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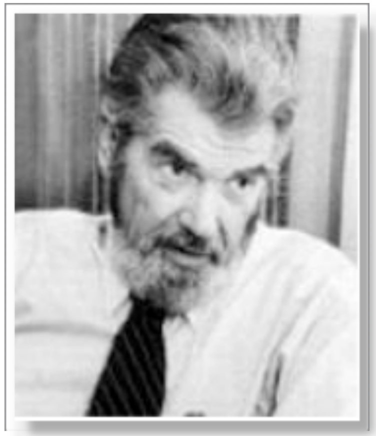
The Peter Principle Revisited: a Computational Study

"Who should you promote to increase the efficiency of your organization?"

Common sense answer: within the reasonable **assumption** that a member who is competent at a given level will be competent also at an higher level of the hierarchy, it seems a good deal to **promote the best member** from the lower level!

But is such an assumption always valid?

The Peter Hypothesis



In the late sixties **Laurence J. Peter**, a Canadian author, educator, psychologist and management theorist in US, **put into question** such a common sense assumption by observing that a new position in a given organization usually requires **different work skills** for effectively performing the new task (often completely different from the previous one).

Therefore, the **Peter hypothesis** was that the competence of a promoted member at the new level could be **uncorrelated** to that at the previous one.

The Peter Principle

On the basis of his hypothesis 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*"

L. J. Peter and R. Hull, "**The Peter Principle: Why Things Always Go Wrong**", William Morrow and Company, New York (1969).

Actually, in a hierarchy, members are promoted as long as they work competently. But, following the Peter hypothesis, sooner or later they will be promoted to a position at which they will be no longer competent (their "**level of incompetence**"), and there they will remain, being unable to earn further promotions!

Peter's Corollary states that incompetence spreads over the organization since "*in time, every position 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 Peter's effect real ?

In our personal experience everyone of us can find good examples of the Peter Principle:

- a good researcher who is not necessarily a brilliant teacher...
- a good worker who is not necessarily an efficient manager...
- a good soldier who is not necessarily a good commander...
- and a successful entrepreneur who is not necessarily a good prime minister...

Several reflections on bureaucratic inefficiency have been carried out in the context of social science, politics and business management, some of which were directly inspired by the Peter principle and with the purpose of circumventing its adverse effects (see J.Kane, 1970; S.Adams, 1996; E.P.Lazear, 2001; D.L.Dickinson et al., 2007; P.Klimek et al. 2009).

However, as far as we know, we still lack a computational study that not only would reproduce the Peter principle dynamics, but also would allow, in particular, the exploration of alternative strategies in order to find the best way for improving the efficiency of a given organization.

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The Peter principle revisited: A computational study

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A R T I C L E   I N F O

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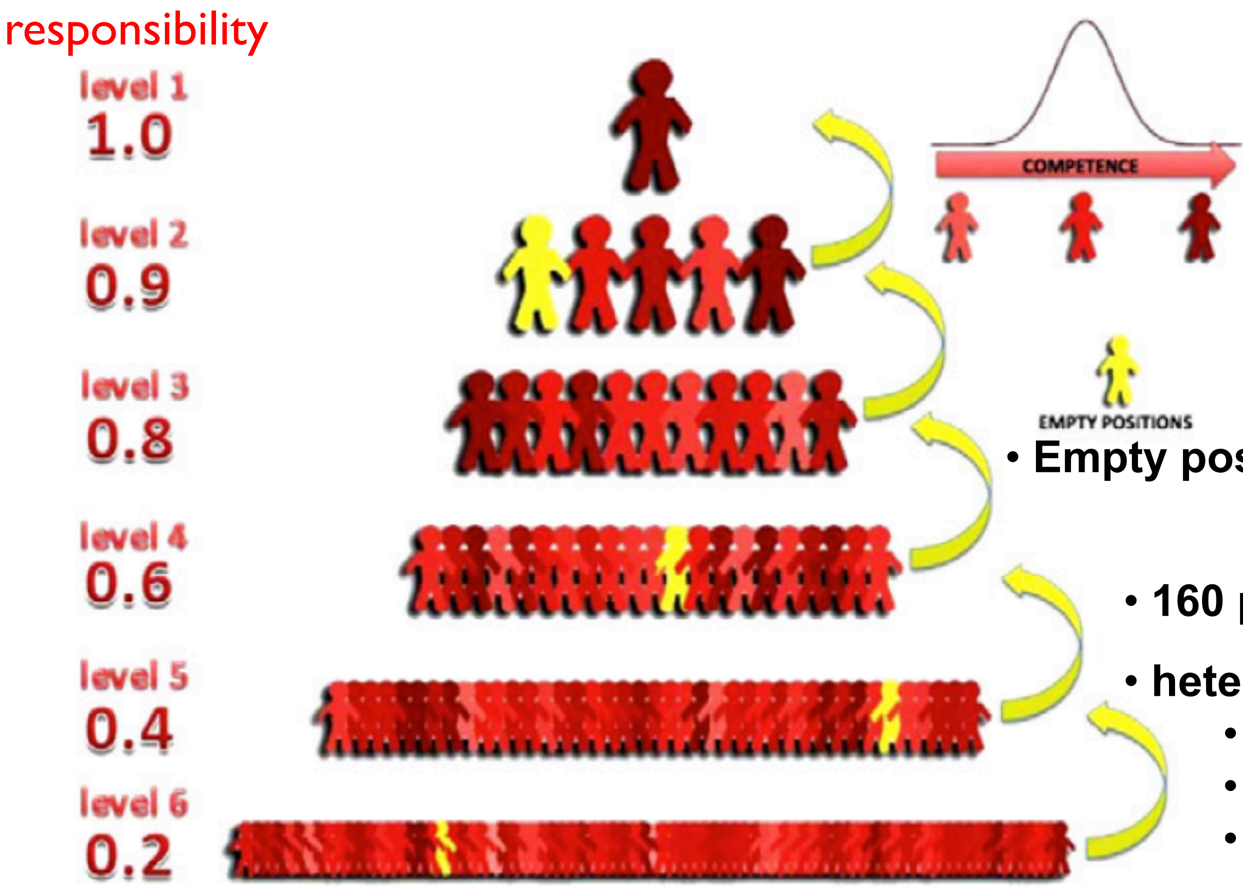
A B S T R A C T

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.

Agent Based Simulation of a prototypical hierarchical organization



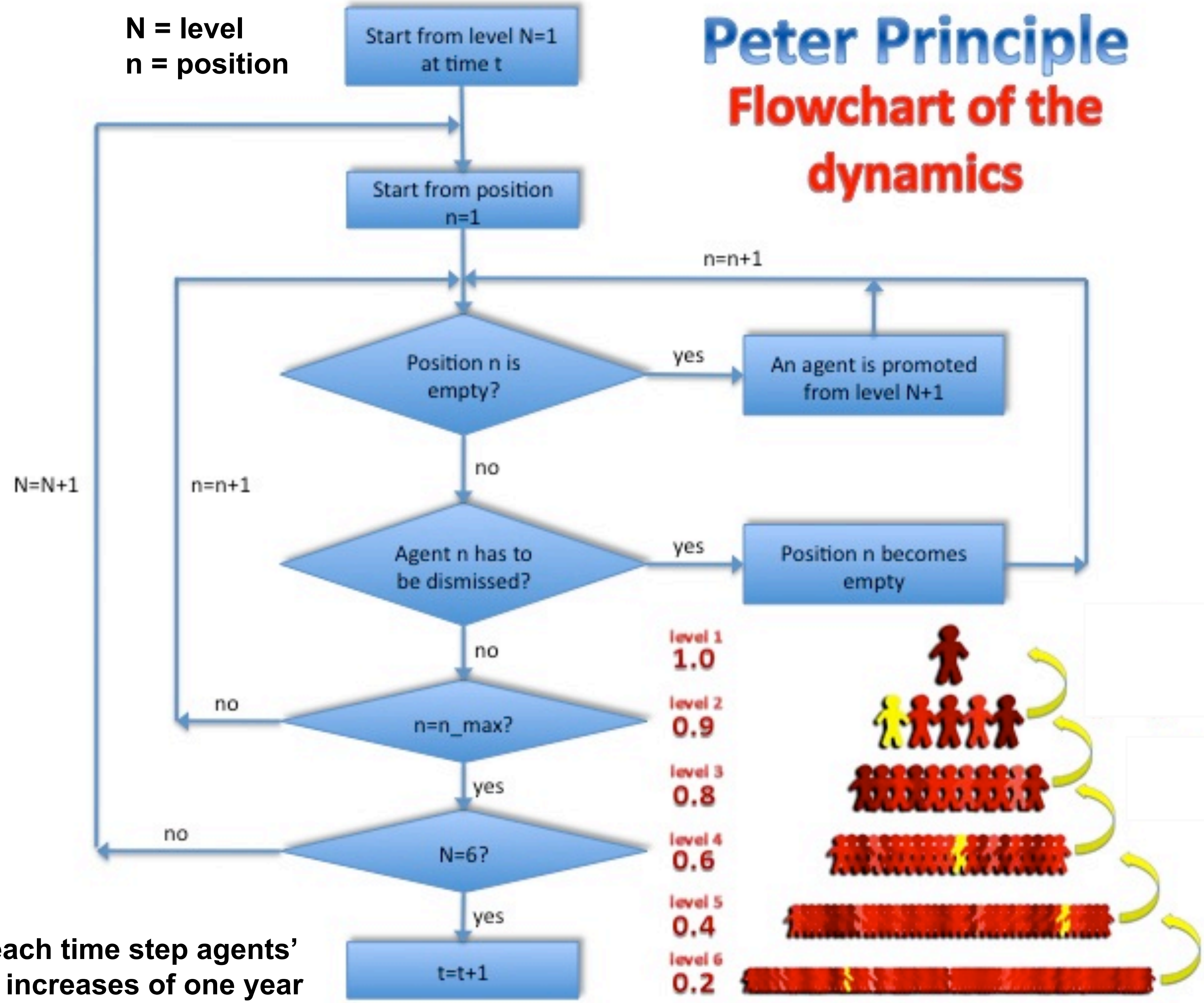
Initial conditions and new engagements:
normal distribution for both
age (average 25y - std-dev 5y)
and
competence (average 7 - std-dev 2)

- **Empty positions** are in yellow
  - **age > 60 years** (retired)
  - **competence < 4** (dismissed)
- **160 positions** over **6 levels;**
- **heterogeneous agents** characterized by:
  - **age** (18-60 years)
  - **competence** (1-10, red intensity)
  - **responsibility** (0.2-1.0)
- the term "**competence**" includes all the features characterizing the average performance of an agent in a given position at a given level

NetLogo
http://ccl.northwestern.edu/netlogo/

Peter Principle
Flowchart of the dynamics

N = level
n = position



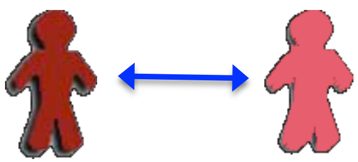
At each time step agents' age increases of one year

Four strategies for selecting the member to promote at an higher level

•***The Best :*** it is selected the most competent member of the previous level

•***The Worst :*** it is selected the less competent member of the previous level

•**Random :** it is selected a member randomly chosen from the previous level (uniform distrib.)

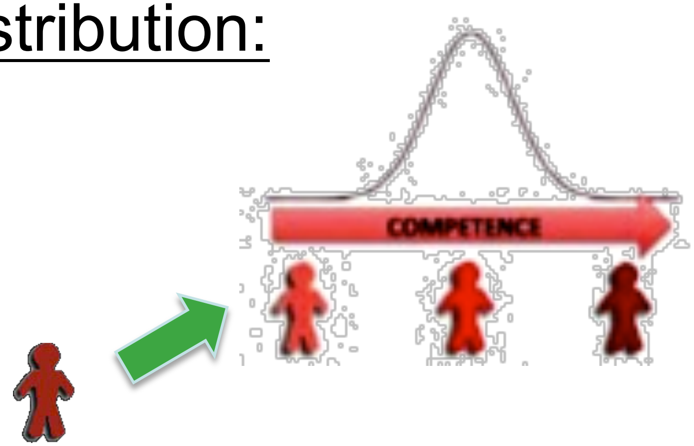


•**Alternate :** it is selected the best and the worst member of the previous level, with probability, respectively, p and (1 – p)

Two hypothesis for competence transmission

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

- ***Peter Hypothesis***: each agent does not keep the same competence when promoted to a higher level and his new competence is randomly chosen from a normal distribution:



Normal distribution
average 7
std-dev 2

Evaluation of the organization efficiency

We define the Global Efficiency of the organization as:

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

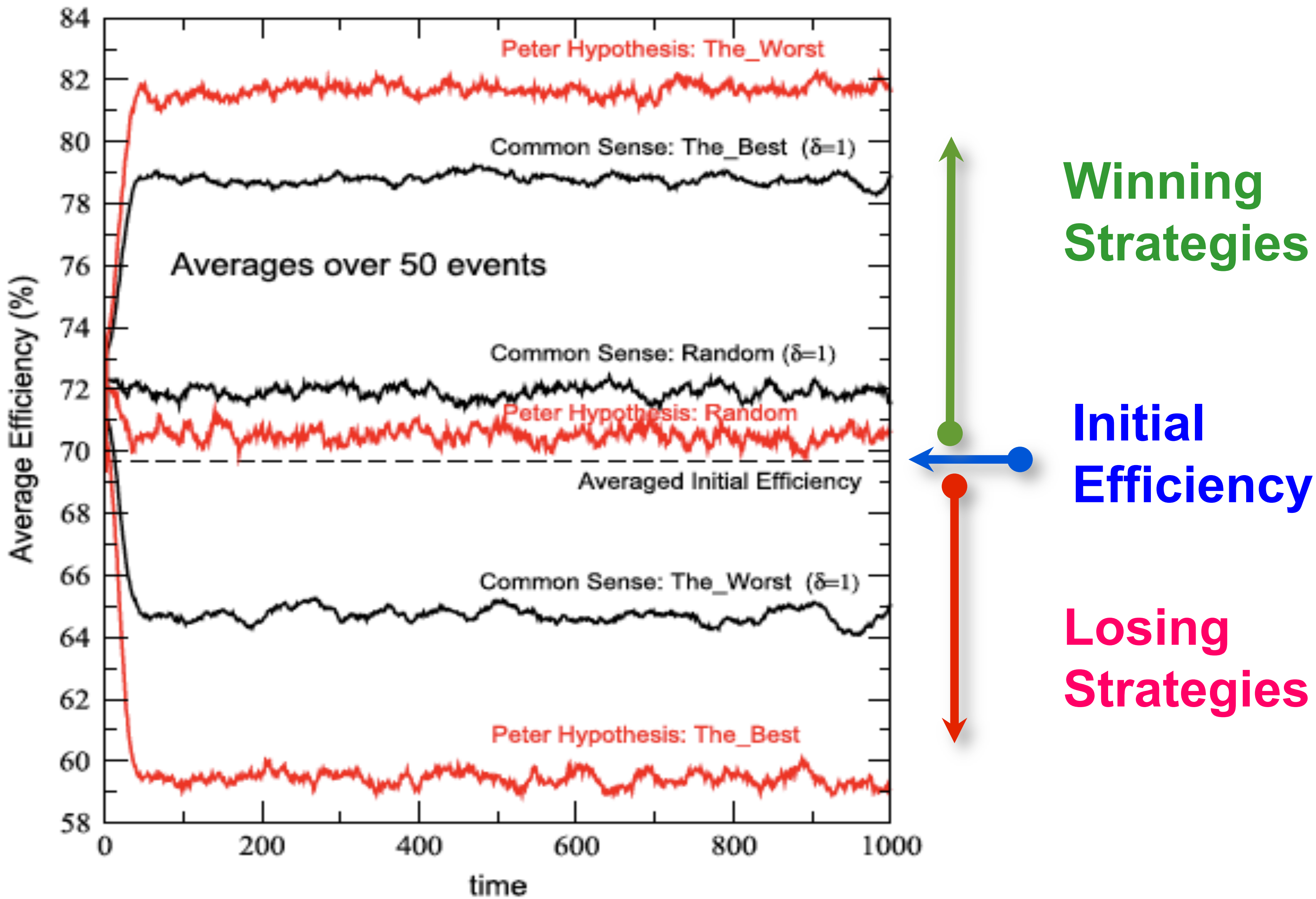
dove:

r_i with $i = 1, 2,..., 6$ — Degree of responsibility of level *i*

C_i with $i = 1, 2,..., 6$ — Total competence of level *i*

E_{max} — Maximum efficiency

Time evolution of the global efficiency



Effects of different strategies on individual careers

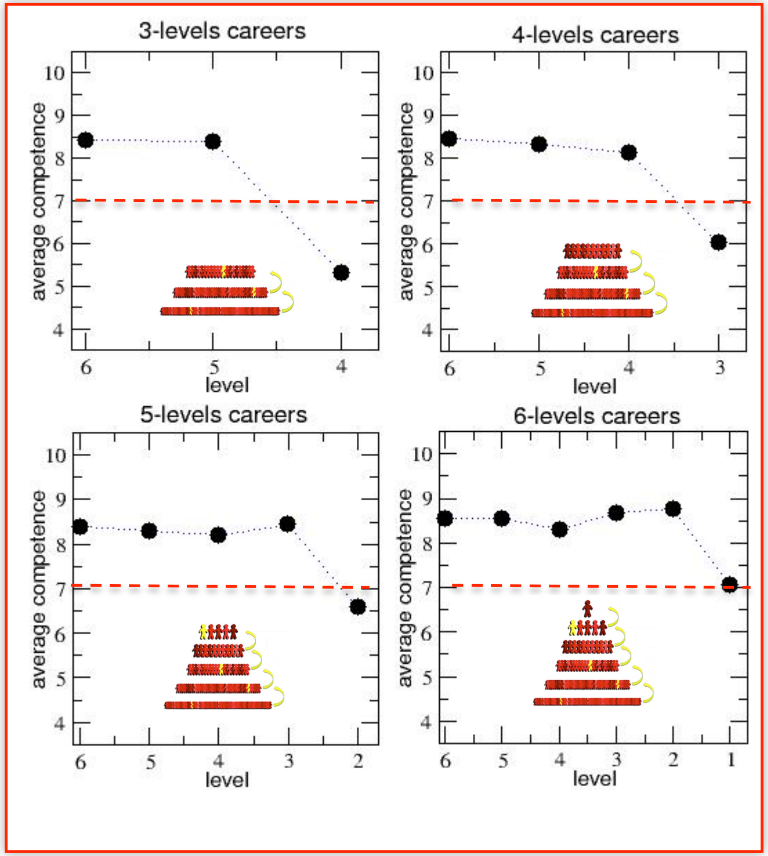
The Best

+

Peter Hypothesis

(losing strategy)

"Every new member in a hierarchical organization climbs the hierarchy until he reaches his level of minimum competence"

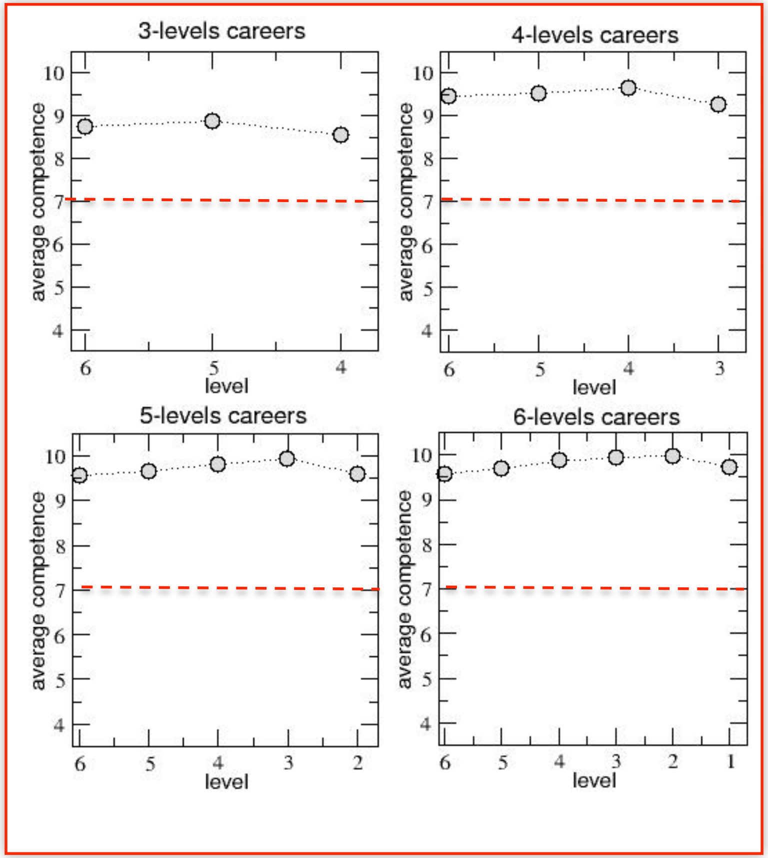


The Best

+

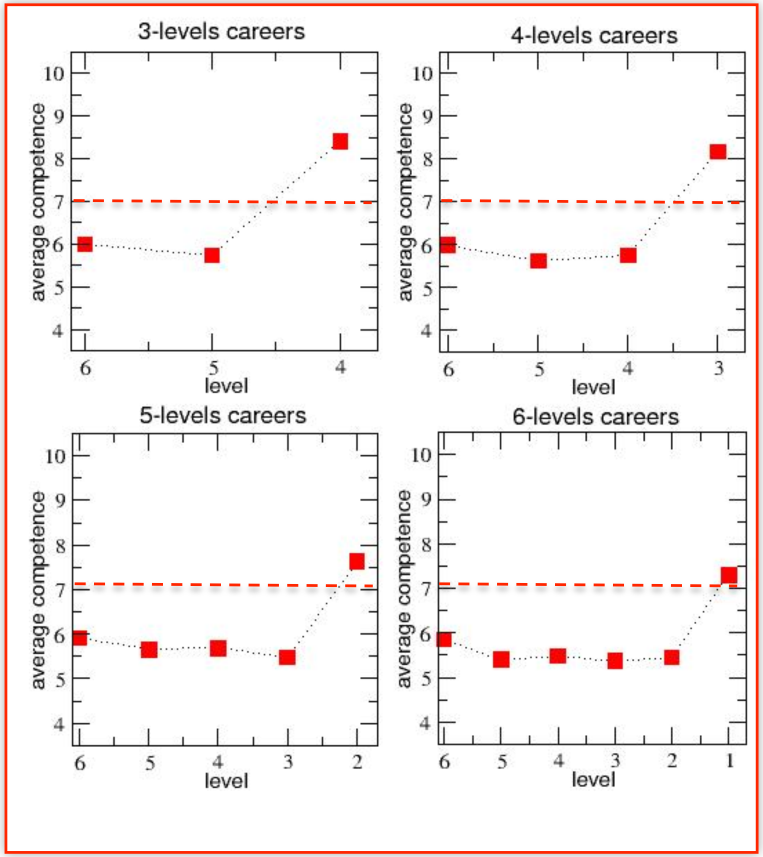
Common Sense

(winning strategy)

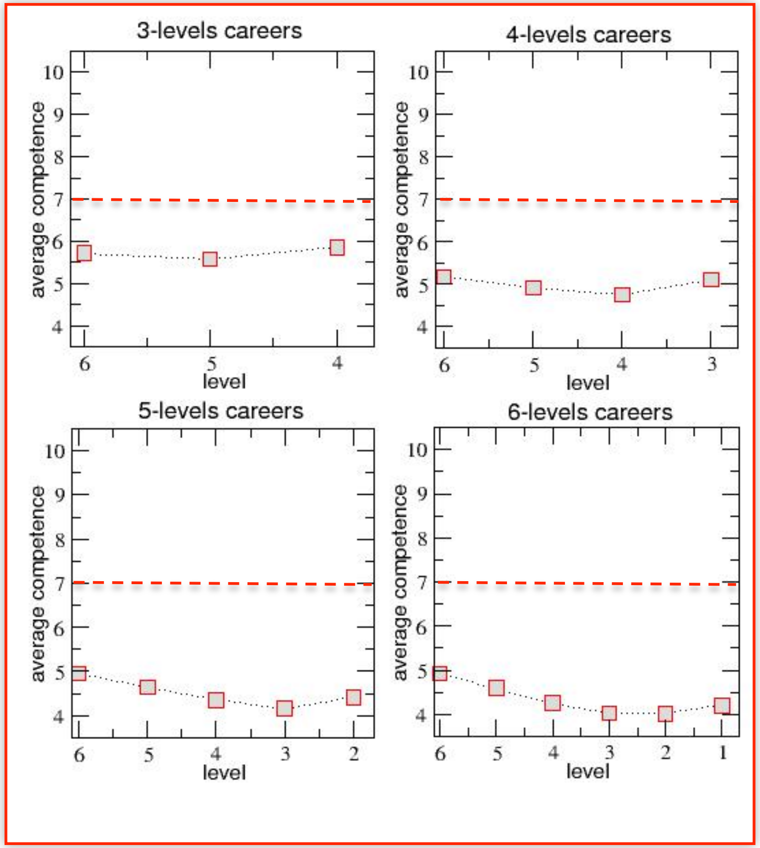


Effects of different strategies on individual careers

The Worst
+
Peter Hypothesis
(winning strategy)

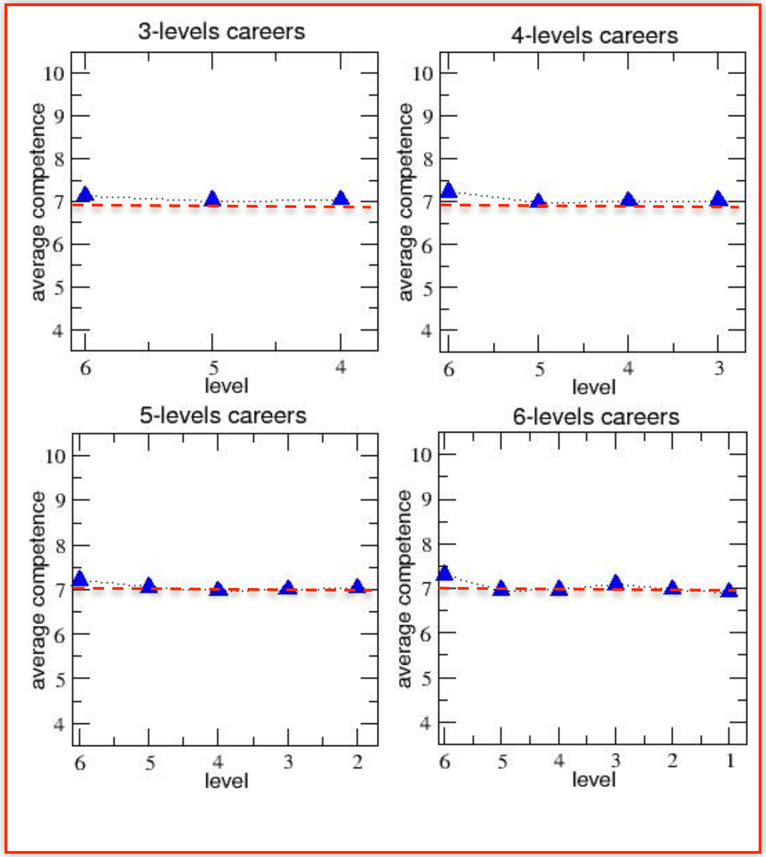


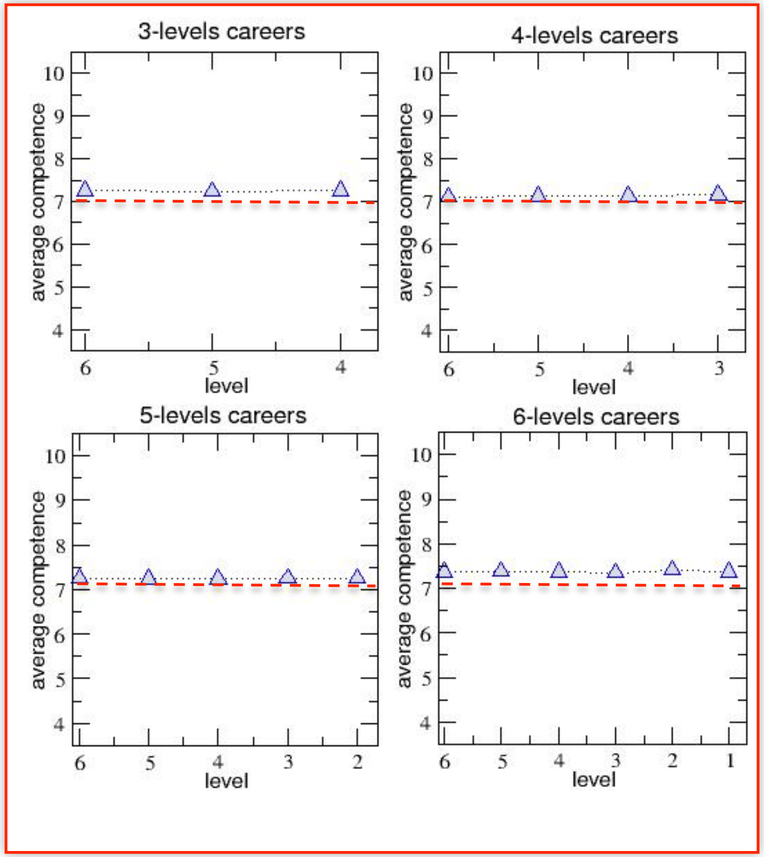
The Worst
+
Common Sense
(losing strategy)



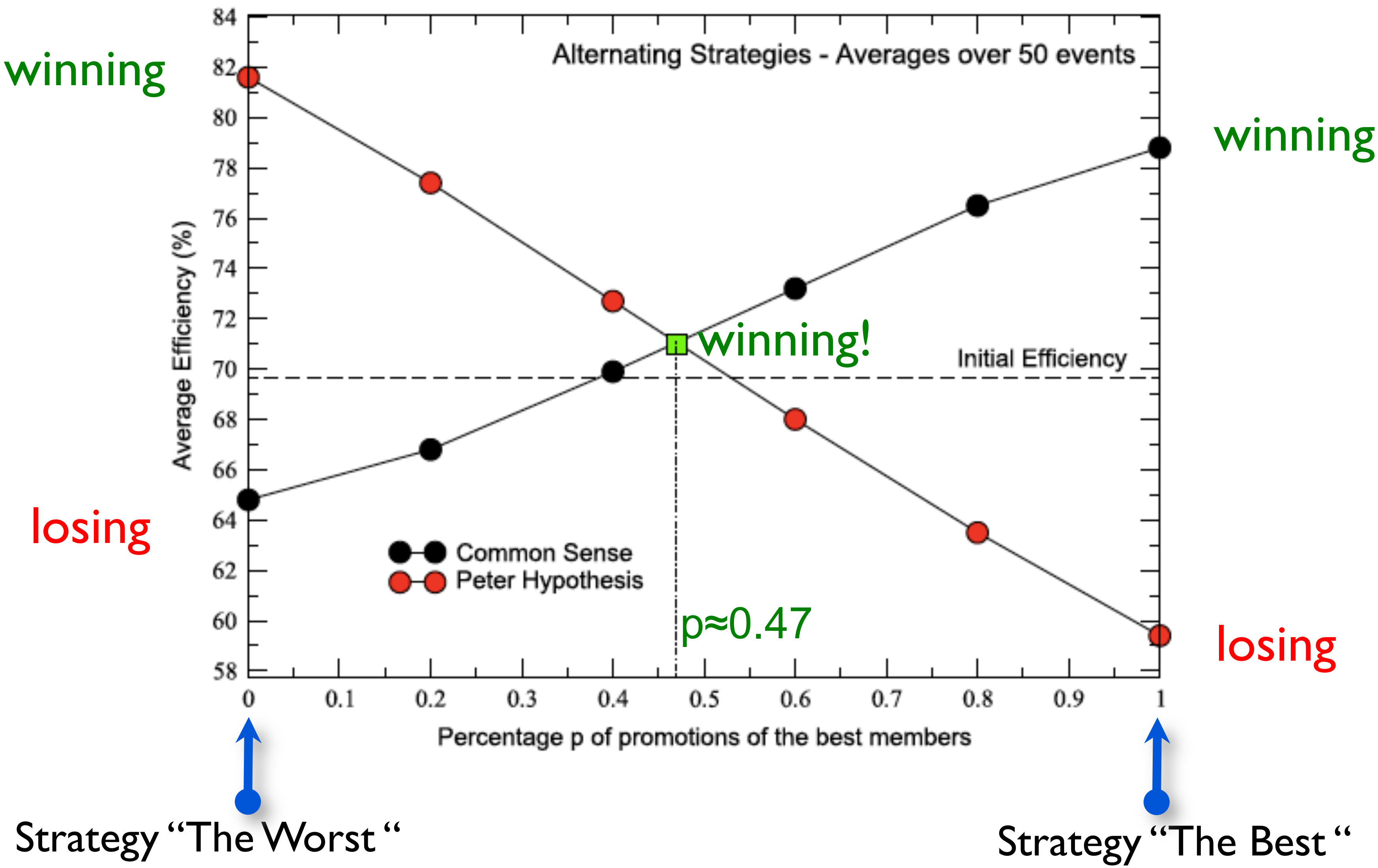
Effects of different strategies on individual careers

Random + Peter Hypothesis (winning strategy)	Random + Common Sense (winning strategy)





Asymptotic Global Efficiency for the Alternate Strategy:
The Best (p) – The Worst (1-p)



Analogies with Parrondo Paradox in Game Theory
(Nature, 1999)

Game theory

Losing strategies can win by Parrondo's paradox

In a game of chess, pieces can sometimes be sacrificed in order to win the overall game. Similarly, engineers know that two unstable systems, if combined in the right way, can paradoxically become stable. But can two losing gambling games be set up such that, when they are played one after the other, they becoming winning? The answer is yes. This is a striking new result in game theory called Parrondo's paradox, after its discoverer, Juan Parrondo[1,2]. Here we model this behaviour as a flashing ratchet[3], in which winning results if play alternates randomly between two games.

There are actually many ways to construct such gambling scenarios, the simplest of which uses three biased coins (Fig. 1a). Game A consists of tossing a biased coin (coin 1) that has a probability (p_1) of winning of less than half, so it is a losing game. Let $p_1 = 1/2 - \epsilon$, where ϵ, the bias, can be any small number, say 0.005.

Game B (Fig. 1a) consists of playing with two biased coins. The rule is that we play coin 2 if our capital is a multiple of an integer M and play coin 3 if it is not. The value of M is not important, but for simplicity let us say that $M=3$. This means that, on average, coin 3 would be played a

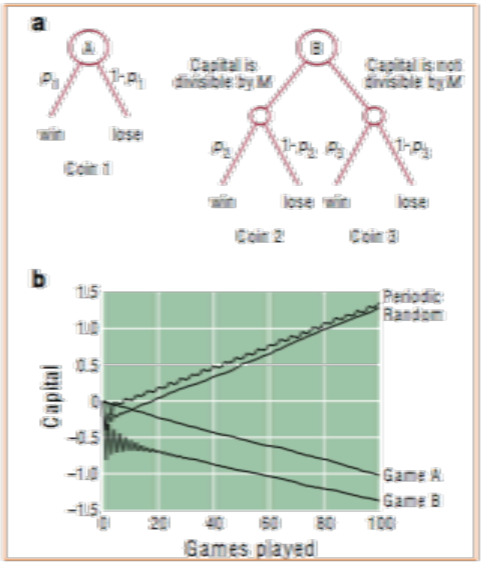


Figure 1 Game rules and simulation. **a**, An example of two games, consisting of only three biased coins, which demonstrate Parrondo's paradox, where p_1, p_2 and p_3 are the probabilities of winning for the individual coins. For game A, if $\epsilon=0.005$ and $p_1=1/2-\epsilon$, then it is a losing game. For game B, if $p_2=1/10-\epsilon$, $p_3=3/4-\epsilon$ and $M=3$ then we end up with coin 3 more often than coin 2. But coin 3 has a poor probability of winning, so B is a losing game. The paradox is that playing games A and B in any sequence leads to a win. **b**, The progress of playing games A and B individually and when switching between them. The simulation was performed by playing game A twice and game B twice, and so on, until 100 games were played; this is indicated by the line labelled 'Periodic'. Randomly switched games result in the line labelled 'Random'. The results were averaged from 50,000 trials with $\epsilon=0.005$.

slope, the particles are massaged uphill. This is only possible if the sawtooth shape is asymmetrical in a way that favours particles spilling over a higher tooth.

The flat slope is like game A, where the bias ϵ is like the steepness of the slope. Game B is like the sawtooth slope, where the difference between coin 2 and coin 3 is like the asymmetry in the tooth shape. In the brownian ratchet case, there are two types of slope, with falling particles, but when they are switched the particles go uphill. Similarly, two of Parrondo's games have declining capital that increases if the games are switched or alternated. The games can be thought of as being a discrete ratchet and are known collectively as a parrondian ratchet.

Game theory is linked to various disciplines such as economics and social dynamics, so the development of parrondian-like strategies may be useful, for example for modelling cases in which declining birth and death processes combine in a beneficial way.

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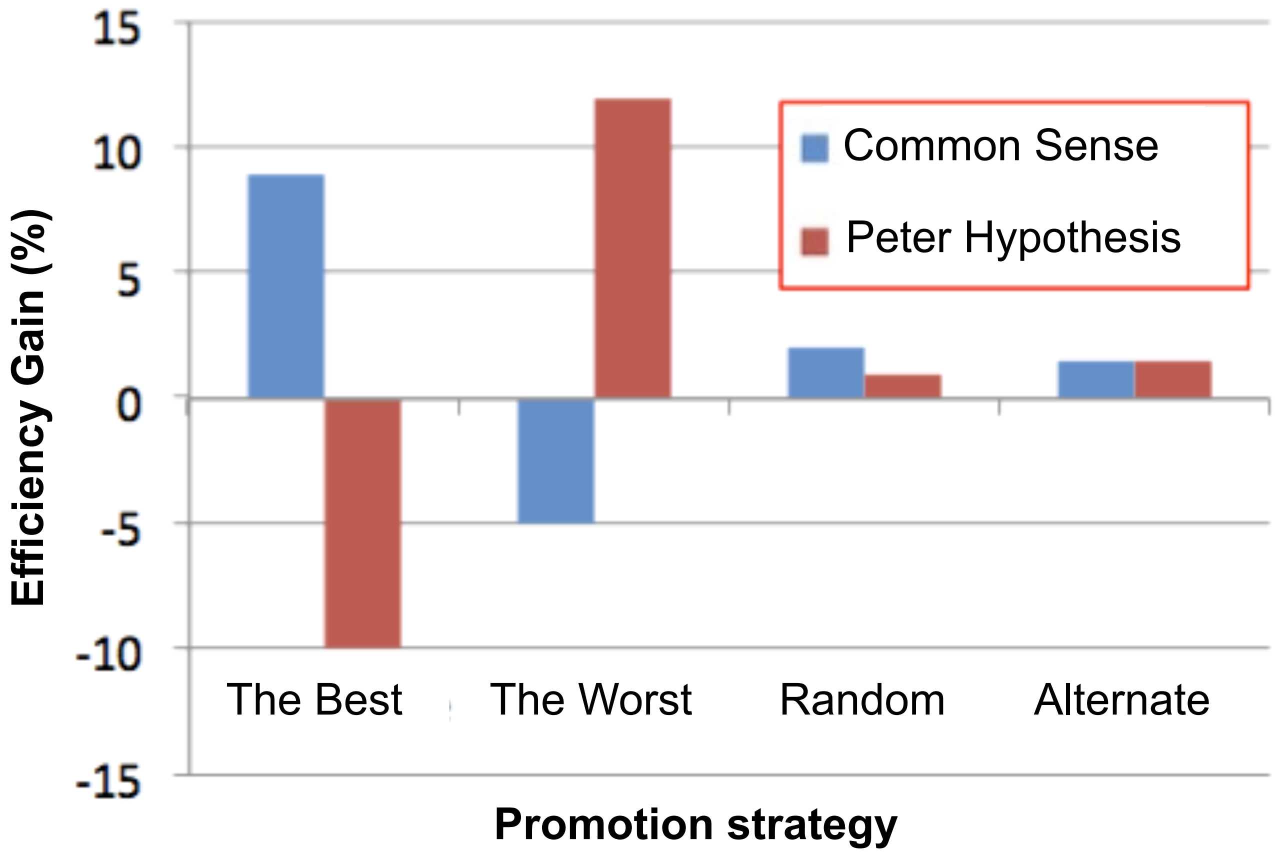
Summary

Our results confirm that, **if one does not know what mechanism of competence transmission is acting** in a given organization, the best promotion strategy seems to be that of choosing a member at random or, at least, that of choosing alternately, in a random sequence, the best or the worst members!

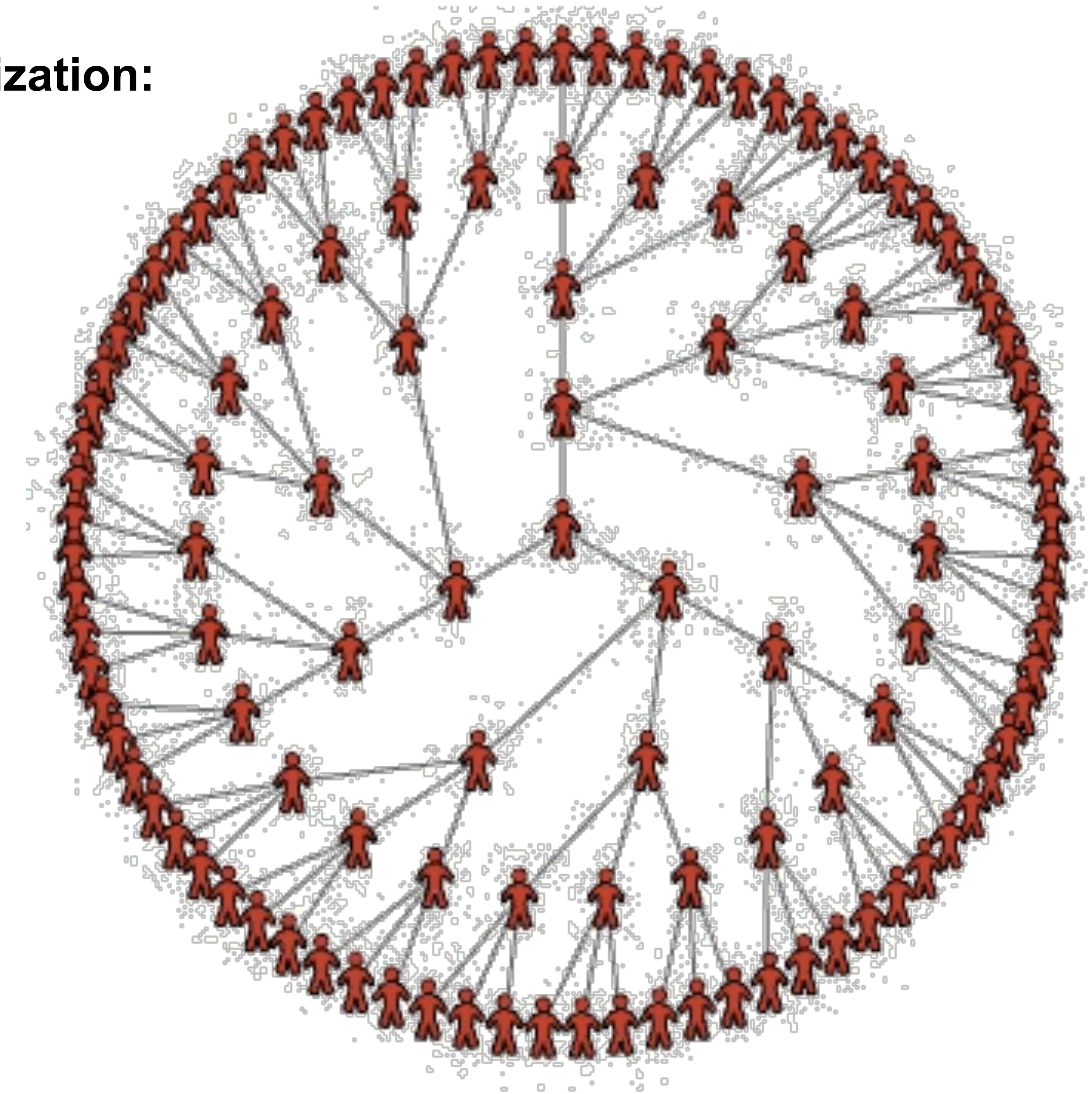


Simulations with hierarchical networks confirm the previous scenario

Hierarchical-modular organization:
K levels
L subordinates at each level

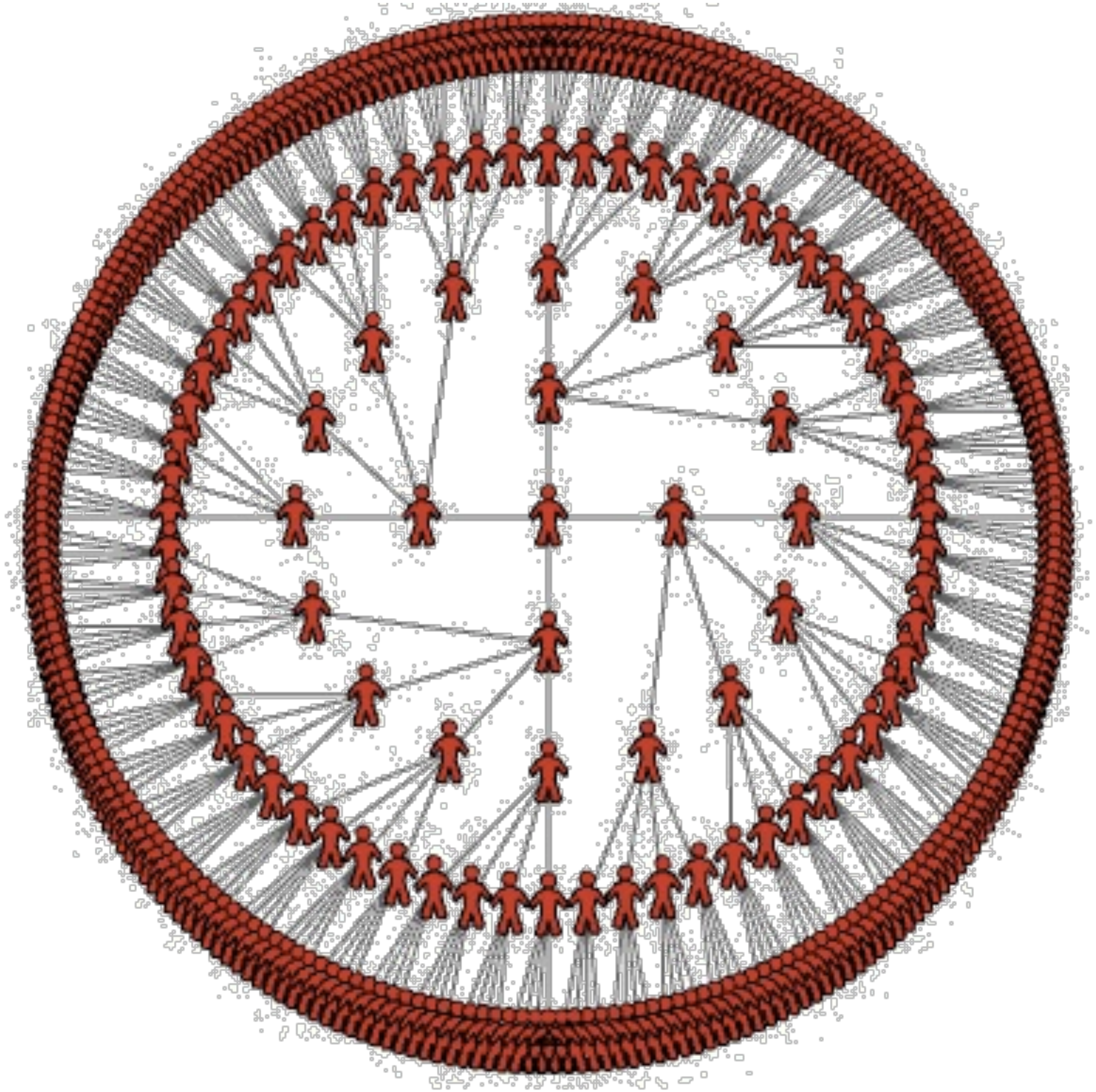
Total number of members:
N=(L^K – 1)/(L–1)

K=5, L=3 → **N**=121



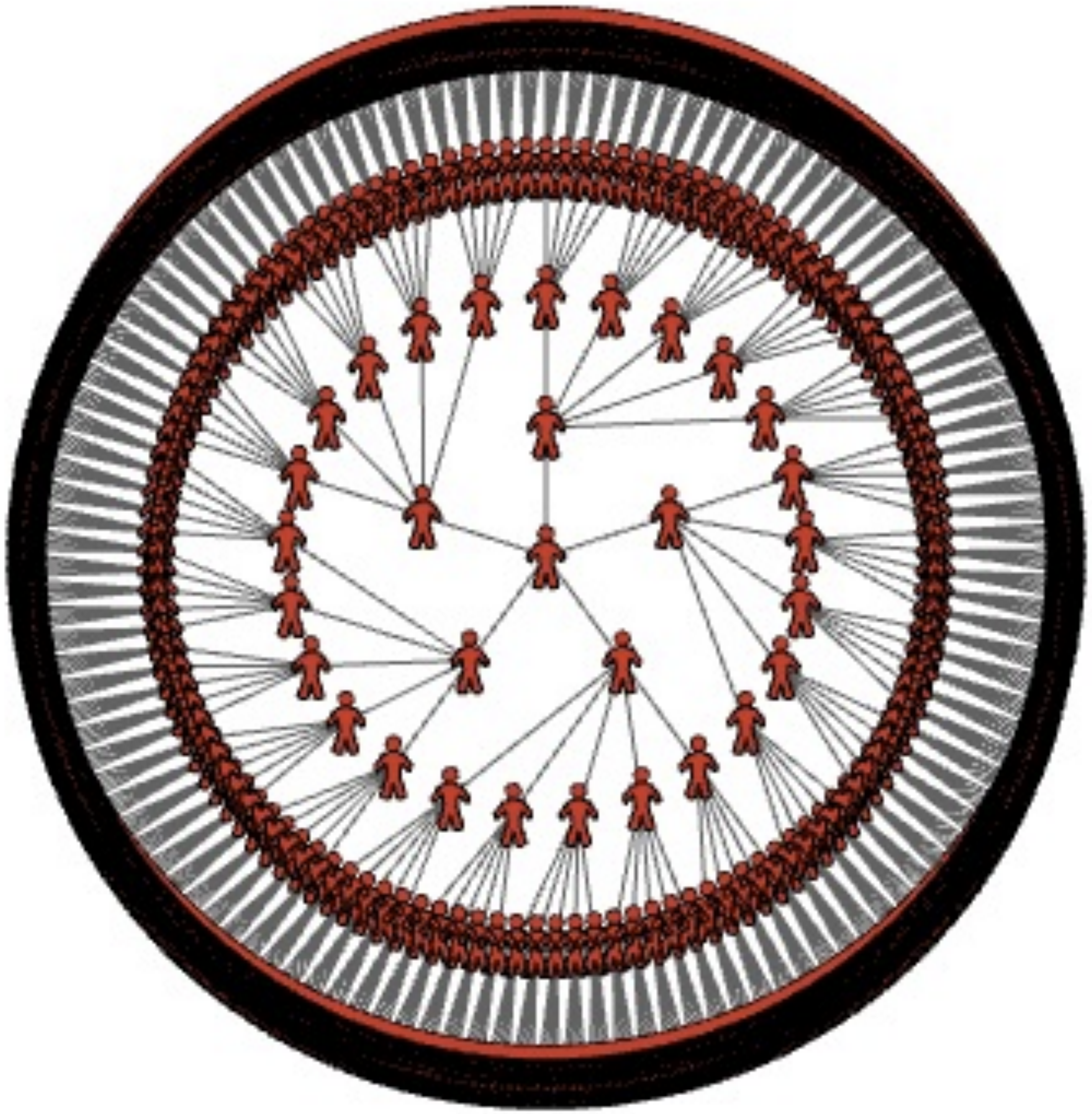
Simulations with hierarchical networks confirm the previous scenario

K=5, L=4 → **N**=341



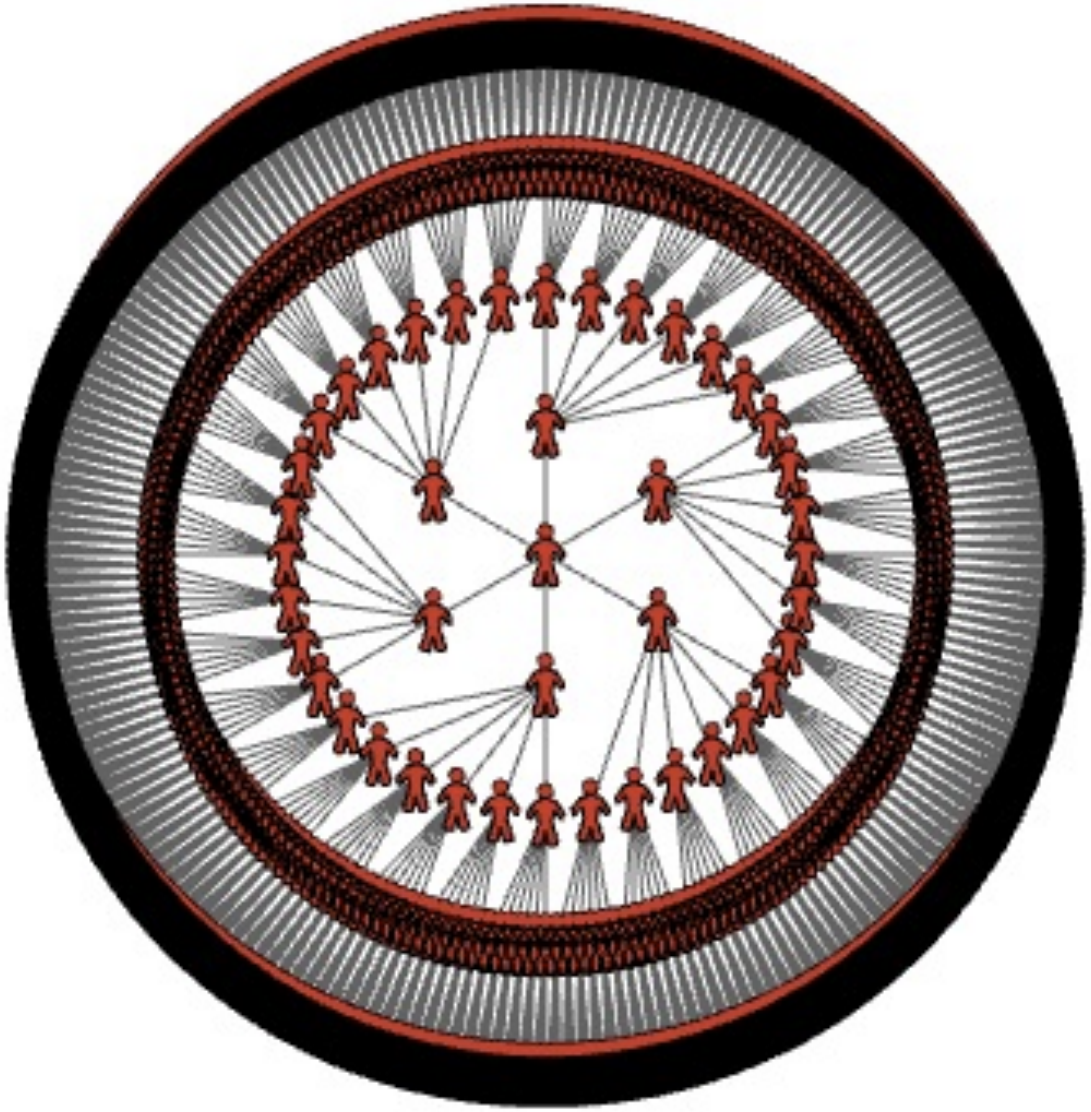
Simulations with hierarchical networks confirm the previous scenario

K=5, L=5 → **N**=781

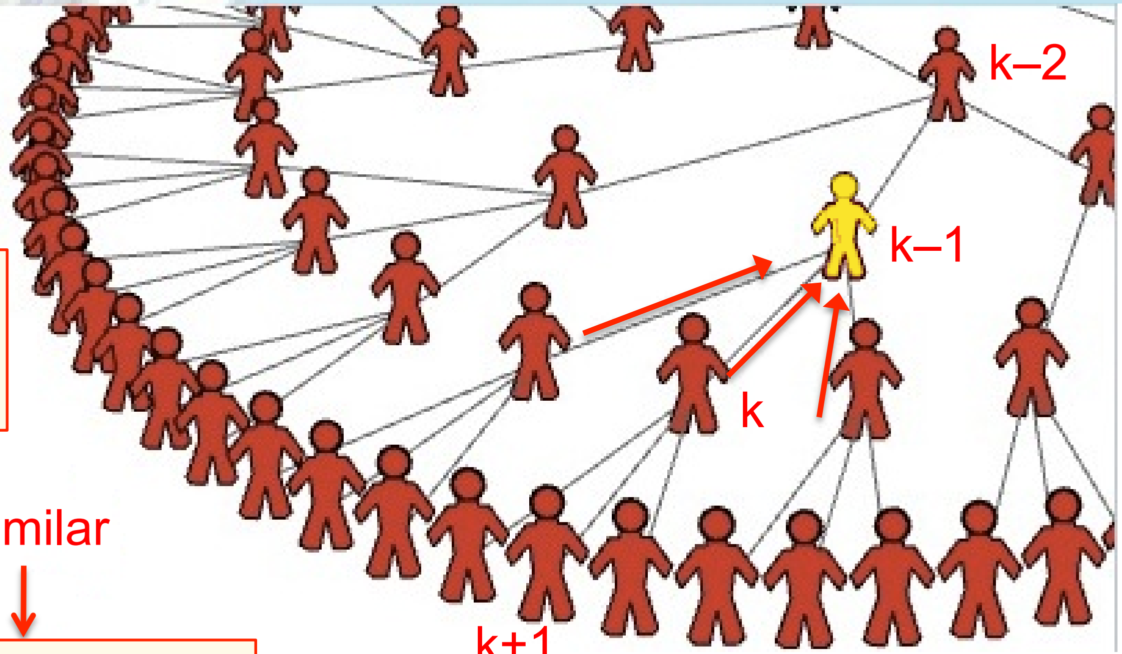


Simulations with hierarchical networks confirm the previous scenario

K=5, L=6 → **N**=1555



Introduction of new rules...



Promotions: Global - Neighbors

An empty position at level (k–1) can be filled only by its first neighbors (subordinates) at level k

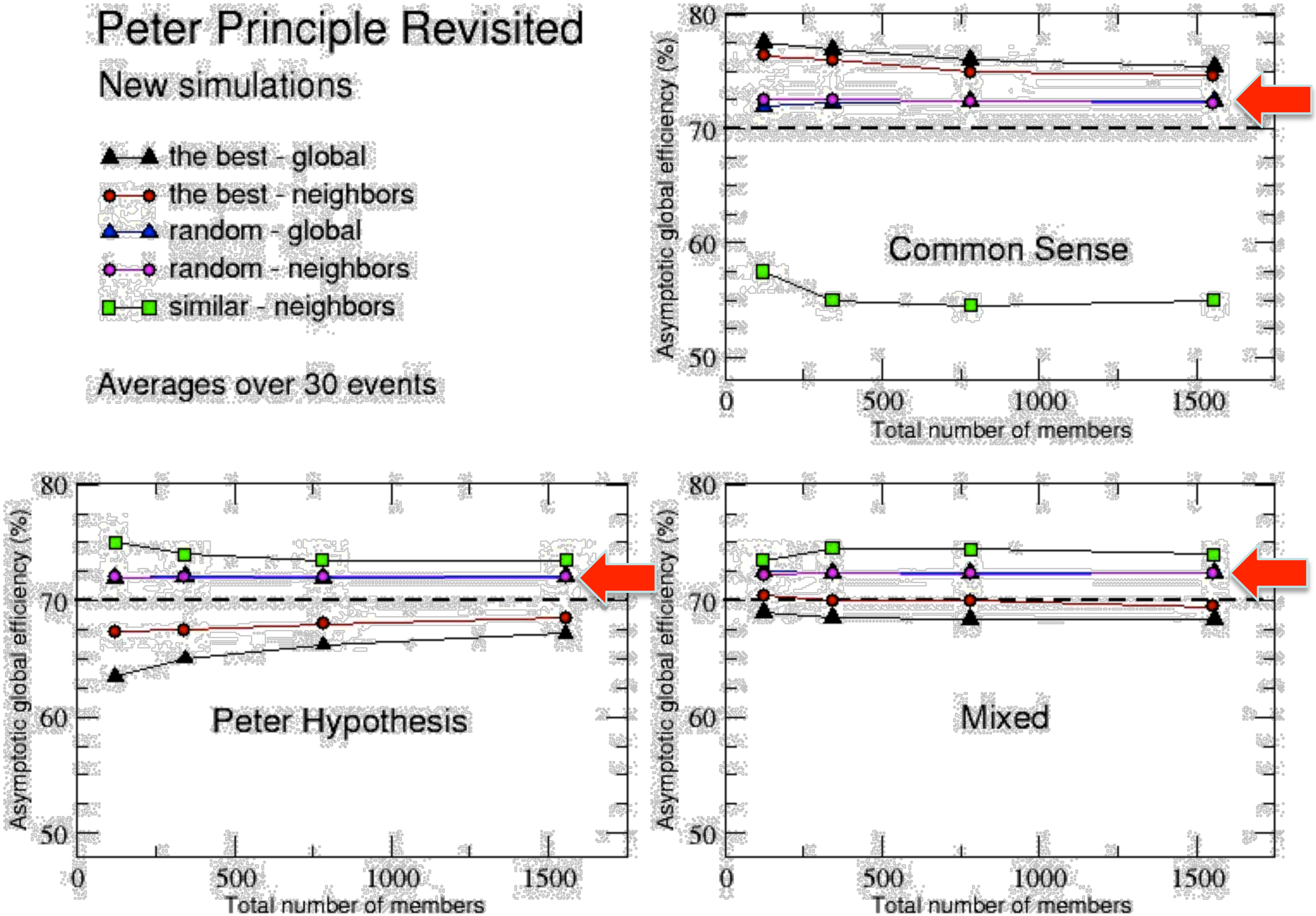
Strategies: The Best - Random - Similar

From level k is promoted the subordinate with the competence more similar to the manager at level (k–2)

Competence transmission: Common Sense - Peter Hypothesis - Mixed

- first promotion from bottom level : Peter Hypothesis
- next promotions to upper levels: Common Sense

Results: robustness of random strategy!



Quick spreading of our idea over the web community!

arXiv: version

The New York Times

July, 9 2009

Idea of the Day

Must Reads From the Week in Review Staff

July 9, 2009, 6:13 AM

Foiling the Peter Principle

Today's idea: Want to avoid the worst effects of the Peter Principle — under which competent people are promoted to their maximum incompetence? Try promoting some incompetents in the first place, a study suggests.

Business | Posthumous kudos to the Canadian psychologist Laurence Peter, of the Peter Principle, in the form of research from the University of Catania in Italy: Computer modeling affirms his 1969 dictum that promoting people to new roles based on competence in their last jobs saps an organization's efficiency, because widespread incompetence is the unexpected result.

NBC

Promotional material?

The research also finds ways to counter the Peter Principle, and they are at least as counterintuitive as Peter's counterintuitive notion itself: (1) "promote randomly the best and the worst members in terms of competence" or (2) simply promote people at random. The authors say their modeling shows that either method improves, or at least doesn't worsen, the efficiency of an organization.

But will your company ever try this? Maybe that's because it's run by a bunch of ... well, you know. [arXiv.org, Technology Review]

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» The Clue That Could Explain The

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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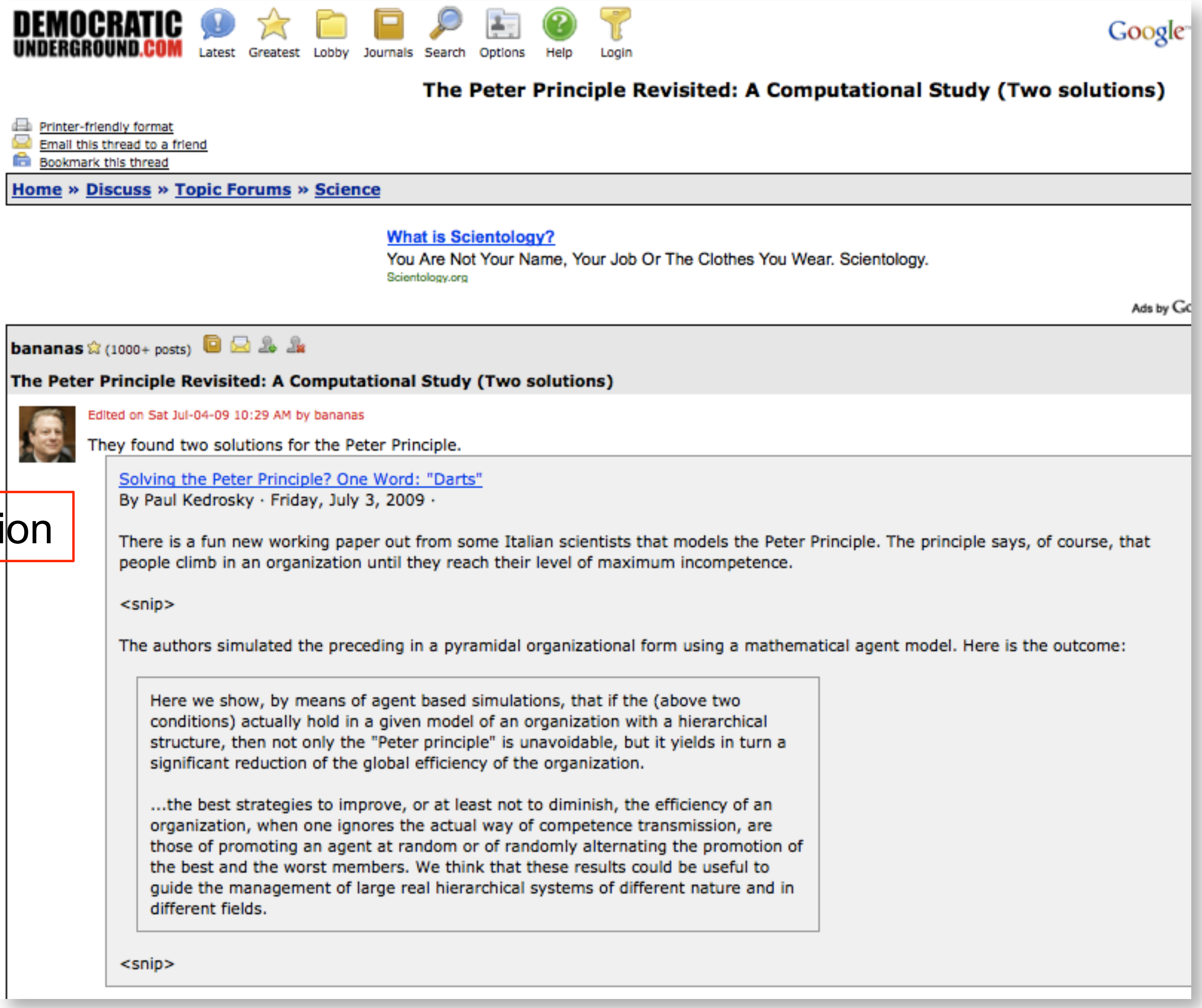

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The Peter Principle Revisited: A Computational Study (Two solutions)

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>

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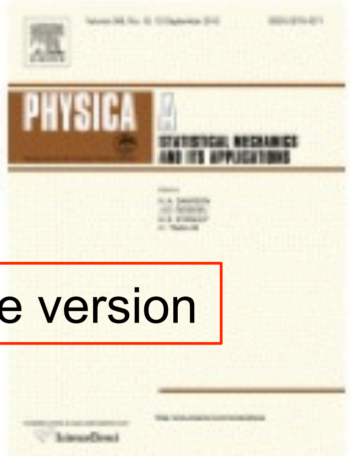

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   Physica A: Statistical Mechanics and its Applications, Volume 387, Issue 14, June 2008, Pages 3480-3494
   Tomaschitz, R.
   Cited by Scopus (6)
2. **Thermodynamic variables of microquasars inferred from tachyonic spectral maps**
   Physica A: Statistical Mechanics and its Applications, Volume 385, Issue 2, November 2007, Pages 558-572
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3. **Cooperative behavior in evolutionary snowdrift game with bounded rationality**
   Physica A: Statistical Mechanics and its Applications, Volume 388, Issue 23, December 2009, Pages 4856-4862
   Ni, Y.C.; Xu, C.; Hui, P.M.; Johnson, N.F.
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   Physica A: Statistical Mechanics and its Applications, Volume 311, Issue 3-4, August 2002, Pages 590-614
   Barabasi, A.L.; Jeong, H.; Neda, Z.; Ravasz, E.; Schubert, A.; Vicsek, T.
   Cited by Scopus (361)
5. **The Peter principle revisited: A computational study**
   Physica A: Statistical Mechanics and its Applications, Volume 389, Issue 3, February 2010, Pages 467-472
   Pluchino, A.; Rapisarda, A.; Garofalo, C.

NewScientist

December 2009

Mark Buchanan

Incompetence rules

So your organisation is managed by people who couldn't run a burger stand? Here's why

"It sounds counter-intuitive, but the best promotion strategy might be to choose people at random"

IN THIS season of goodwill, spare a thought for that much-maligned bunch, the men and women at the top of the management tree. Yes, the murky machinations of the banking bosses might have needlessly plunged millions into penury. Yes, the actions of our political leaders might seem to be informed more by dubious wheeler-dealing than by Socratic wisdom. And yes, the high-ups in your own company might well be the self-important time-wasters you've always held them for.

Don't blame them, though. It's not their fault. There are good reasons to expect that bosses can't help but be incompetent – adrift on a sea of troubles they neither understand nor can control. Better to take pity on the poor souls: there with the grace of the promotion committee go all of us.

The idea that high-level incompetence is inevitable was formulated in the 1969 best-selling book *The Peter Principle: Why things always go wrong*. Its authors, psychologist Laurence Peter and playwright Raymond Hull, started from the observation that while jobs generally get more difficult the higher up any ladder you climb, most people only come equipped with a more or less fixed level of talent that corresponds to their intelligence, knowledge and energy. At some point, then, they will be promoted into a job they can't quite handle. They will, as Peter and Hull put it, "reach the level of their own incompetence". And there they will stay, fouling up operations until they either retire or some egregiously inept act gets them fired.

The problem is what they get up to in the meantime. "They end up distracting us from their crummy work with giant desks," says Robert Sutton of the Stanford Graduate School of Business in California. "They replace action with incomprehensible acronyms, blame others for failure, and cheat to create the illusion of progress." Meanwhile, Peter and Hull concluded, the actual work gets done by those who have not yet scaled the summit of their own incompetence. That would be you and me, then.

Pervasively inept

The "Peter principle" undoubtedly appeals to the cynic in all of us. It is also quite possibly true, if subsequent academic studies are to be believed. The longer a person stays at a particular level in an organisation, the more most measures of their performance fall – including subjective evaluations and the frequency and size of pay rises and bonuses. It is a finding entirely consistent with the idea that people eventually become bogged down by their own incompetence.

Economist Edward Lazear, also of Stanford, is one person who has tried to pin down why. His suggestion is that it is down to chance. People mostly get promoted because they have performed a particular task unusually well. That could be because they are generally competent, but equally they might just by fluke have been well-suited to that one job.

Lazear postulated that every worker's ability to do his or her job well is determined by their basic competence plus an additional transitory component determined by circumstance. There is no guarantee that this transitory component will be maintained after a promotion, especially if the new position requires different abilities. An electrician doing excellent work on the factory floor might not have the interpersonal skills needed to manage a team of electricians. A skilled and sensitive doctor might flounder when faced with the multitudinous difficulties of running a hospital. A cabinet minister prudently managing the finances of a nation might not necessarily be the best choice to step up and lead it.

In other words, following promotion a person is likely to regress to their baseline competence, losing that extra something that prompted their rise. That baseline might be above or below the degree of competence demanded in the new, high-level job. If in a particular workplace the staff who are promoted consistently fall short in this respect, promotion can become the dominant force driving pervasive ineptitude, Lazear's mathematical models showed.

It is a view underpinned by simulations of promotion dynamics performed in early 2009 by physicist Alessandro Pluchino and colleagues at the University of Catania in Italy (*Physica A*, vol 389, p 467). They started by accepting the conventional notion that people who do well at one level will do well at the next one up. If the employees who are most successful in their job are always selected to move up the ladder, then the organisation rapidly fills with competent individuals, especially at the higher levels.

But what happens if the conventional idea is false and employees' ability to perform at higher levels has no link to their competence at lower levels? The result is profoundly different, as you might expect. Promoting the best-performing employees merely takes people out of positions where they are doing well and pushes them upwards until they arrive at a position for which they lack the requisite skills. Their promotion history then comes to an end: the Peter principle wins out.

"The system locks incompetence into place," says sociologist Cesare Garofalo, one of the authors. "This might happen in any organisation where the tasks of the different levels are very different from each other."

As he points out, companies often try to avoid this outcome by giving employees extra training before a promotion, in the expectation that this will supply any missing skills. But the new analysis suggests that there may be another way to achieve a similar end: subvert the seemingly inescapable logic that the best should always be promoted, and at least sometimes promote the poor performers too. By removing people from jobs for which they have low competence, such a strategy increases overall organisational efficiency, measured as a weighted average of employee competence, with higher-level positions counting for more.

Of course, such a strategy is not without its dangers. Doing your job badly is all too easy, and a promotion paradigm that obviously rewards underperformance would spell disaster. Garofalo suggests how to work round this problem and still use promotion to release poorly performing employees from jobs unsuited to their skills. "This is obviously counter-intuitive," he says, "but the best promotion strategy seems to involve choosing people more or less at random."

"This is a really interesting alternative approach to looking at the Peter principle," says Rajiv Mehta, a professor of marketing at the New Jersey Institute of Technology in Newark. "But it would turn on its head almost every established theory of human behaviour and would face a multitude of problems."

Among other things, random promotion seems certain to undermine the morale of staff who work hard at their jobs. "I think you'd have dissatisfied and alienated employees with low commitment," says Mehta. "They'd be disloyal corporate citizens and from there it's only a hop, skip and a jump to conclude that there'd be high rates of dysfunctional employee turnover." A better way to stop people getting locked in jobs they do badly, he suggests, would be the more conventional strategy of regular job rotation.

With no obvious solution in sight, perhaps we should just resign ourselves to being ruled by supposed betters who are in fact hopeless incompetents. At least – and here's a thought to take into the new working year – it means that when things go wrong at the top, it is most probably a cock-up, not a conspiracy. ■

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THE 9TH ANNUAL YEAR IN IDEAS

A B C D E F G H I K L M O P **R** S T U W Z

Random Promotions

In 1969, the Canadian psychologist Laurence J. Peter posited the "Peter Principle": people in a workplace are promoted until they reach their "level of incompetence." This happens, Peter argued, because we wrongly assume that people who are good at their jobs will also be good at jobs that are one rung up on the corporate ladder – so we promote them. But often the new job is so different from the previous job that the employee can't handle it. Now performing incompetently, the employee stays in place, dragging the efficiency of the firm downward. Eventually the entire economy becomes like the paper company Dunder Mifflin in "The Office" – clogged with incompetence.

Is there any way to avoid this trap? Yes, by promoting people at random. That's what a trio of Italian scientists discovered this year. They created a computer model of a 160-person corporation and programmed it with Peter Principle-like logic: the best performers were promoted, but they had only a random likelihood of being good at their new jobs. Sure enough, the firm was soon cluttered with incompetents, and its efficiency plunged. But then the researchers tried something different: they reprogrammed the firm so that it promoted people entirely randomly, and the overall efficiency of the firm improved.

ILLUSTRATION BY OPEN

They also tried alternately promoting the absolute best and absolute worst performers. That, too, worked out better than promoting on merit. The scientists say these strategies work because they harness "Parrondo's Paradox," a piece of game theory in which you win by alternating between two losing strategies. "In physics or game theory, this isn't new," says Andrea Rapisarda, a physicist at the University of Catania in Italy and a co-author of the study, which was recently published in the journal Physica A.

As Rapisarda points out, if you could know for sure that the people being promoted would excel in their new jobs, that would be the best strategy of all. But if you aren't sure – and in the real world, we rarely are – then random works better. CLIVE THOMPSON

Concluding Remarks

Bad news: our agent based simulations confirm that the Peter Principle holds in any hierarchical organization when the transmission of competence between the levels of the hierarchy is not correlated

Good news: possible strategies to overcome it do exist. The more efficient are the random strategy and the alternate strategy with p≈0.5

Robustness of random strategies: more realistic simulations shown that the efficiency of random strategy is very robust, since it is the only strategy which is always winning

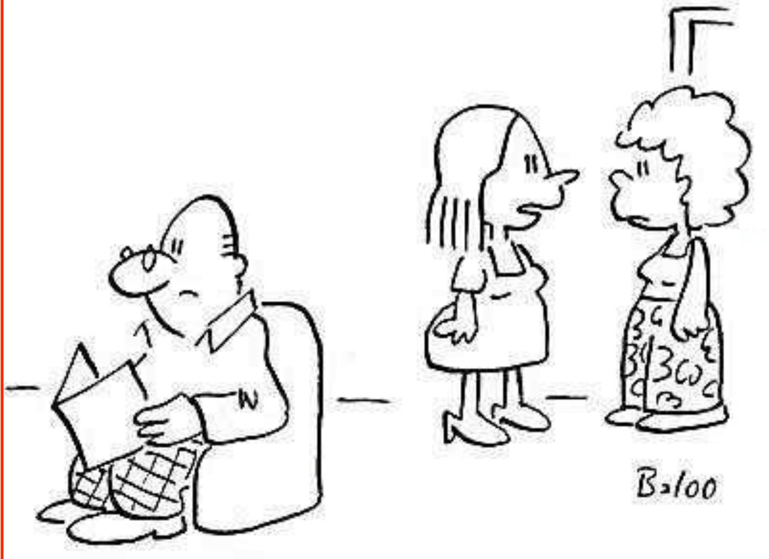
We think that these results could be useful to guide and improve the management of large real hierarchical organizations, and also in non-human contexts, as e.g. **grid-computing** (job-assigment policies, etc...)

Thank you for the attention!

Ref: A.Pluchino, A.Rapisarda, C.Garofalo, “The Peter Principle Revisited: a Computational Study”, Physica A 389 (2010) 467

Online supplementary material:

http://oldweb.ct.infn.it/cactus/peter-links.html



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