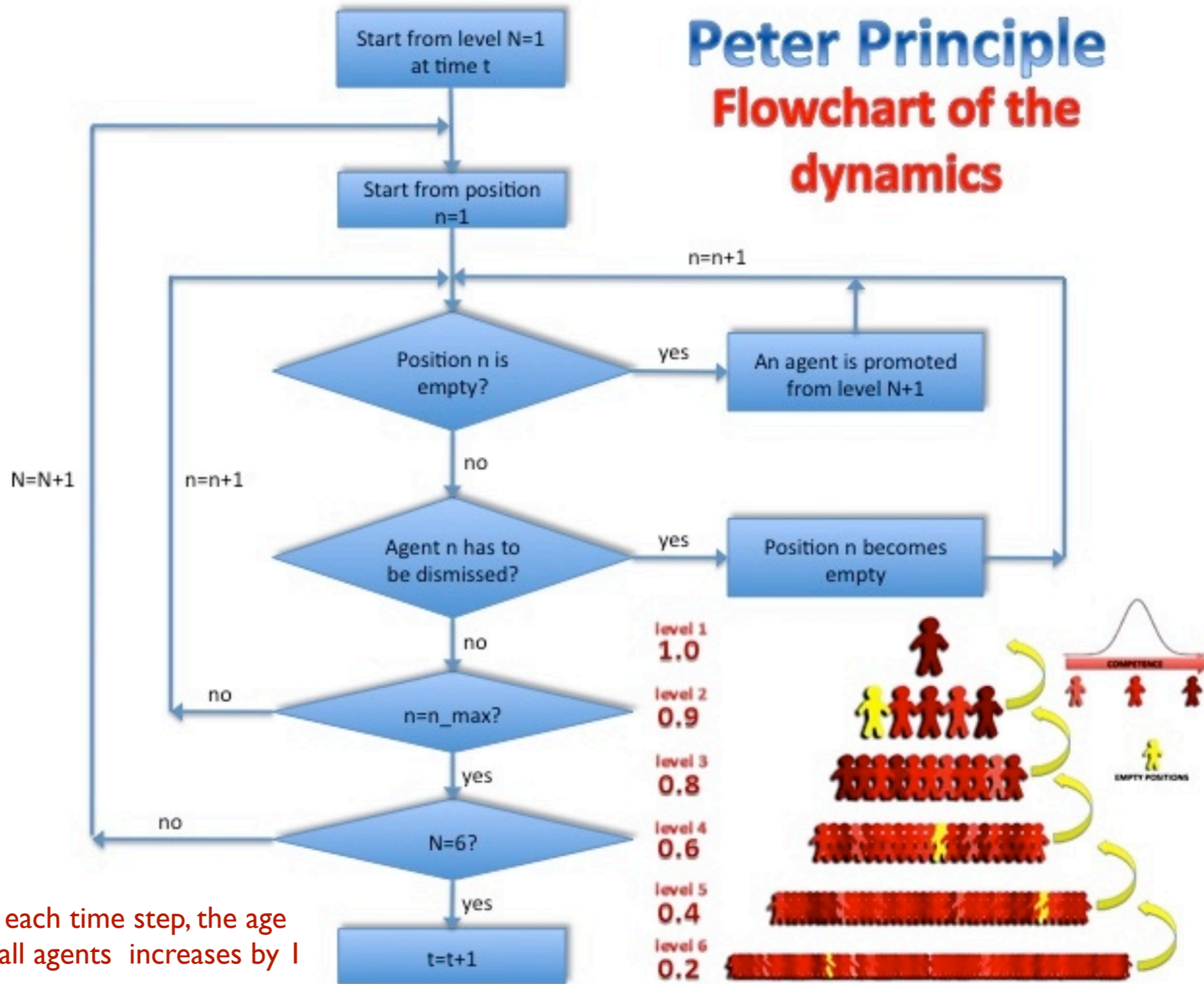
Positions become empty if

age > 60 or competence < 4



Dynamics

Peter Principle Flowchart of the dynamics





simulations

The screenshot displays the NetLogo simulation interface for an organization simulation. It is divided into several sections:

- 1. CREATE ORGANIZATION:** A panel with a 'time' display showing 44.
- 2. ASSIGN AGE AND COMPETENCE:** A series of sliders for 'n-level-1' through 'n-level-6' with values 1, 5, 11, 21, 41, and 81 respectively. It also includes sliders for 'mean-PDF-competence' (7.0), 'stdev-PDF-competence' (2.0), 'retirement-threshold' (60 years), and 'dismissal-threshold' (4.0).
- 3. START SIMULATION:** A panel with a 'PDF-competence' histogram and a 'Plot-Efficiency' line graph showing 'Global Efficiency' increasing from 63.15 to 80.5 over 'time' from 0 to 46.3.
- Control Panels:** Includes 'new-competences' (set to 'Common Sense (+-delta)'), 'delta-comp' (1.0), 'promotion-strategy' (set to 'The Best strategy'), and 'p-parameter' (0.50).
- 3D Visualization:** A 3D view of the organization hierarchy. The top level has 1 member (red). The second level has 5 members (4 red, 1 yellow). The third level has 11 members (10 red, 1 yellow). The fourth level has 21 members (all red). The fifth level has 41 members (all red). The sixth level has 81 members (all red). A legend indicates 'The color intensity is proportional to the competence (4-10)'. On the right, statistics are shown: 'Tot members 160', 'Average Competence (4-10) 7.215', 'initial efficiency % 70.17', and 'global efficiency % 79.84'. A vertical list of response sliders (resp1 to resp6) has values 1, 0.9, 0.8, 0.6, 0.4, and 0.2.

Freeware Software developed by Uri Wilensky at Northwestern University Boston

<http://ccl.northwestern.edu/netlogo/>

Two different hypotheses

Two different hypotheses

- *Common Sense: **the agent** keeps the same competence (with a small random error) when promoted to a higher level*

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Two different hypotheses

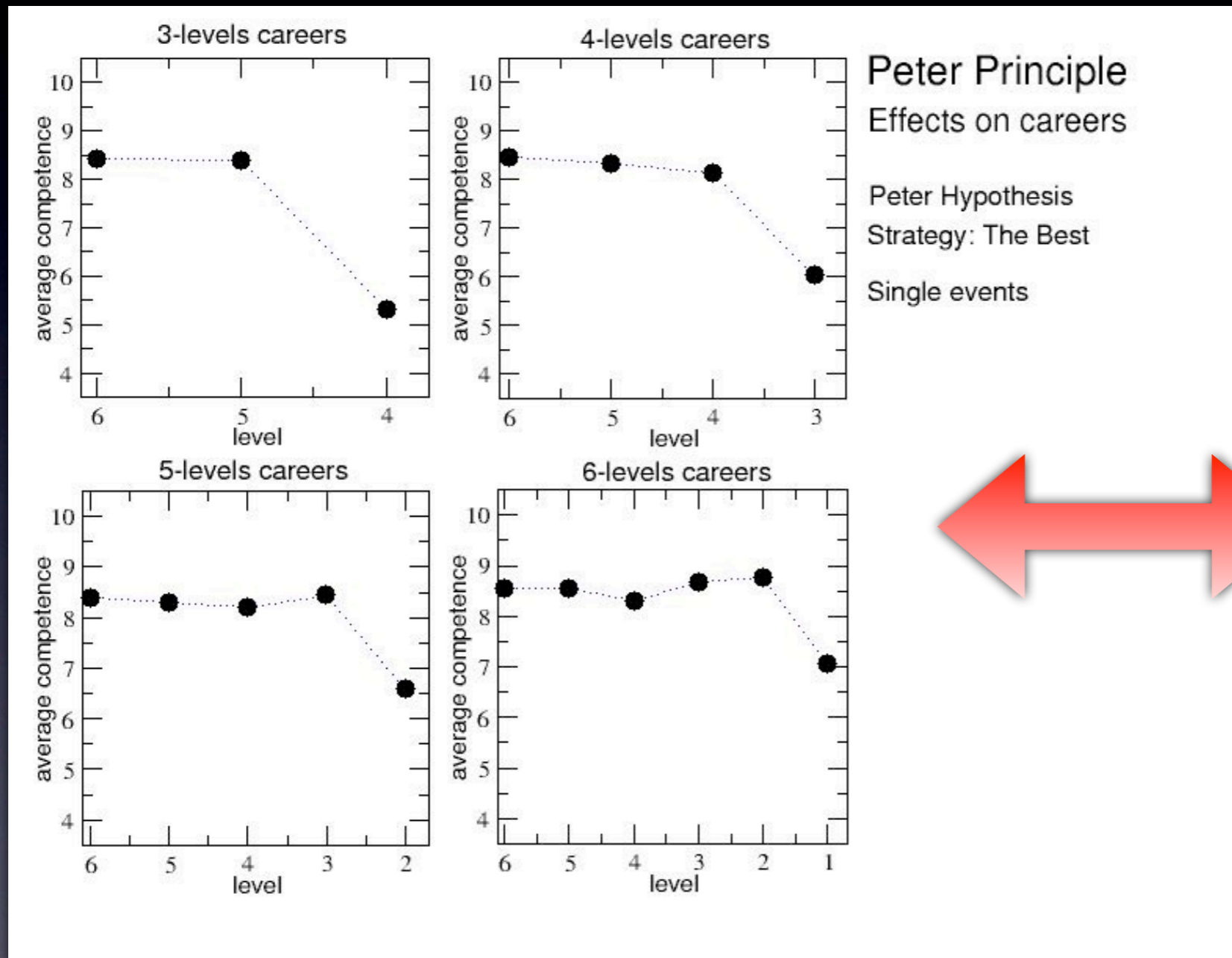
- *Common Sense: **the agent** keeps the same competence (with a small random error) when promoted to a higher level*
- *Peter Hypothesis: **the agent** does not keep the same competence when promoted to a higher level and his new competence is completely random*

Two different hypotheses

- *Common Sense: **the agent** keeps the same competence (with a small random error) when promoted to a higher level*
- *Peter Hypothesis: **the agent** does not keep the same competence when promoted to a higher level and his new competence is completely random*

First results on careers

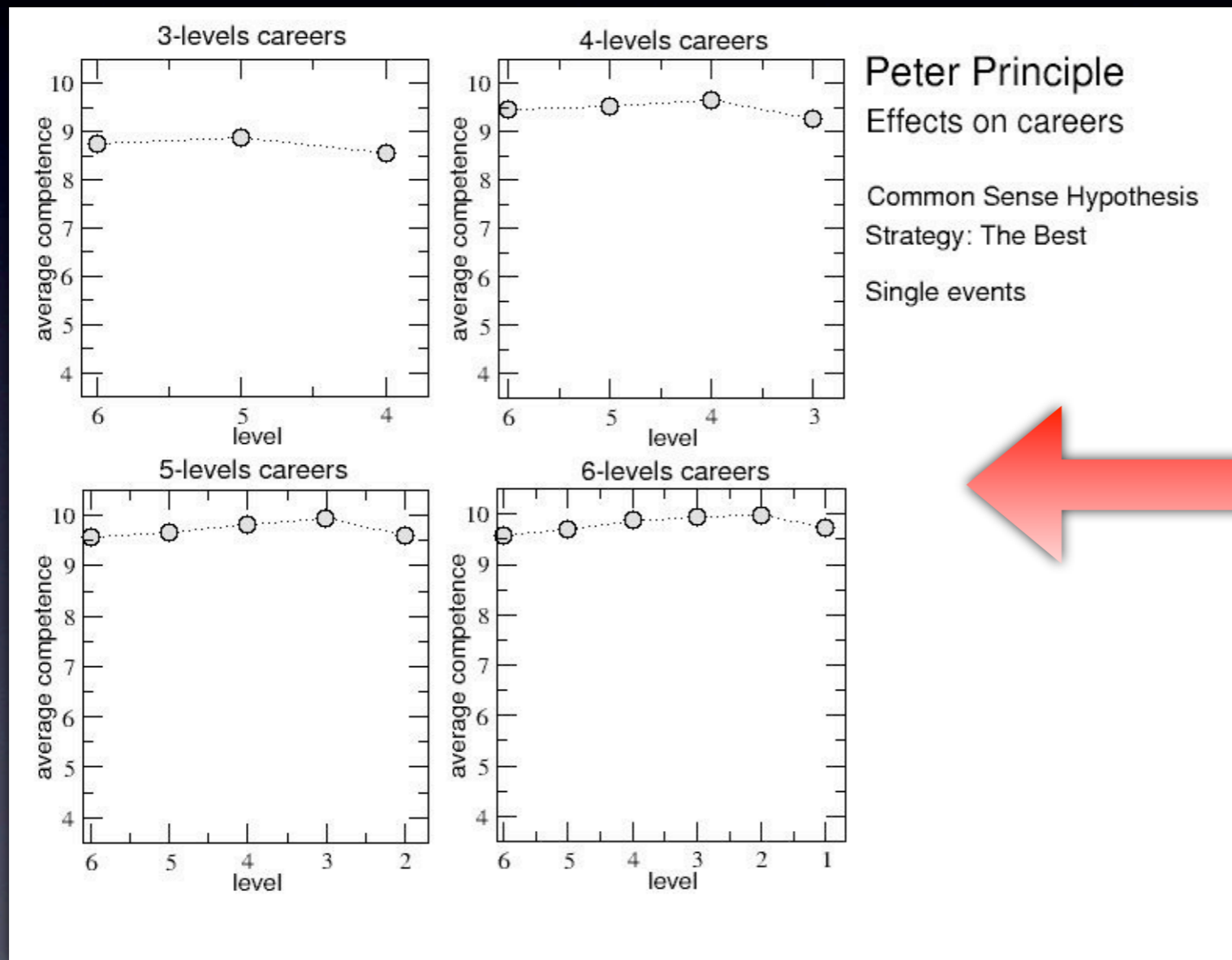
The principle in action: Peter hypothesis



Peter Principle
Effects on careers
Peter Hypothesis
Strategy: The Best
Single events

The agent reaches his minimum of competence or his maximum level of incompetence at the end of his career...if one promotes *the best*

The principle in action: *Common sense*



Peter Principle

Effects on careers

Common Sense Hypothesis

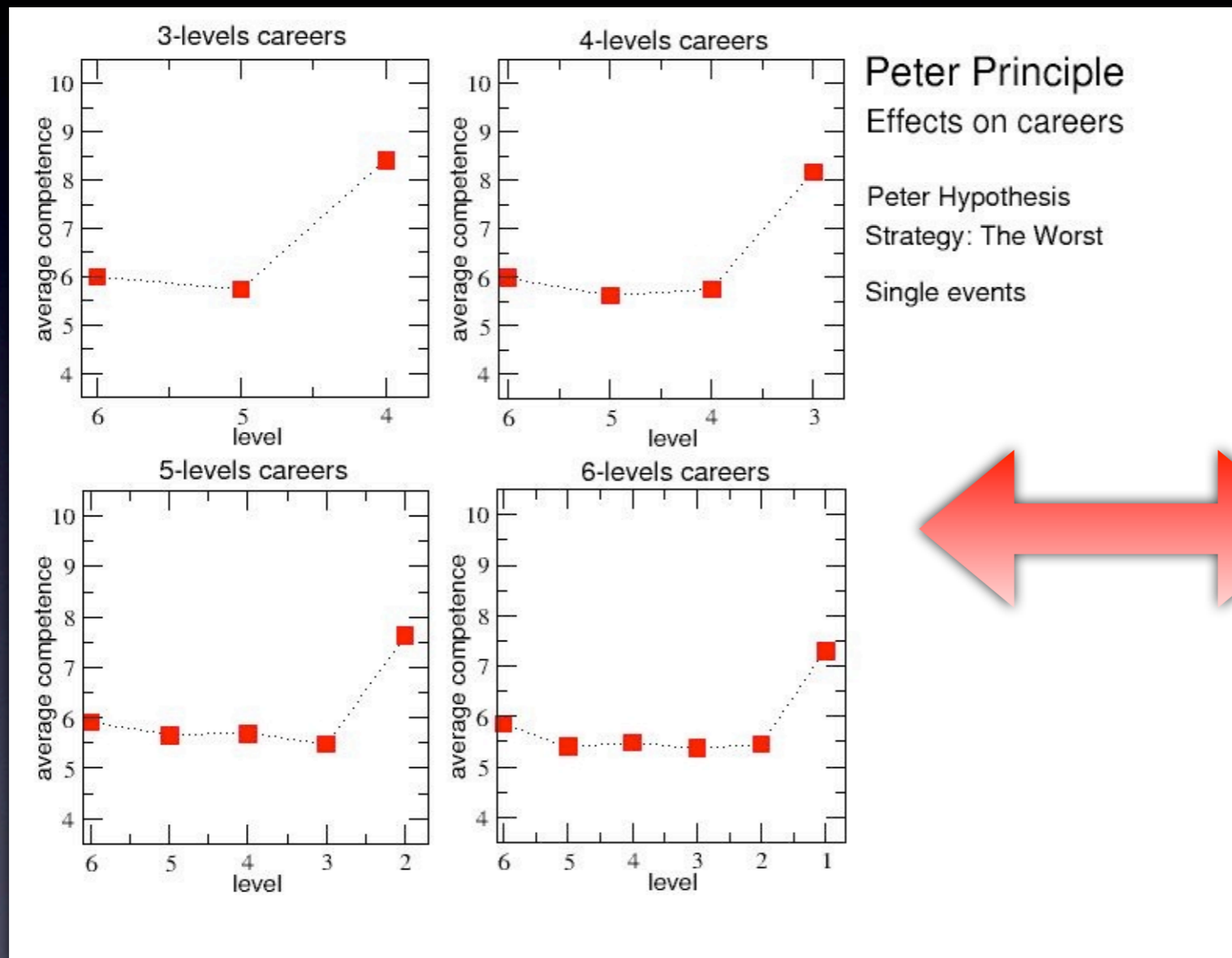
Strategy: The Best

Single events



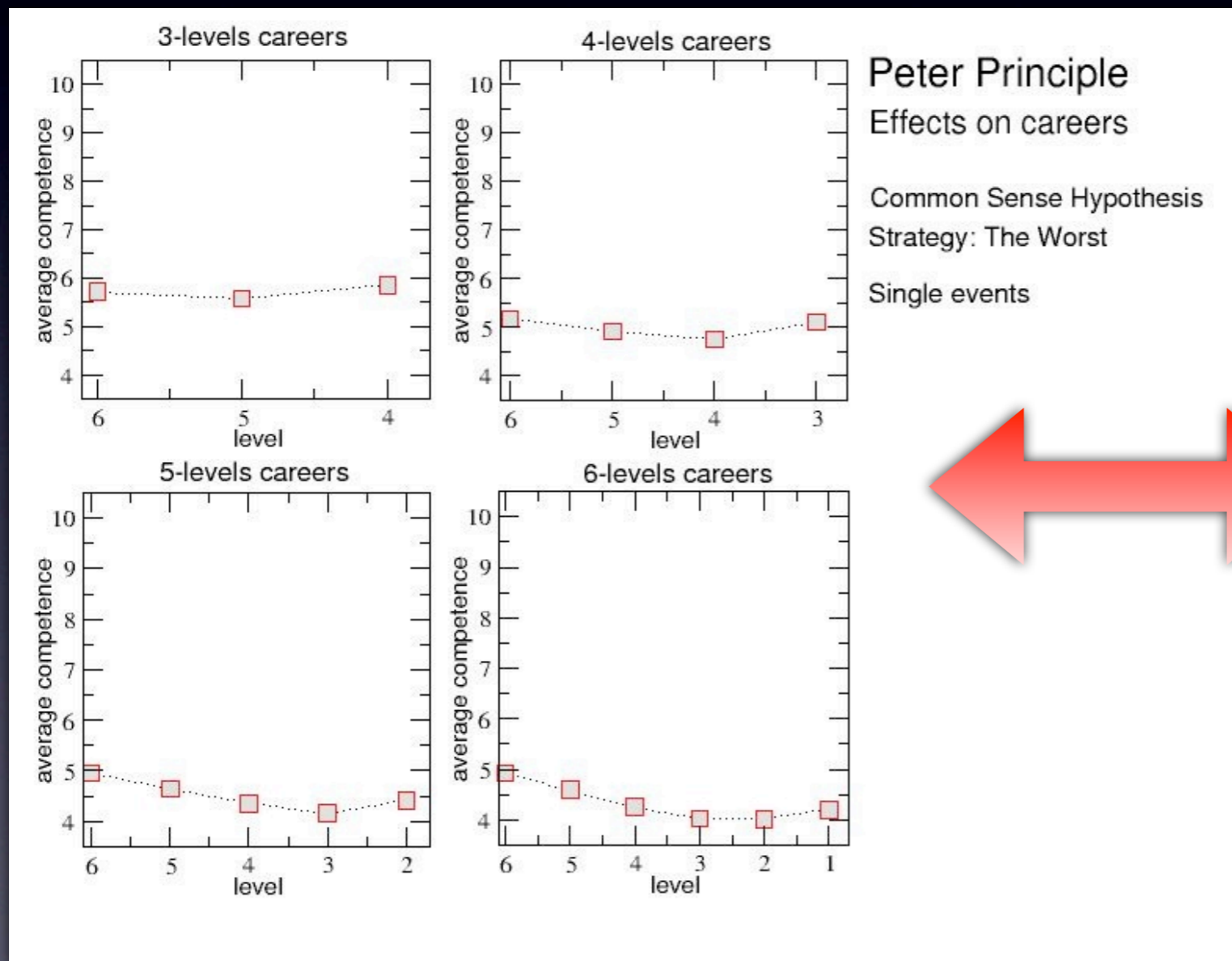
The competence remains almost constant if one promotes *the best*

On the other side, within Peter hypothesis....



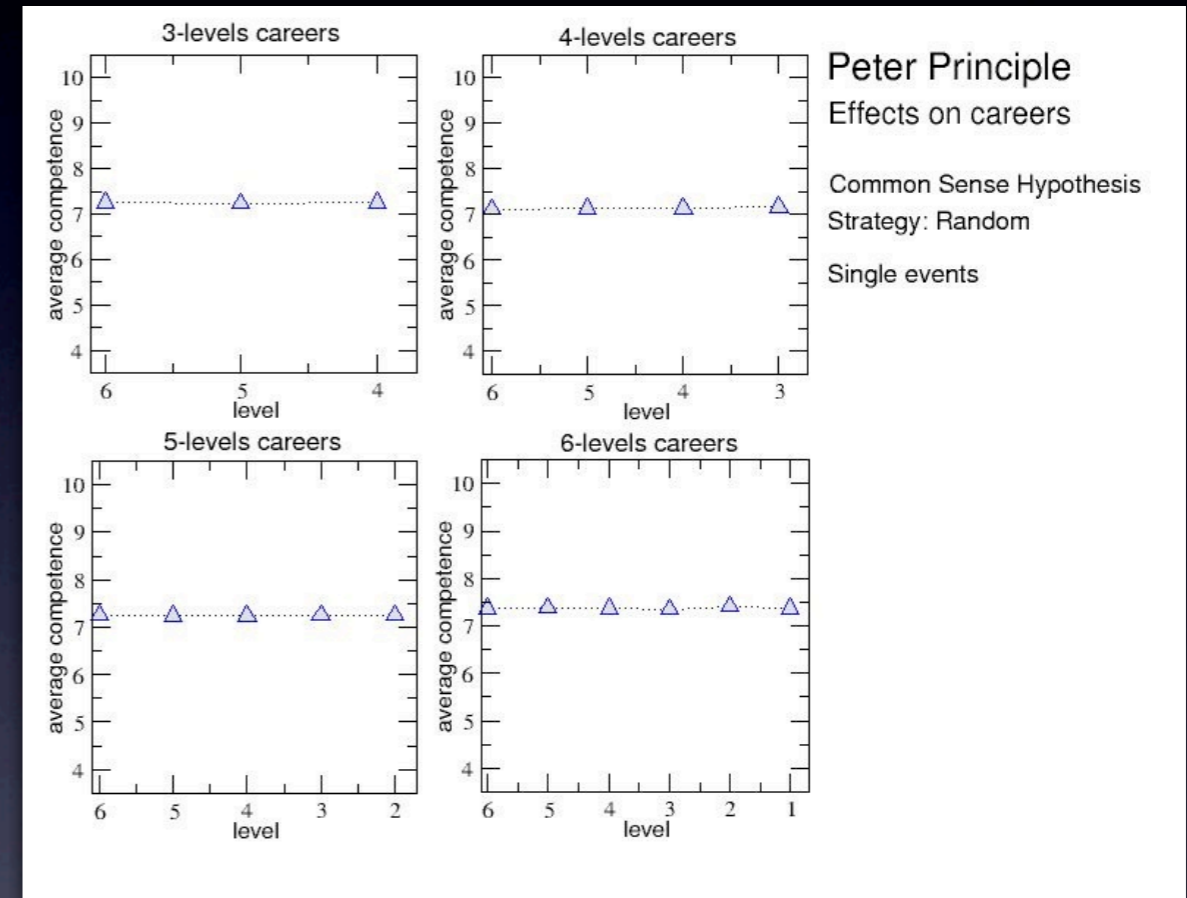
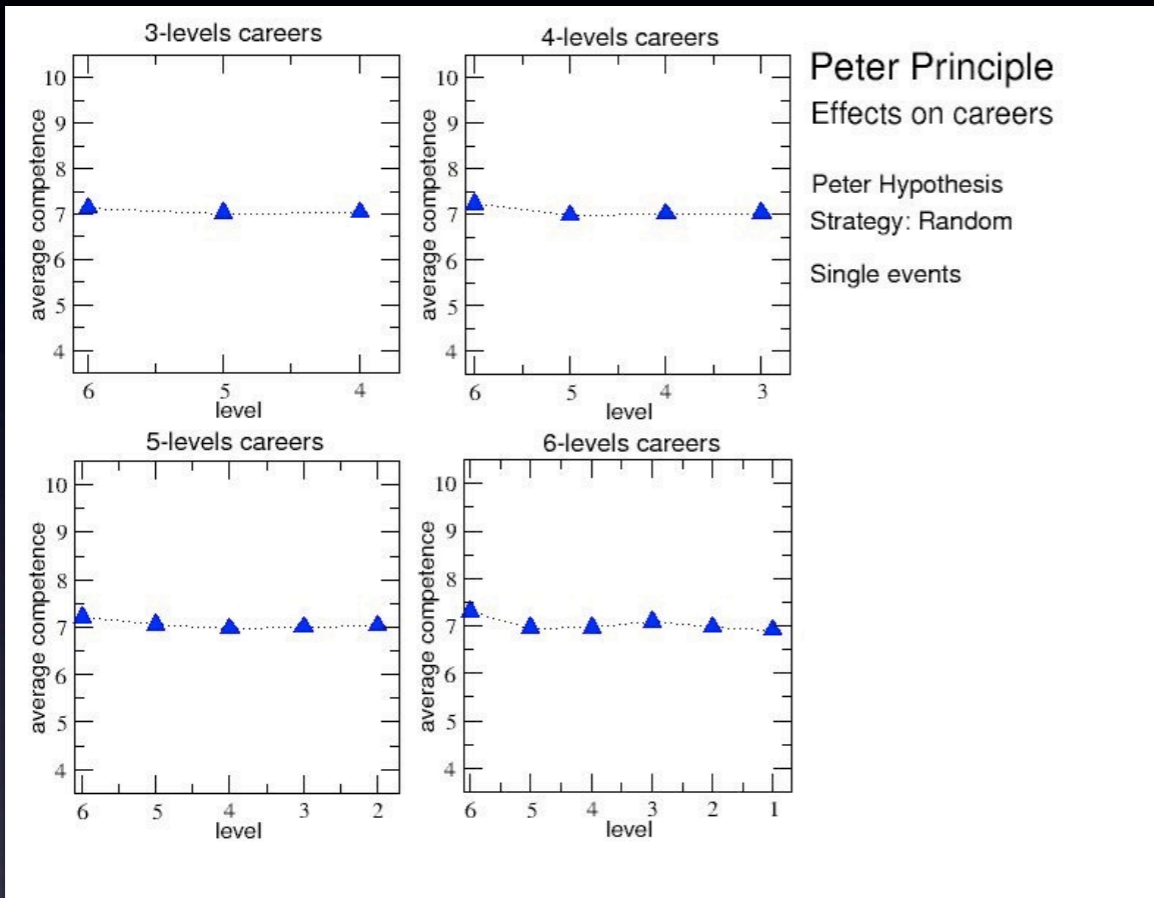
The agent reaches his maximum of competence at the end of his career...if one promotes *the worst*

while in the Common Sense hypothesis...



The competence remains almost constant...if one promotes *the worst*

In both cases the competence remains constant for a random promotion strategy



But what happens for
the global efficiency of
your organization ?

Global Efficiency

One can define the global efficiency of the system by adopting the following formula

$$E(\%) = \frac{\sum_{i=1}^6 C_i r_i}{E_{max}} \cdot 100$$

where

r_i with $i = 1, 2, \dots, 6$

is the level dependent factor of responsibility

C_i with $i = 1, 2, \dots, 6$

total competence of the level i

E_{max}

maximal value of the efficiency obtained considering the maximal competence for all agents

online applet

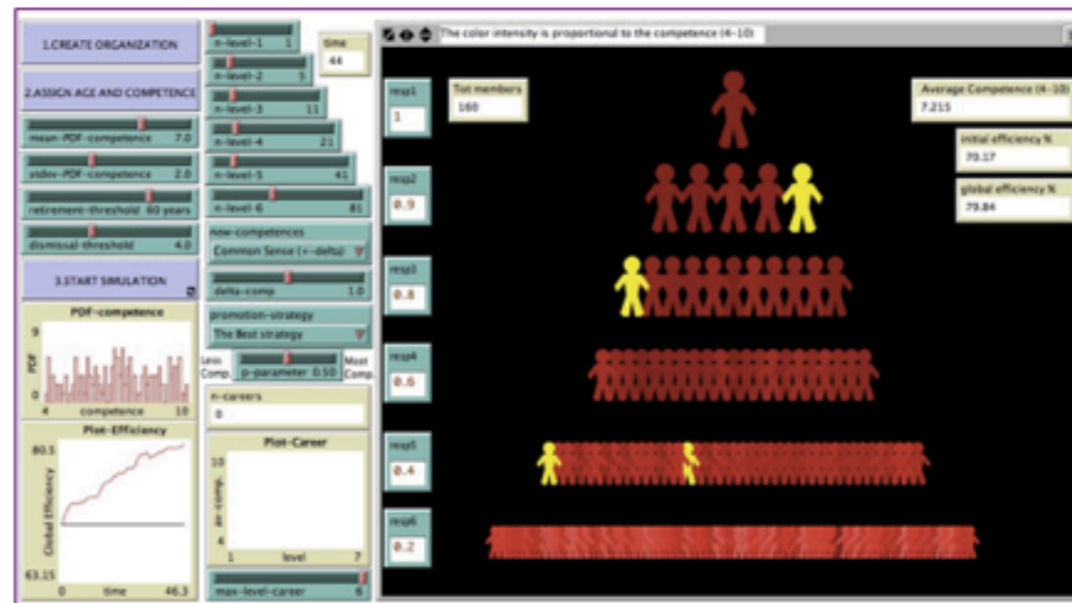
http://www.ct.infn.it/cactus/peter_principle_sup_material.html

Who should you promote to improve the efficiency of your organization?

"Peter Principle Revisited: a Computational Study" by A.Pluchino, A.Rapisarda and C.Garofalo, Physica A 2009, in press (doi:10.1016/j.physa.2009.09.045)

[Versione in Italiano qui](#)

Click on the image below to start the Java applet



WHAT IS IT?

In the late sixties the Canadian psychologist Laurence J. Peter advanced the apparently paradoxical principle which can be summarized as follows: 'Every new member in a hierarchical organization climbs the hierarchy until he reaches his level of maximum incompetence'. Despite its apparent unreasonableness, such a principle would realistically act in any organization where the way of promotion rewards the best members and where the competence at their new level in the hierarchical structure does not depend on the competence they had at the previous level, usually because the tasks of the levels are very different between each other. This applet, realized with NetLogo, shows that if the latter two features actually hold in a given model of an organization with a hierarchical structure, then not only the 'Peter principle' is unavoidable, but it yields in turn a significant reduction of the global efficiency of the organization.

HOW IT WORKS

The applet consider a prototypical pyramidal organization made by six levels, where each agent is characterized by an 'age', increasing in time, and by a 'degree of competence', which is represented by a colour scale of increasing intensity and which includes all the features characterizing the average performance of the agent in a given position at a given level. At each time step all the agents with a competence under a given dismissal-threshold or with an age over a given retirement-threshold leave the organization and their positions become empty (yellow). Simultaneously, any empty position at a given level is filled by promoting one member from the level immediately below, going down progressively from the top of the hierarchy until the bottom level has been reached. Finally, empty positions at the bottom level are filled with the recruitment of new members. The applet provides two possible ways for the transmission of the competence of an agent from one level to the next one: the 'common sense hypothesis', where a member inherits his old competence in his new position with a small random variation δ delta, and the 'Peter hypothesis', where the new competence of every agent is independent from the old one and is assigned randomly. For each one of these two ways exist three different ways for choosing the agent to promote at the next level: the most competent ('The Best' strategy, suggested by the common sense and adopted also in the Peter principle), the less competent ('The Worst' strategy) or one agent at random ('Random' strategy). In order to evaluate the global performance of the organization was introduced a parameter, called 'global efficiency', calculated step by step by summing the competences of the members level by level, multiplied by a level-dependent factor of responsibility ranging from 0 to 1 and increasing by climbing the hierarchy (such a factor takes into account the weight that the performance of the agents of different levels have on the global efficiency of the organization). The result is normalized to its maximum possible value and to the total number of agents, so that the global efficiency can be expressed in percentage.

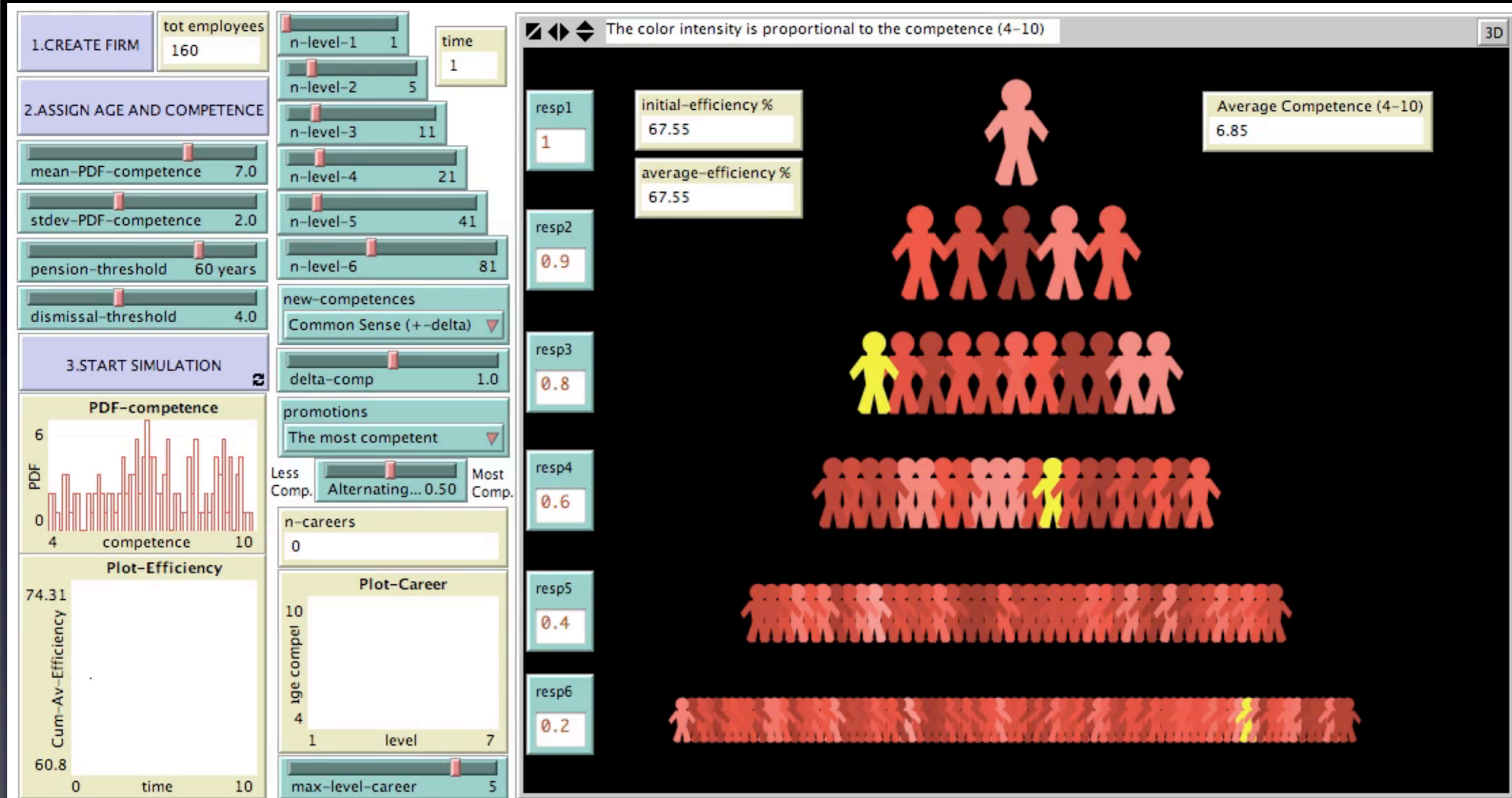
CREDITS

This applet was realized by A.Pluchino, Department of Physics and Astronomy, University of Catania, and it is provided as supplementary information for the paper "Peter Principle Revisited: a Computational Study" by A.Pluchino, A.Rapisarda and C.Garofalo, Physica A 2009, in press

Results for the organization efficiency

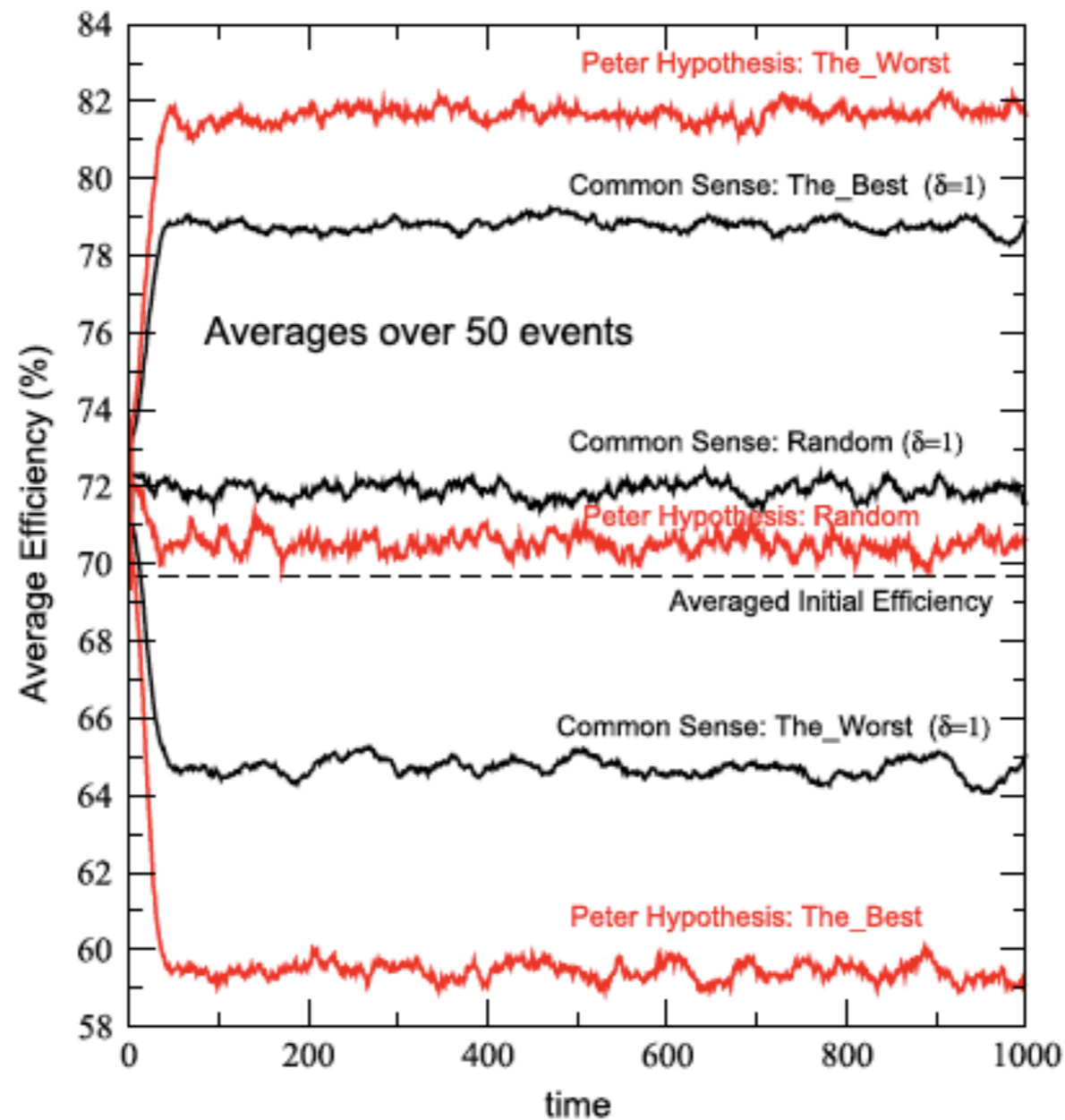
http://www.ct.infn.it/cactus/peter_principle_sup_material.html

Results for the organization efficiency



http://www.ct.infn.it/cactus/peter_principle_sup_material.html

Efficiency time evolution for different strategies



winning strategies

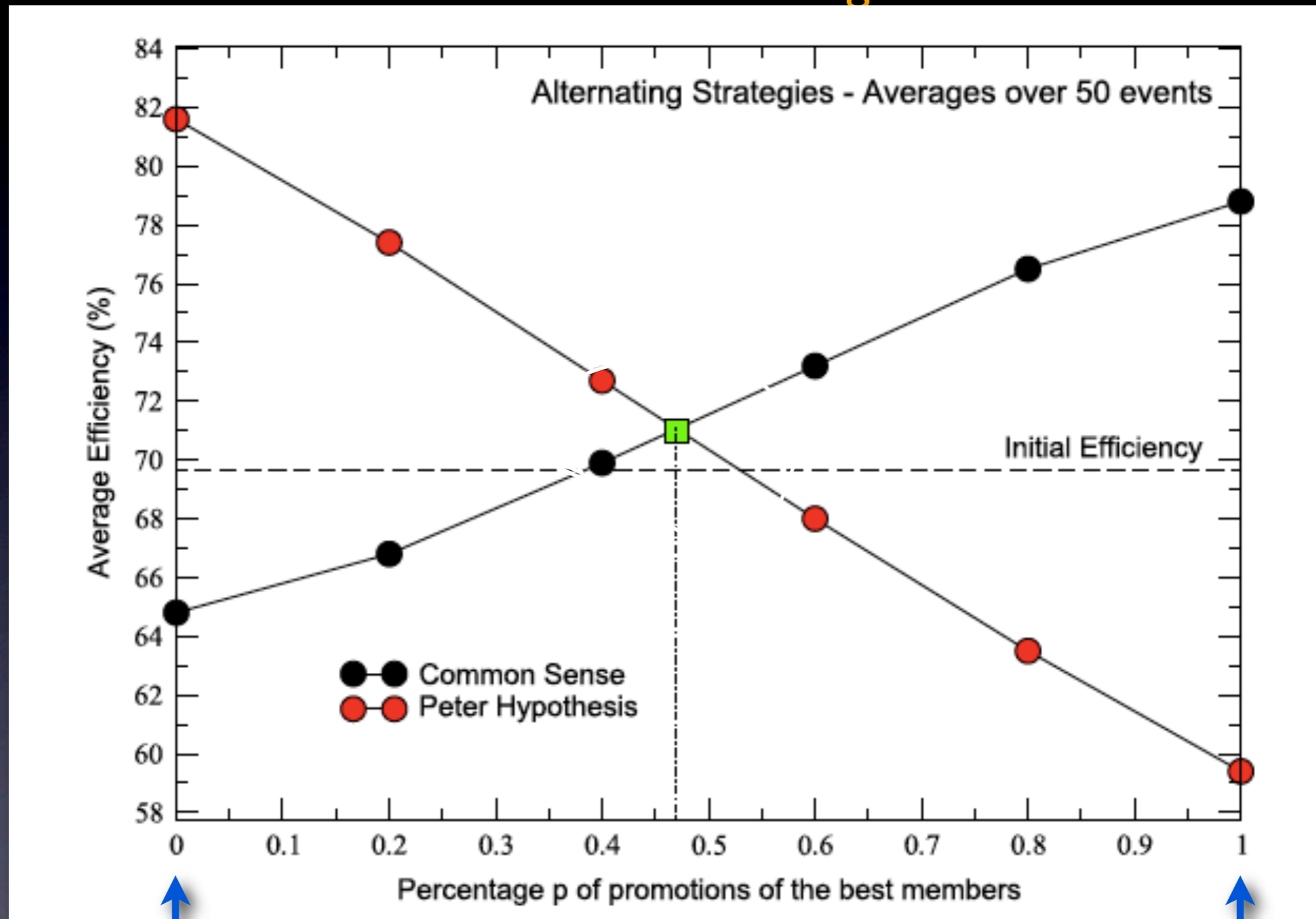
losing strategies

initial efficiency

In general one does not know with certainty which hypothesis (*Common Sense* or *Peter Hypothesis*) is more valid for the organization one wants to study

If one wants to maximize the global efficiency or at least minimize the risk for diminishing it in both cases, then the *random promotion strategy* seems to be the *best solution*

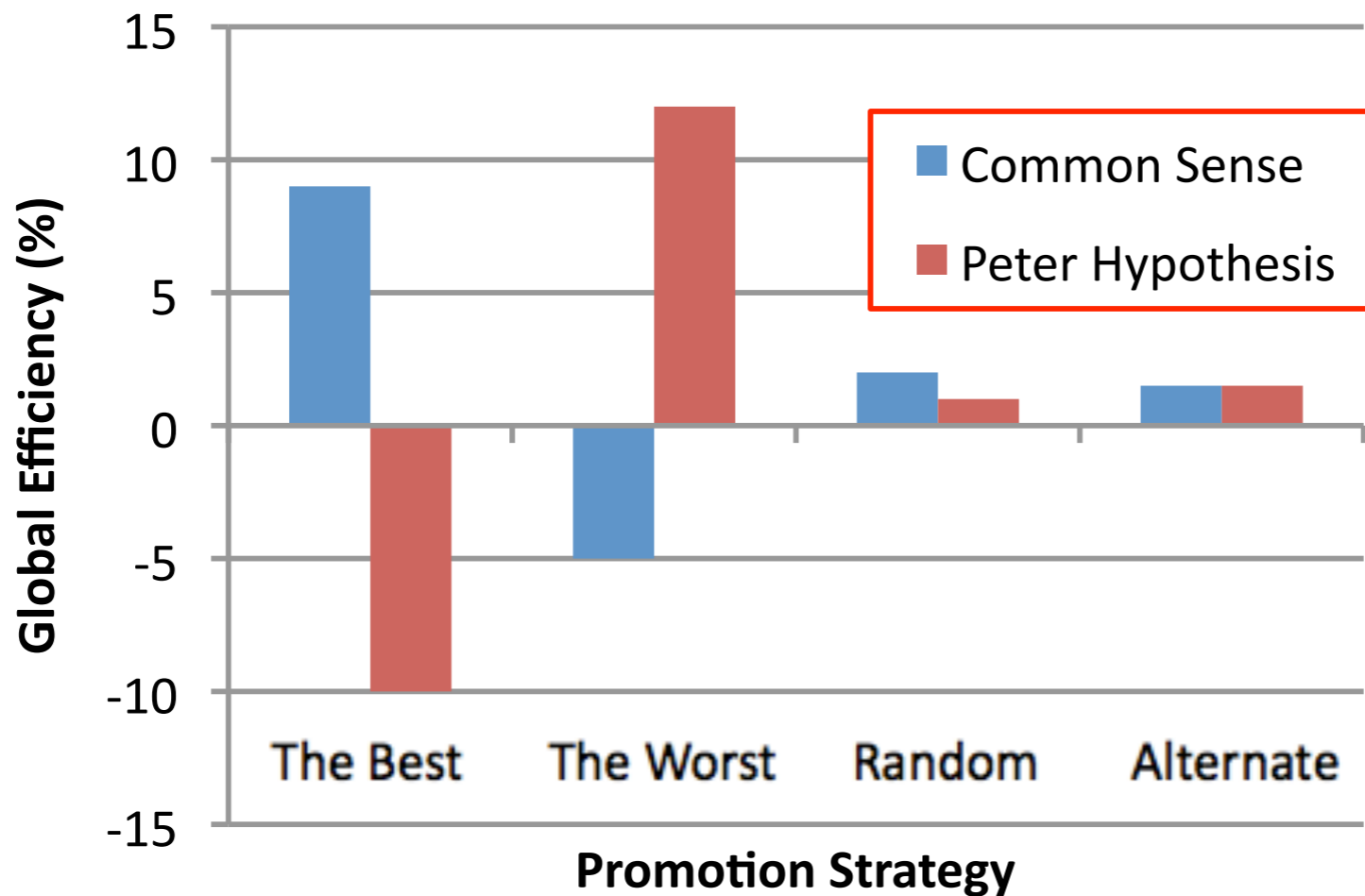
Another possible solution is...alternating the promotion of the best and the worst agent



The Worst strategy

The Best strategy

Summary of the results for different promotion strategies



These results are quite robust with respect to the numbers of agents and the number of levels of the hierarchy

The Generalized Peter Principle

The Peter Principle is a special case of a more general statement:

“Anything that works will be used in progressively more challenging applications until it fails.”

This is "The Generalized Peter Principle."

So we can imagine applications for

1. Objects or tools of various kind
2. Clusters of personal computers: Grid
3. Models, Theories, Ideas
4. etc.

Experimental confirmation

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Is it possible to make some real experiment?

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Difficult for a real firm, but...

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- with small non-profit groups
- with scientific groups
- with pc clusters within the Grid project

Concluding remarks

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- For the future:

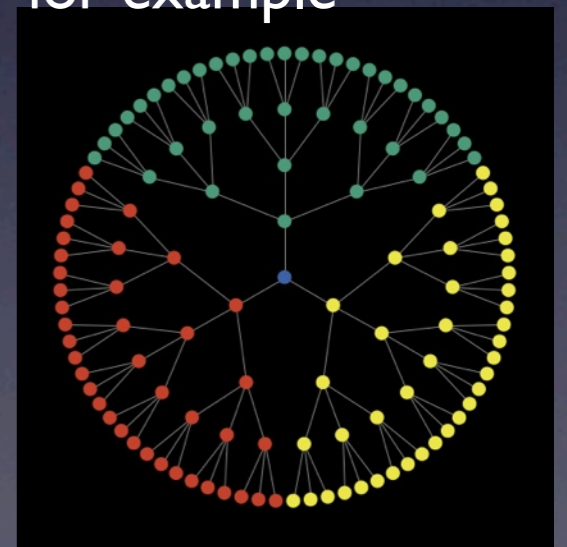
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 - study other possible promotion strategies

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- **Good news:** there are possible strategies to overcome it
- The principle can be generalized and these results can be applied to different scenarios in order to improve the efficiency of the system under investigation
- **For the future:**
 - study other possible promotion strategies
 - investigate organizations with a different structure

for example



On-line debates

The paper has stimulated interesting debates already before publications

It has been cited among many others by **MIT Technology Review**

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the physics arXiv blog

Monday, July 06, 2009

Why Incompetence Spreads through Big Organizations

Promoting the people most competent at one job does not mean that they'll be better at another, according to a new simulation of hierarchical organizations.

There's a paradox at the heart of most Western organizations. The people who perform best at one level of an organization tend to be promoted on the premise that they will also be competent at another level within the organization. I imagine that most readers will have had personal experience at the way that this hypothesis fails in practice.

In 1969, a Canadian psychologist named Laurence Peter encapsulated this behavior in a rule that has since become known as Peter's Principle. Here it is:

"All new members in a hierarchical organization climb the hierarchy until they reach their level of maximum incompetence."

That's not as unfair as it sounds, say Alessandro Pluchino and buddies from Universita di Catania, who have modeled this behavior using an agent-based system for the first time. They say that common sense tells us that a member who is competent at a given level will also be competent at a higher level of the hierarchy. So it may well seem a good idea to promote such an individual to the next level.

The problem is that common sense often fools us. It's not so hard to see that a new position in an

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The Peter Principle Revisited: A Computational Study (Two solutions)

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The Peter Principle Revisited: A Computational Study (Two solutions)

Edited on Sat Jul-04-09 10:29 AM by bananas

They found two solutions for the Peter Principle.

[Solving the Peter Principle? One Word: "Darts"](#)
By Paul Kedrosky · Friday, July 3, 2009 ·

There is a fun new working paper out from some Italian scientists that models the Peter Principle. The principle says, of course, that people climb in an organization until they reach their level of maximum incompetence.

<snip>

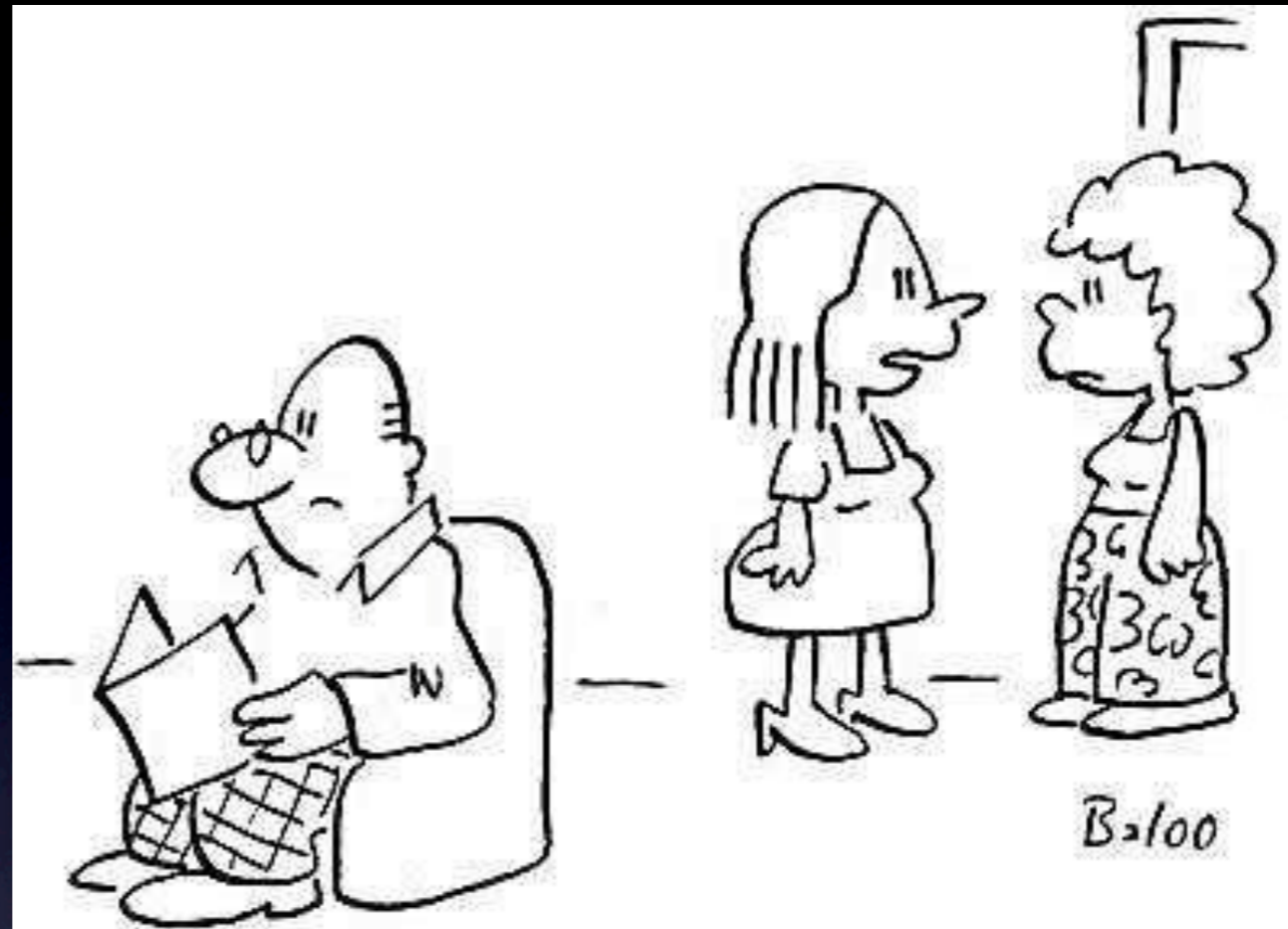
The authors simulated the preceding in a pyramidal organizational form using a mathematical agent model. Here is the outcome:

Here we show, by means of agent based simulations, that if the (above two conditions) actually hold in a given model of an organization with a hierarchical structure, then not only the "Peter principle" is unavoidable, but it yields in turn a significant reduction of the global efficiency of the organization.

...the best strategies to improve, or at least not to diminish, the efficiency of an organization, when one ignores the actual way of competence transmission, are those of promoting an agent at random or of randomly alternating the promotion of the best and the worst members. We think that these results could be useful to guide the management of large real hierarchical systems of different nature and in different fields.

<snip>

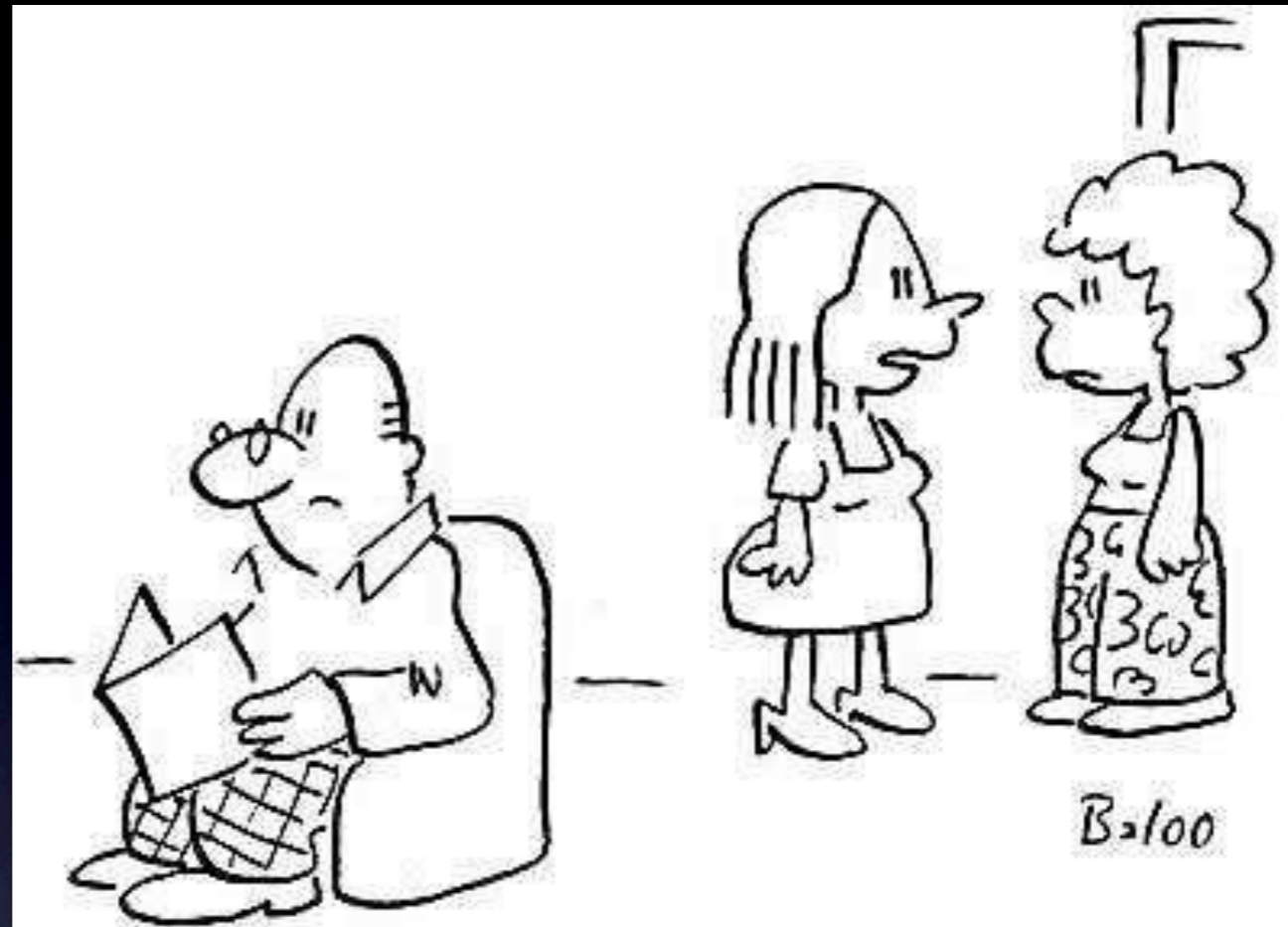
The principle according to a disappointed wife...



"I'd heard about the Peter Principle, of course, but I never really understood it till I got married."

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The principle according to a disappointed wife...



"I'd heard about the Peter Principle, of course, but I never really understood it till I got married."

Thanks