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Zurich** <sup>UZH</sup>

**Institute of Biomedical Ethics**

**University of  
Notre Dame**



**Psychology Department**

# **The Zurich Neuroethics Initiative**

## **Projects and Ideas**

**Markus Christen,**

**University of Zurich & University of Notre Dame**



## Why this talk?

**Context:** Judy collaborates in a proposal we prepare on psychosocial and ethical issues of deep brain stimulation.

This proposal also intends allowing for exchange of PhD students between Vancouver and Zurich for one semester around 2013/14.

**This talk** intends to give an idea of what we have done recently, what we are doing now and what we would like to do in the near future.

You then may decide whether you are inspired by some of those ideas or whether you would like to collaborate in one of those ideas.

**Warning:** I show a lot of material – this is not an in-depth discussion of an ethical argument. But I can provide you with publications and further information, if required.



## Table of Contents

- What is neuroethics?
- Being critical
- Being practical
- Being theoretical
- Ideas for collaboration (included in project presentations)



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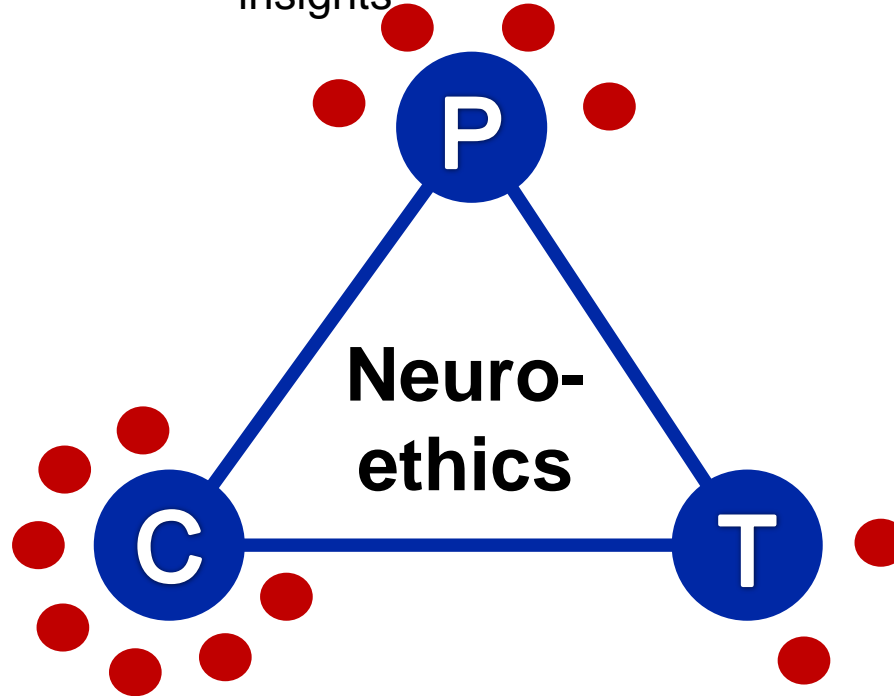
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**What is neuroethics?**

**(And what would you like to master in order to  
become a better neuroethicist?)**



**Practical:** *Improvements*  
based on neuroethical  
insights

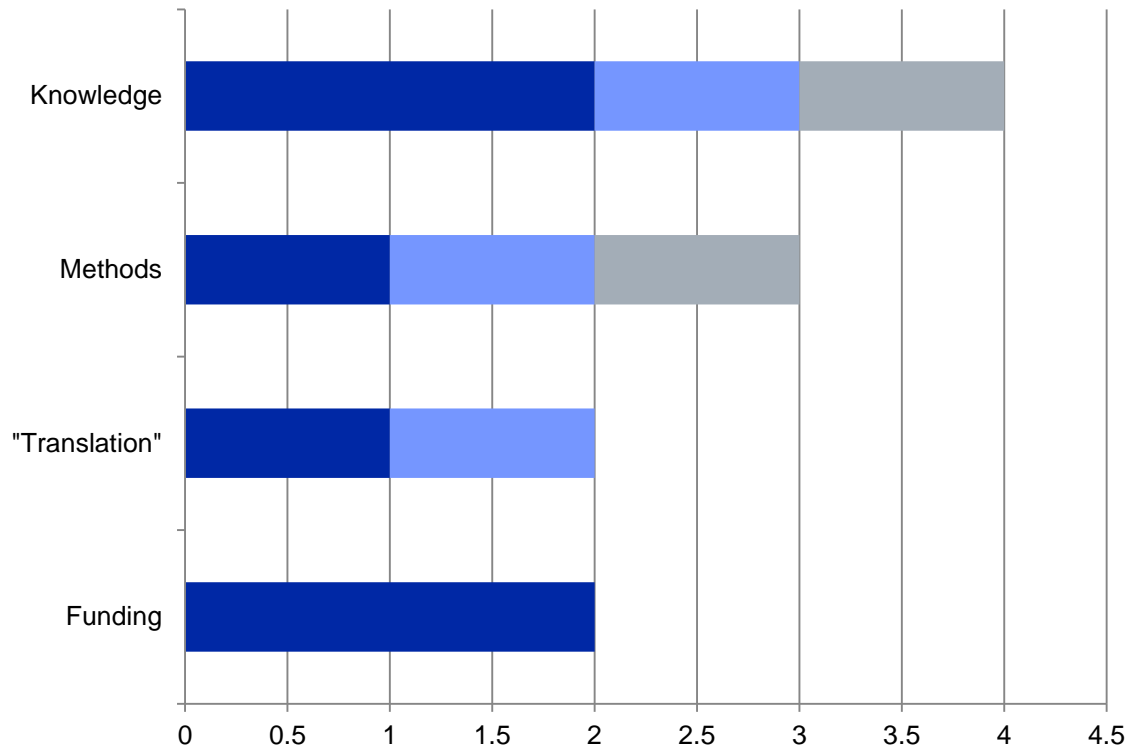


**Critical:** The good  
and *bad* implications  
of neuroscience

**Theoretical:** More  
*insights* into ethics  
and neuroscience



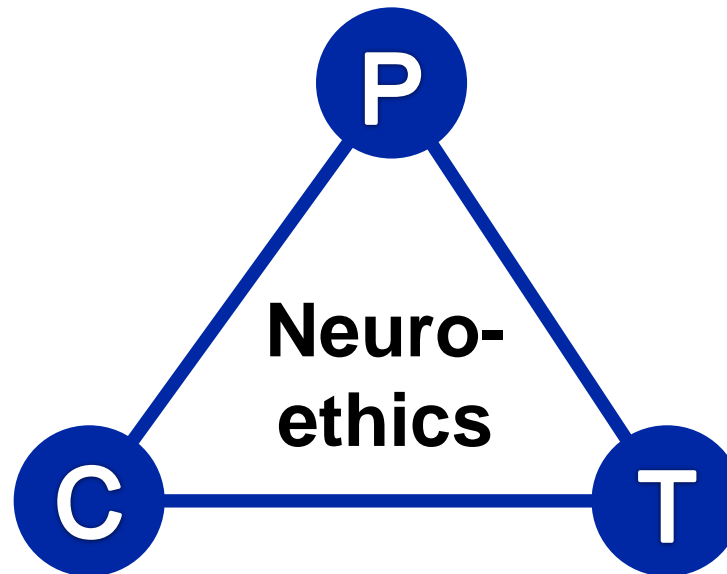
# “Wish list” for becoming a better neuroethicist





**Being practical:**

- Treating (patients)
- Enhancing (humans/technology)
- Communicating (results etc.)



**Being critical:**

- Internal critique
- Normative critique
- Genealogical critique

**Being theoretical:**

- Measuring
- Simulation
- Classifying
- Conceptual analysis



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# Being critical

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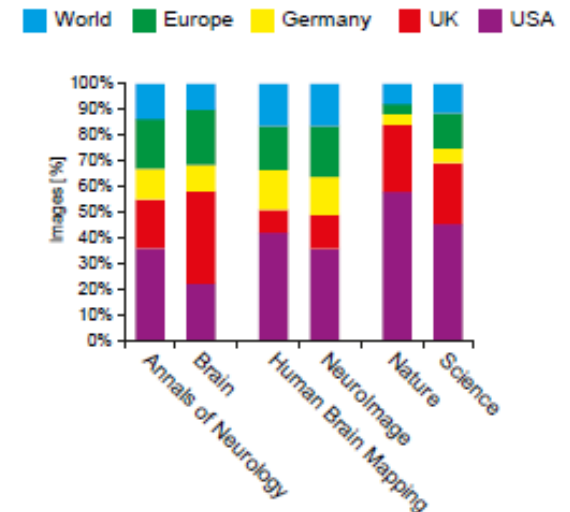
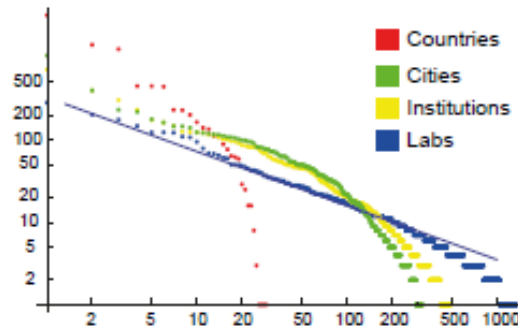
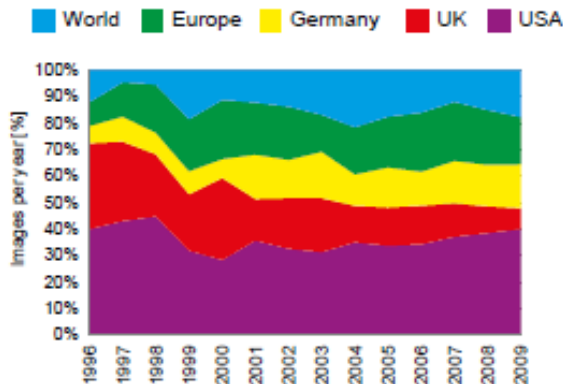




## Internal critique: Iconography of neuroimaging (1)

Analyzing the effect of presenting neuroimage results on the process of knowledge generation within neuroscience and on a broader audience requires empirical information on the display practice in neuroimaging.

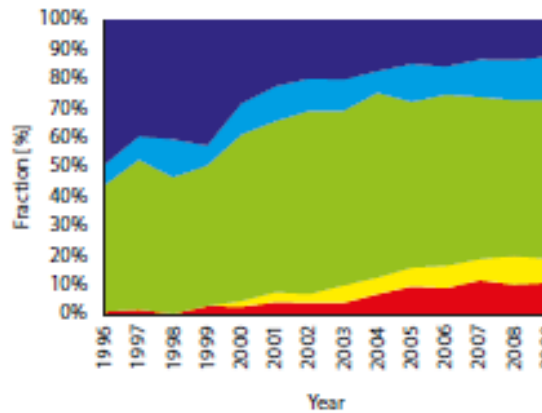
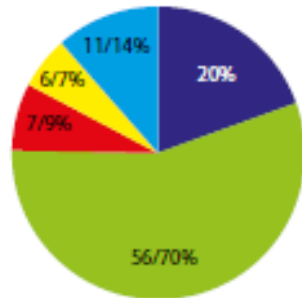
We evaluated 9,179 functional images (fMRI and PET) with respect to color use, image structure, image production software and other factors that determine the display practice in neuroimaging for six major journals representing three target groups from 1996 to 2009.



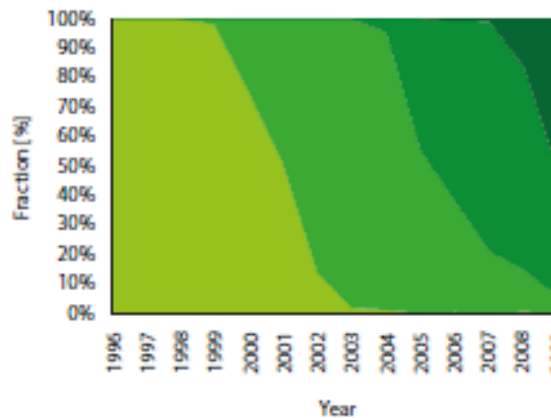
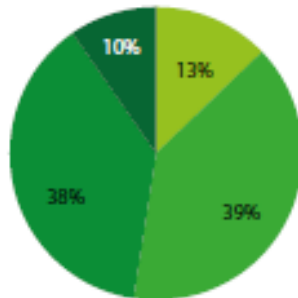


# Software used for producing neuroimages

a)



b)

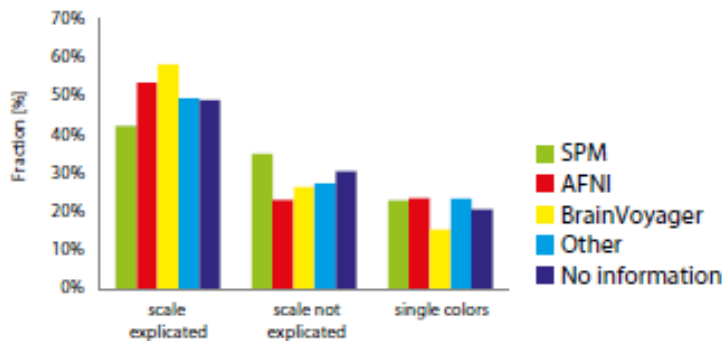




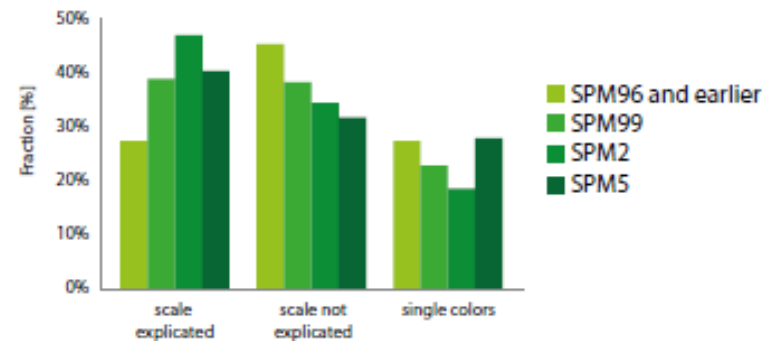
## Explication of color scales for activation

In 38.2% of the images that displayed neuronal activations using color scales, the scale was not explicated (i.e., the colors are not associated with numbers either by using a scale or by outlining the meaning of the colors in the figure caption).

a)



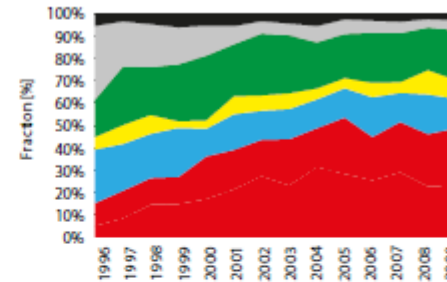
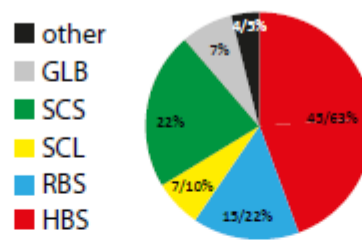
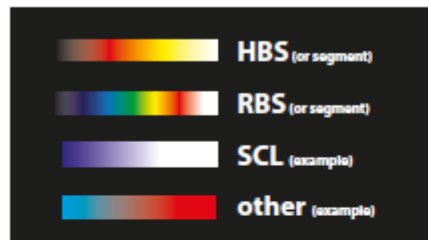
b)



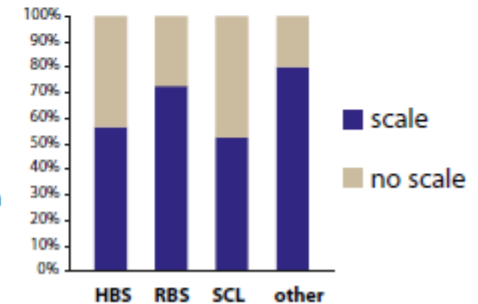
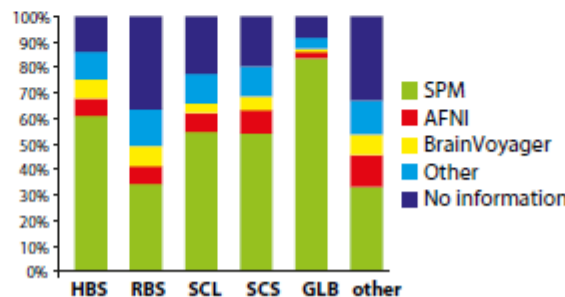
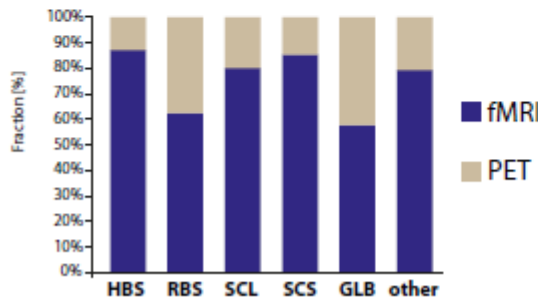


# Major display styles

a)

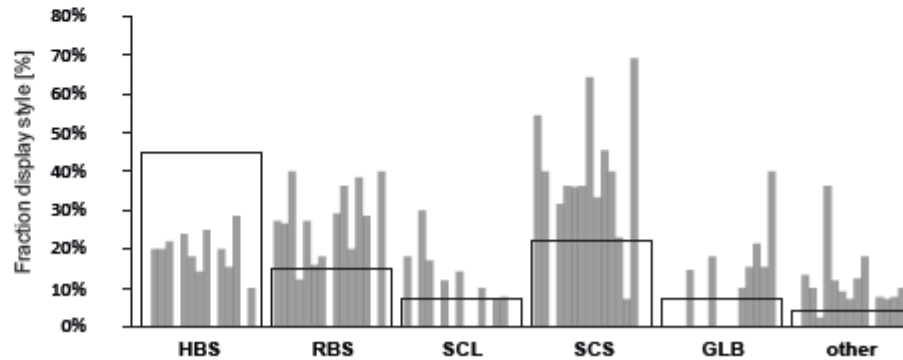
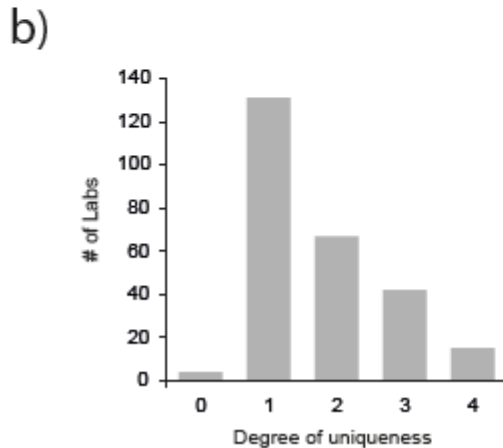
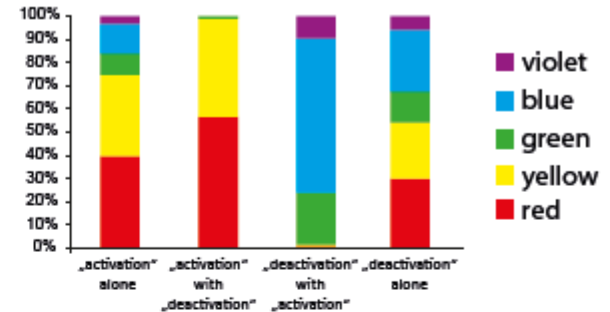
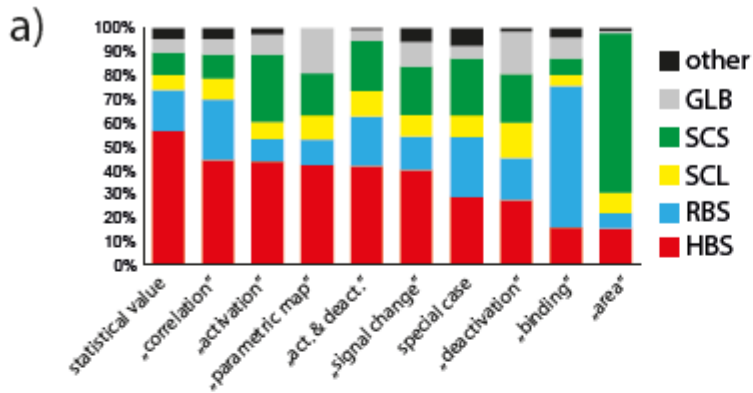


b)





# Trends of standardization





## Internal critique – Summary

We demonstrate a rather broad variety of display styles in neuroimaging despite a remarkable dominance of few image production sites and software systems, outline some tendencies of standardization, and identify shortcomings with respect to color scale explications in neuroimages.

Our results provide a framework for the interpretation of brain images that is both relevant for imaging software improvement, as well as their broader dissemination in the public sphere.

**Collaboration:** Further in-depth analysis (e.g. using text mining tools) of our data set.



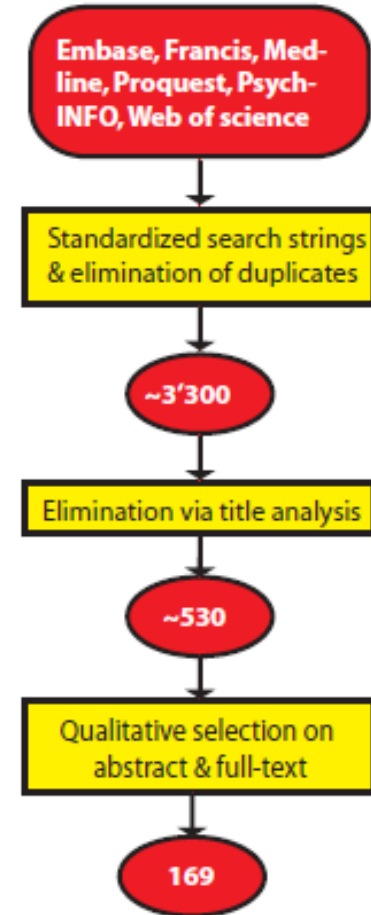
## Normative critique: using frontal lesion patients in moral research

The empirical investigation of human moral behavior is increasingly based on studies that include patients with rare lesions in specific regions of the frontal lobe. This poses two questions from the perspectives of neuroethics and medical ethics:

What is the role of such findings for our understanding of human morality?

How should we deal with such patients in research and clinical practice?

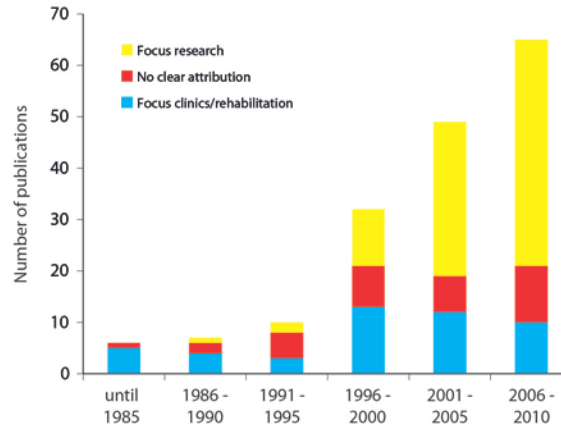
(Christen & Regard, Nervenheilkunde, 2012)





# Some findings of literature analysis

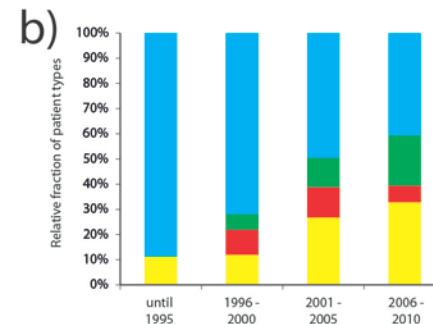
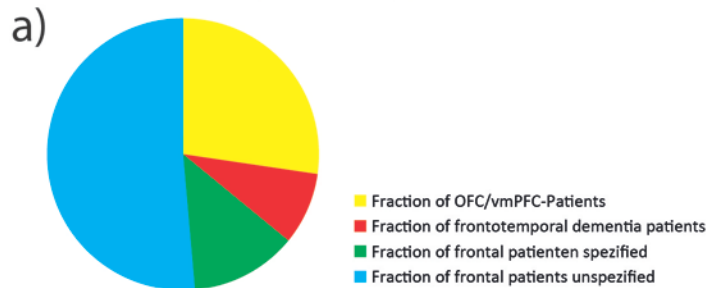
## Focus of moral lesion literature



## Impact of moral lesion literature

	Typical „Phineas Gage“	Untypical „Phineas Gage“
Mean annual citations per publication	11.22	3.05
Mean annual citations per publication (excluding Tukey outlier)	7.61	1.85

## Typology of frontal patients



**Reference:** Christen M, Regard M (in press): Der „unmoralische Patient“. Analyse der Nutzung hirnerkrankter Menschen in der Moralforschung, Nervenheilkunde.





## Normative critique – Summary

We indicate two problems of current work with lesion patients: First, recent studies using patients with frontal lobe lesions in moral research promote a neurodeterminism of human moral behavior, which is insufficiently supported by the current state of knowledge.

Second, there is a shift in research away from clinical issues towards basic research on human morality. The latter point is notable, as the day-to-day handling of neuropsychological patients is challenging and demonstrates constraints of classical principles of medical ethics like autonomy and benevolence..

**Collaboration:** We have prepared a survey among researchers using lesion patients – support would be acknowledged.



# Genealogical critique: genesis of social neuroscience

We analyzed the emergence of social neuroscience using bibliometric and qualitative methods intending to reconstruct origins, properties, and discourses that lead to today's understanding of social neuroscience as a disciplinary field.

(Matusall, Kaufmann, Christen, 2011)

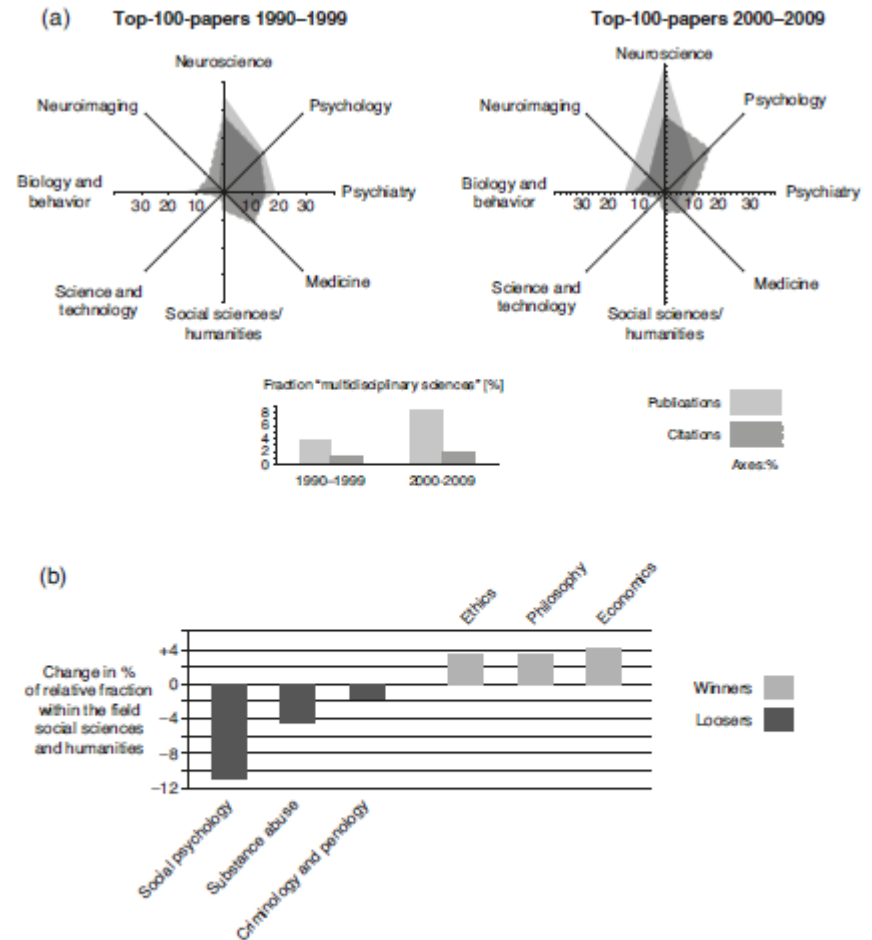
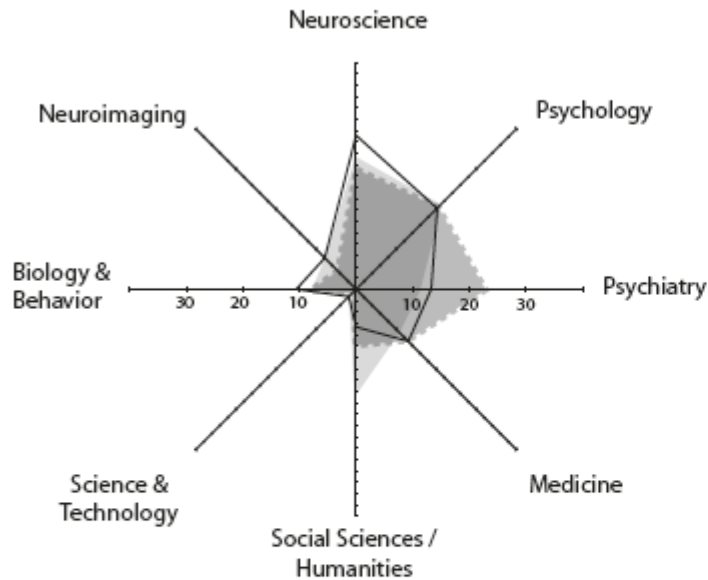


Fig. 2.3 Impact Analysis for Top 100 Papers of the Decades 1990-1999 and 2000-2009: a) The top 100 papers in social neuroscience of the second decade have a different impact profile than those of the first decade and show a larger net-transfer to other disciplinary clusters: 27.9% compared to 17.6%. This is partly explained by the larger fraction of papers from the second decade published in interdisciplinary journals. b) Top 3 winning and losing subject areas forming the cluster "social sciences and humanities" when comparing the appreciation of social neuroscience papers of the 1990s and the 2000s. The papers gained interest in core fields of social science and humanities, namely economics, philosophy, and ethics.

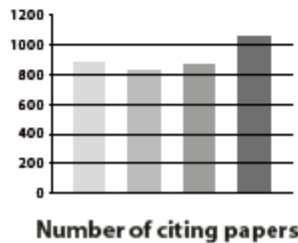
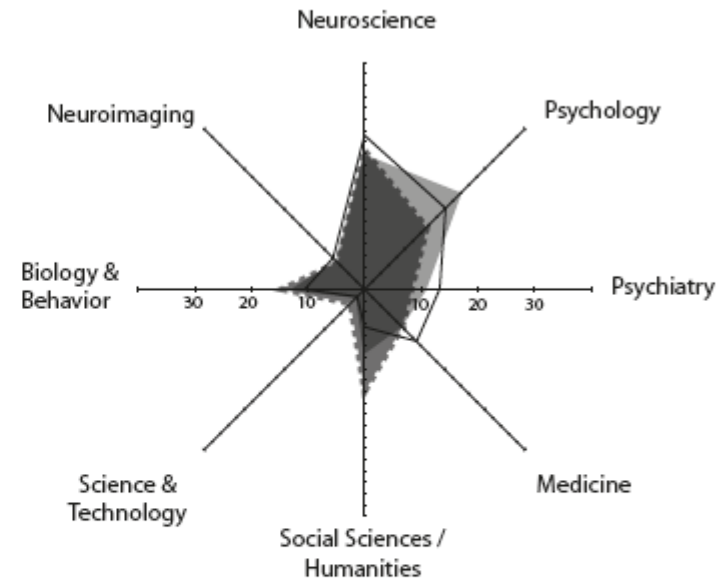




# Agent states and behavior types



### Moral vs. Psychopathy



### Empathy vs. Trust etc.



Moral   
 Psychopathy 

Empathy   
 Trust etc. 

Axes: %



## Genealogical critique – Summary

The disciplinary basis of social neuroscience narrowed over time: being comparably strongly founded in neuroscience, psychology and psychiatry in the 1990s, neuroscience (and neuroimaging) became dominant clusters for publications in the 2000s.

The interest in ‘anormal’ social being (e.g. psychopaths) shifted to an interest in issues of ‘normal’ social behavior.

Although the impact in the disciplinary cluster ‘social sciences and humanities’ is not that large, social neuroscience results gained more attention in core disciplines of this cluster.

**Collaboration:** Advancing the method of “impact analysis” as a tool in bibliometry.



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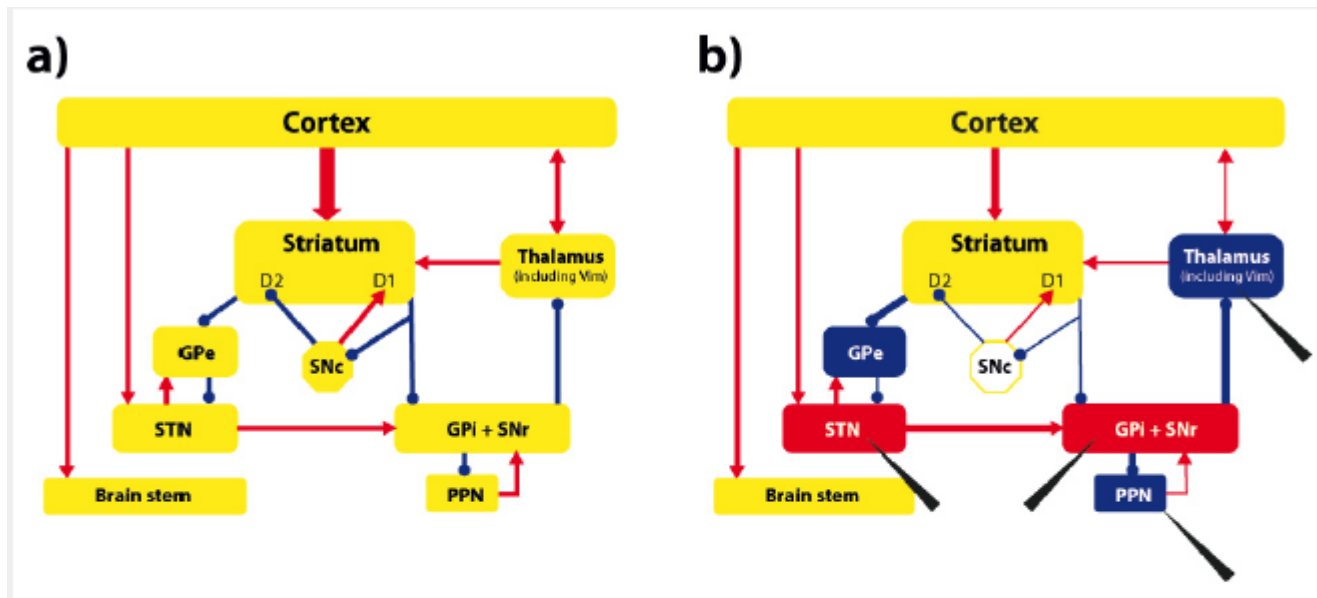
**Being practical**

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# Ethical and psychosocial issues of DBS: DBS in movement disorders

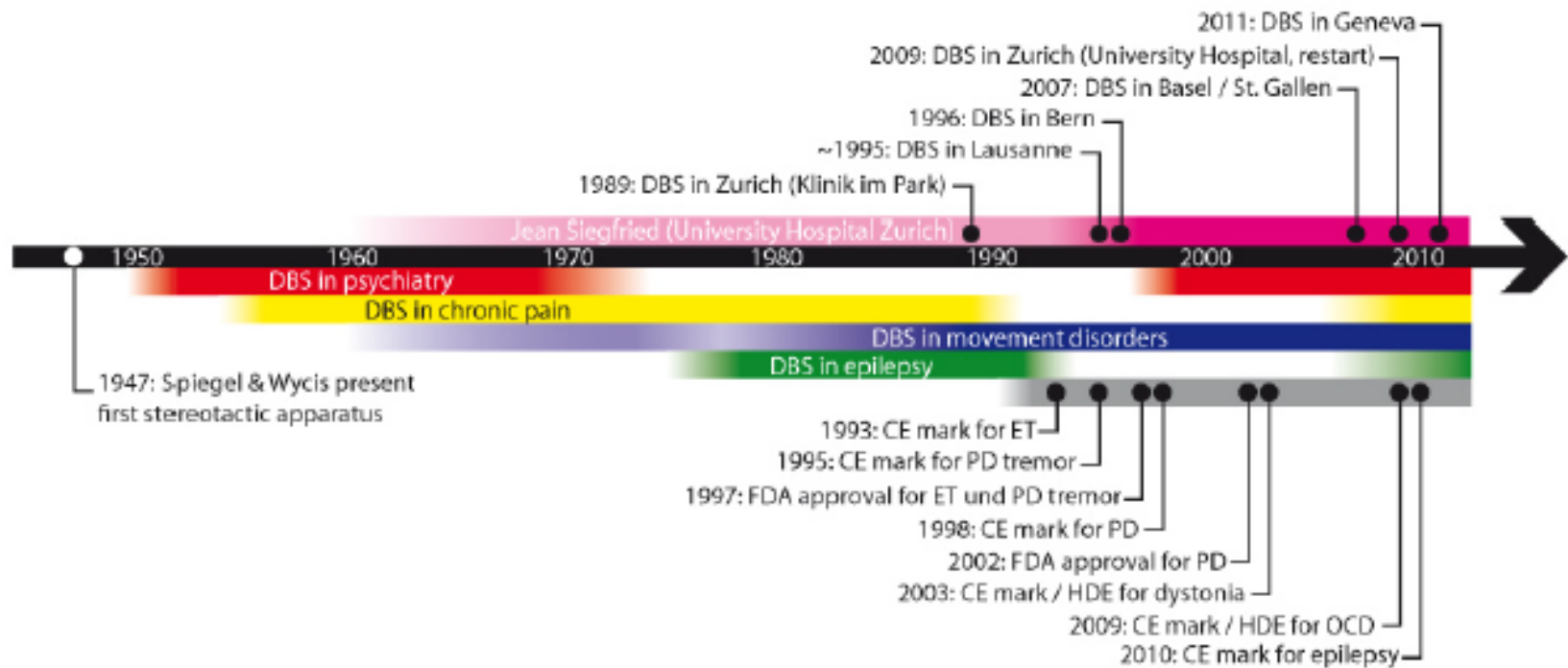


**Figure 2**

A simplified scheme of the basal-ganglia and thalamo-cortical network responsible for movement control (based on [39, 40]). Part a) shows the functional network, where red lines stand for excitatory and blue lines for inhibitory connections. Part b) shows the dysfunctional network resulting from a loss of dopaminergic neurons in the *Substantia nigra pars compacta* (SNc). Network nodes in red color indicate hyper-activation, nodes in blue color hypo-activation. D1/D2: sub-populations of neurons in the striatum; GPe: *Globus pallidus externus*; STN: *Nucleus subthalamicus*; GPI: *Globus pallidus internus*; SNr: *Substantia nigra pars reticulata*; PPN: *Nucleus pedunculopontinus*; Vim: *ventral intermediate part of Thalamus* (Vim). Black arrowheads indicate potential DBS targets in which quadripolar electrodes are stereotactically implanted. The electrodes are connected to a pulse generator (usually placed under the skin in the subclavicular or abdominal area) that controls several parameters of the chronically applied electrical stimulation (frequency, pulse width, and amplitude). The intervention is usually made in the alert patient, as active cooperation by the patient is required for evaluating target accuracy and stimulation benefit while the electrodes are



# Ethical and psychosocial issues of DBS: Historical remarks





# DBS – Bibliometry & Study Quality

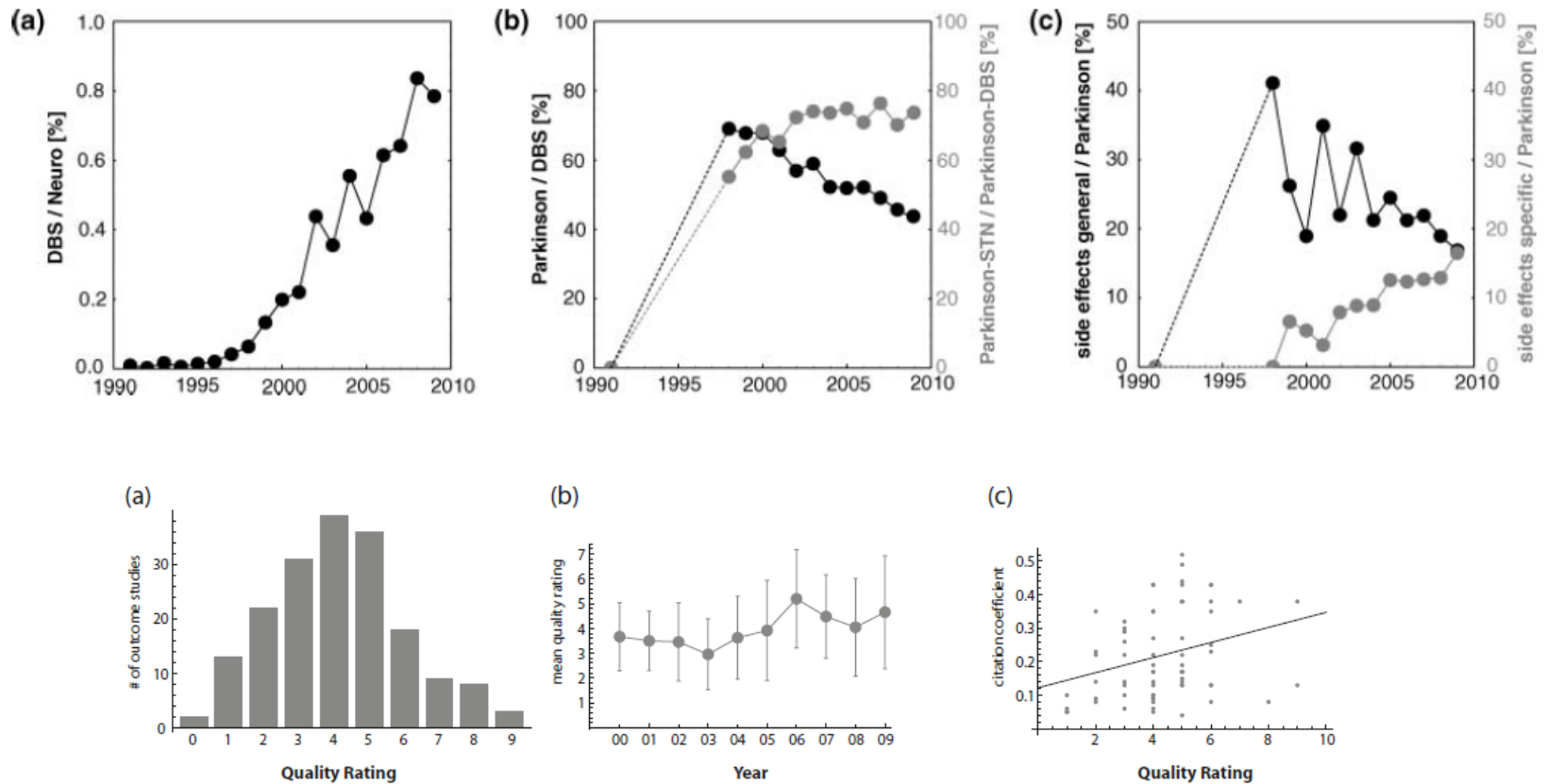


Figure 2. (a) Quality rating distribution of the outcome studies of group 3, (b) time course of the mean quality rating of outcome studies (group 3), and (c) correlation between the citation coefficient of studies (which reflects the appreciation of papers by the authors or reviews) with the quality rating of the studies. The chart also includes the linear approximation of the correlation.

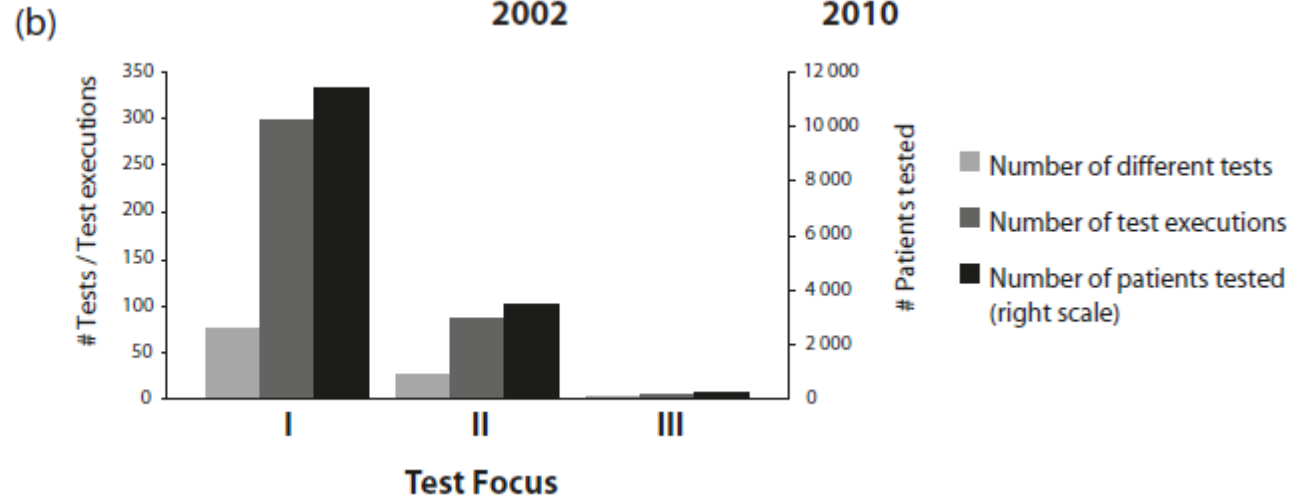
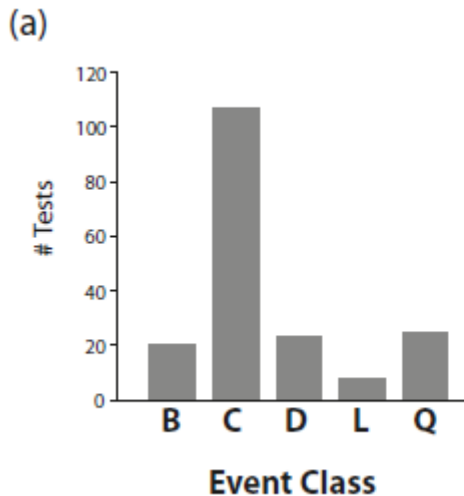
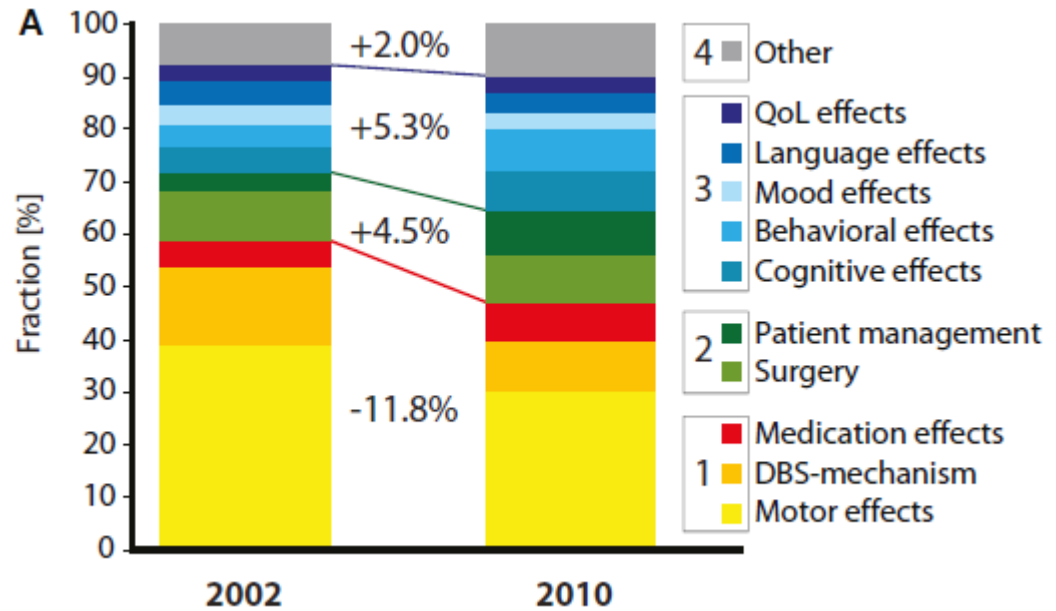




# DBS – Issue classes addressed in DBS studies

The perspective on side effects is very biased in the DBS literature.

This finding might explain the “satisfaction gap” between the physician’s and the patient’s expectation that is discussed in the literature.



## DBS: Improving patient decision making

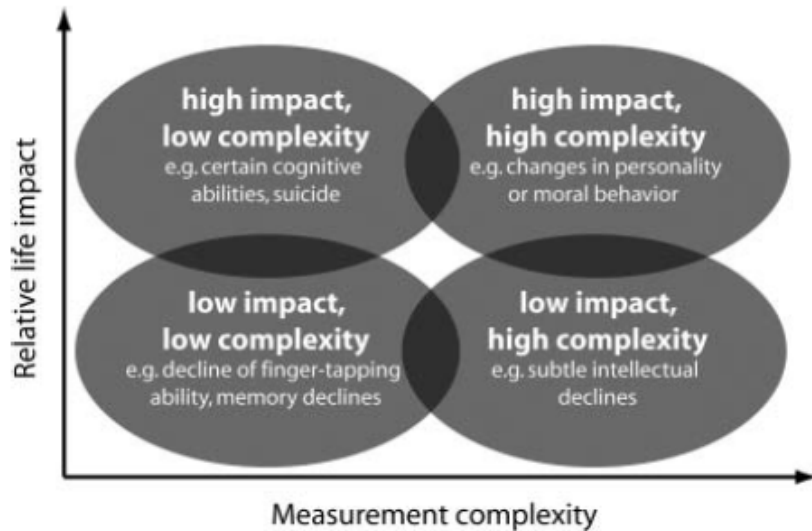


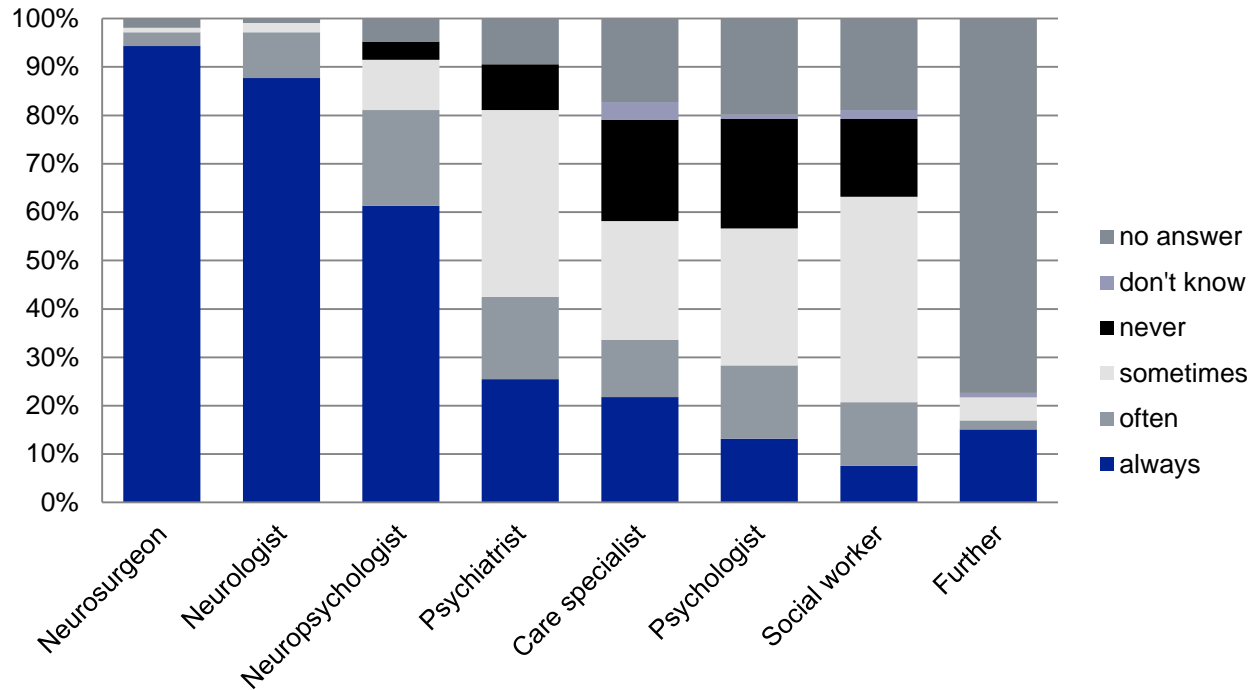
Figure 2. Classification of side effects of STN DBS along the dimensions “measurement complexity” and “relative life impact”; highlighted are four clusters of side effects.





# Some preliminary results of our current DBS survey-based study (1)

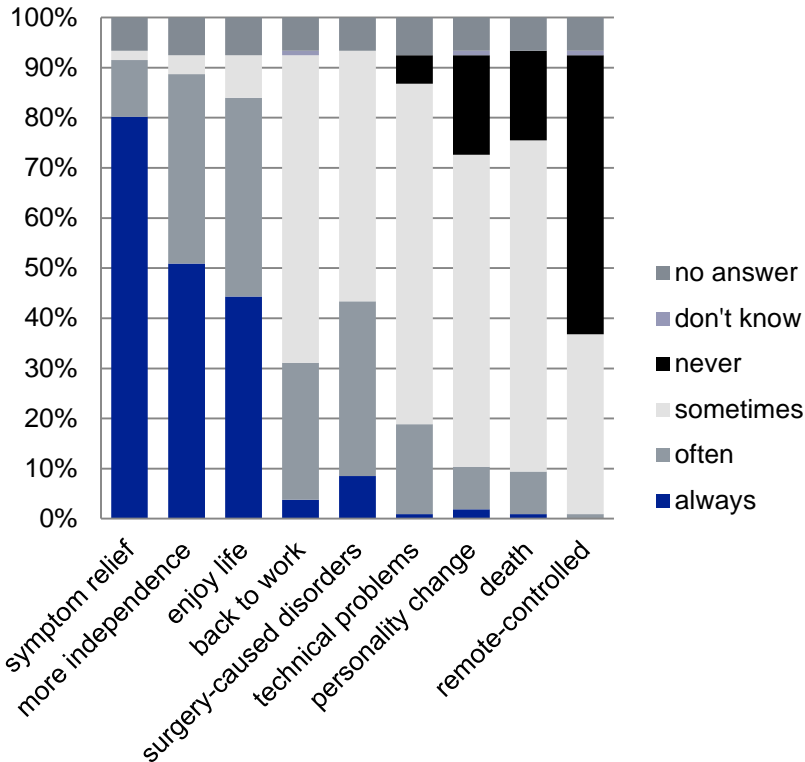
## Involved disciplines in patient assessment



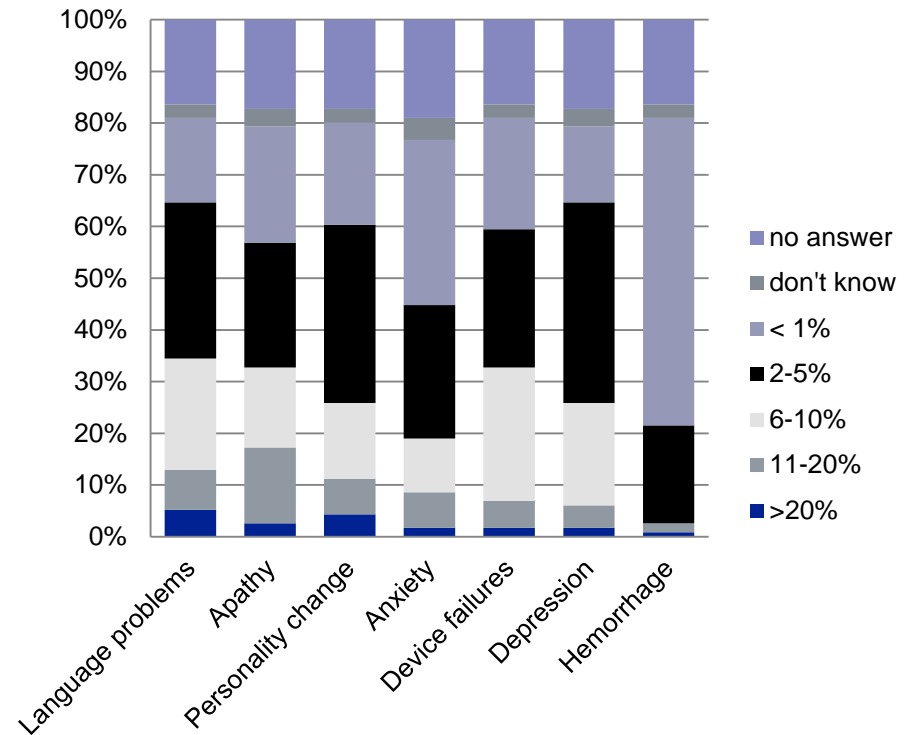


# Some preliminary results of our current DBS survey-based study (2)

### Hopes and Fears of patients



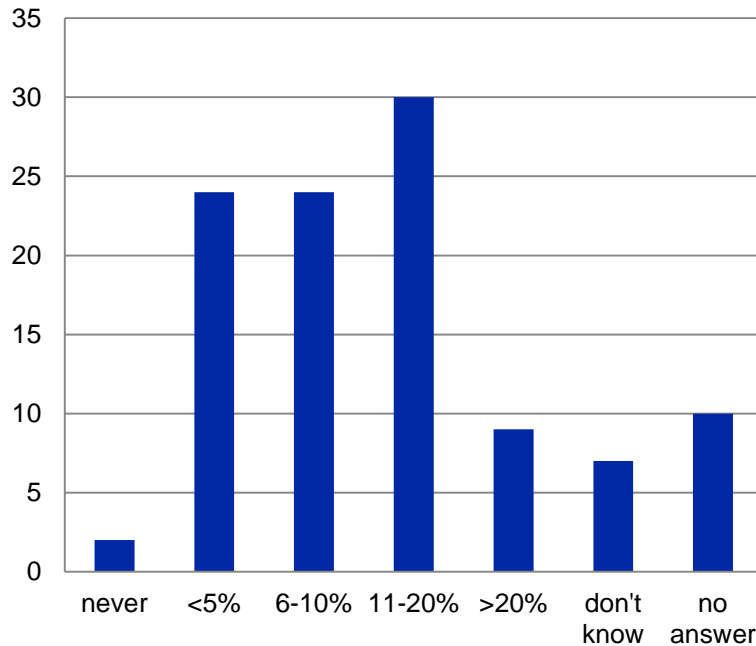
### Probability of adverse events



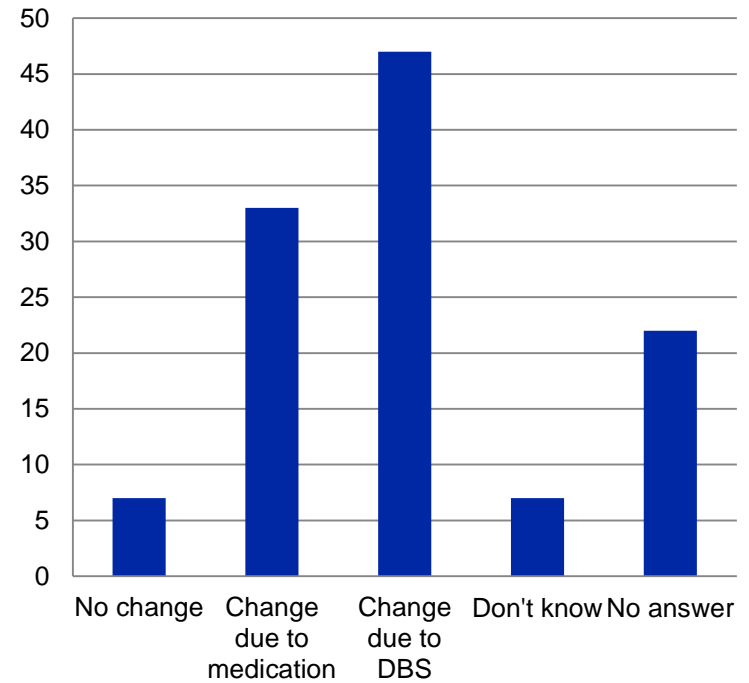


# Some preliminary results of our current DBS survey-based study (3)

### Satisfaction gap



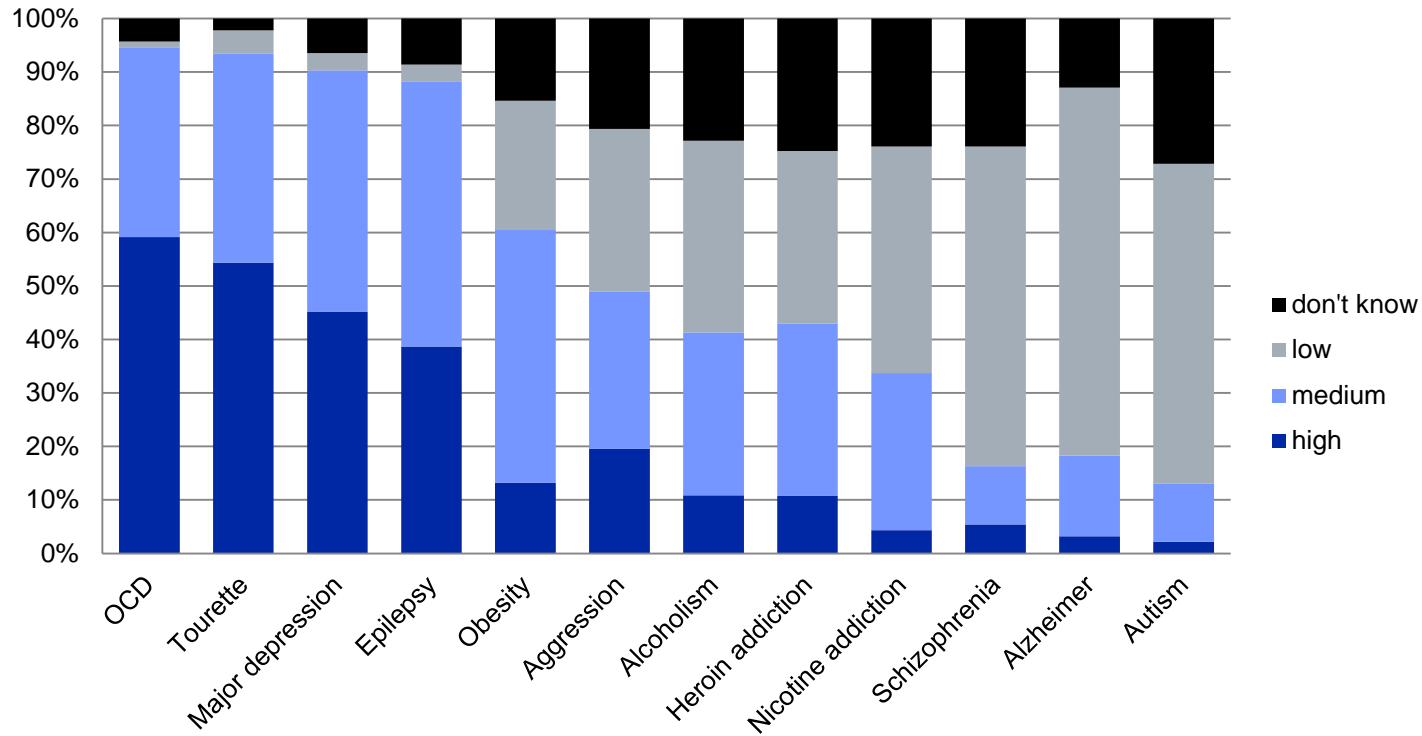
### Personality change





# Some preliminary results of our current DBS survey-based study (4)

## Success probability of future DBS applications





## Being practical: treating patients – Summary

We need a better understanding of the «complex» side effects by taking into account the various perspectives of the involved stakeholders.

This we intend to do in our proposal that we will resubmit.

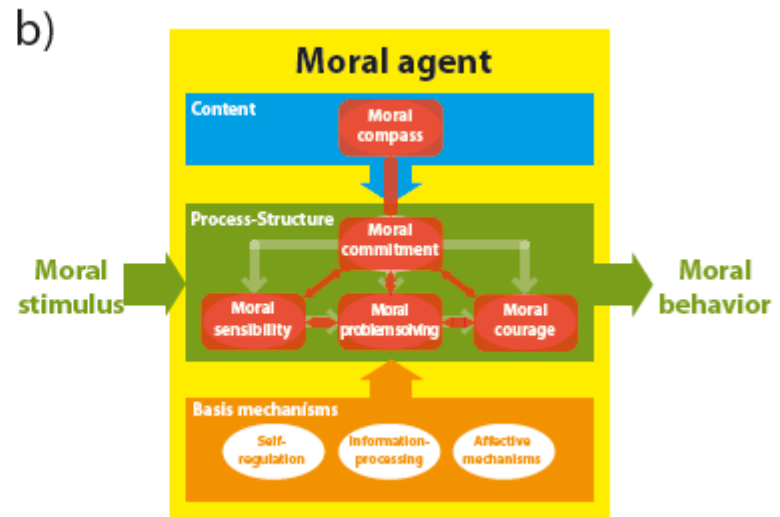
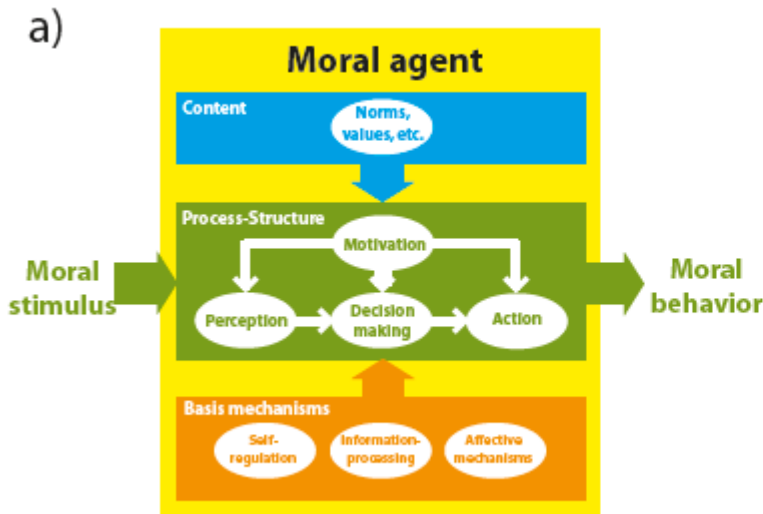
**Collaboration:** Ongoing – we hope to include your expertise.



# Being practical – Creating a Serious Moral Game

The basic idea of a Serious Game is, that it sets up a fictional environment, in which the player is motivated “to play the game” although the game serves an external goal.

We want to create a game setting that serves as a tool for investigating all component of what we call “moral intelligence” (Tanner & Christen, in press).







## Why a Serious Moral Game?

Also in medicine, Serious Games and simulation tools have become an important instrument both for training professionals, as well as for patient therapy. As various studies show that learning preferences of students are strongly shaped by new media technologies like video games, virtual reality environments, the Internet, and social networks, it can be expected that similar developments will transform training of medical students, too

In particular, the complexity associated with ethical decision making could become a fruitful object of a SMG, intending to inform the player (student or medical professional) both on his value spectrum and preferences, as well as on the associated psychological competences like moral sensibility

This, because, it is well-established that medical students and professional need to develop critical self-reflection on their own hidden and divided values and those of their patients and patients' families.



## Being practical: communicating and enhancing

Understanding a SMG as a tool requires (beside others) to resolve a communication task (to communicate “hidden” test results referring to a “sensible competence” (moral behavior) in a way that the person can work with the result) in order to serve an enhancement goal (but in a “classical sense” by improving psychological competences via reflection).

**Collaboration:** Open for any idea.



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**Being theoretical**

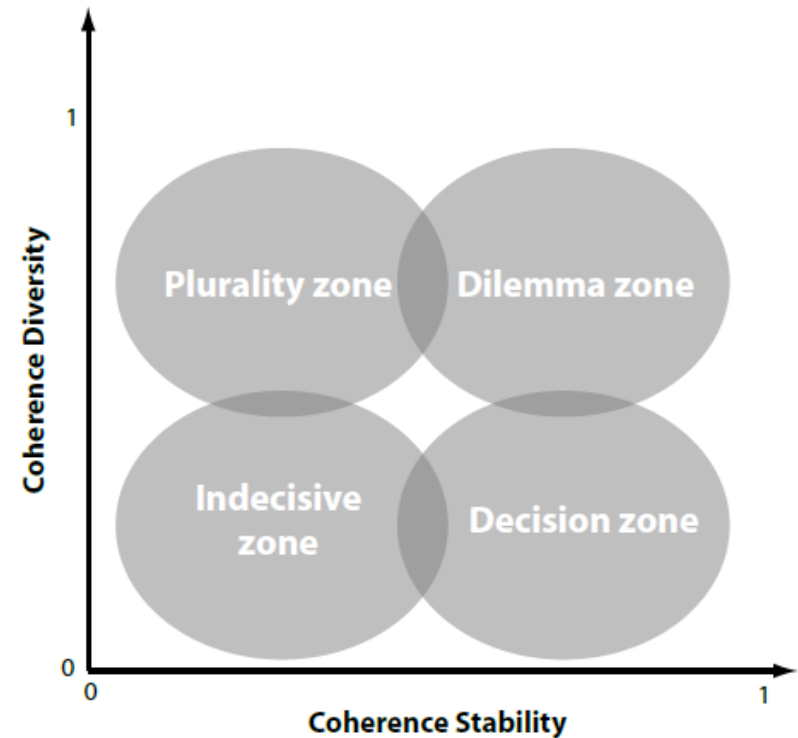
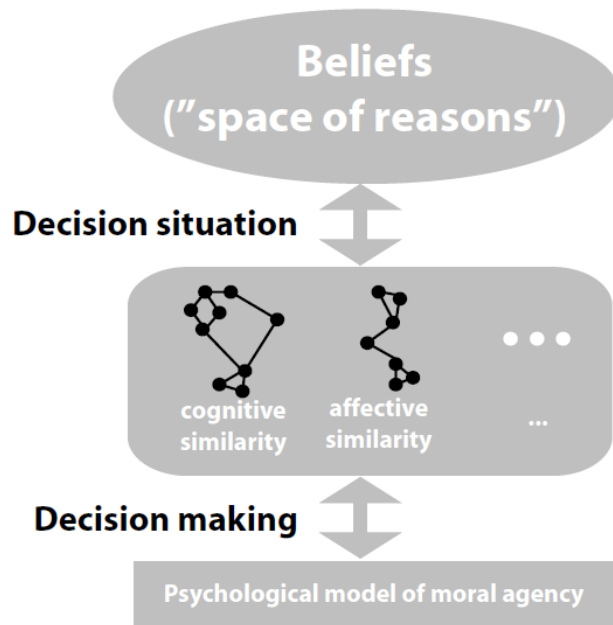
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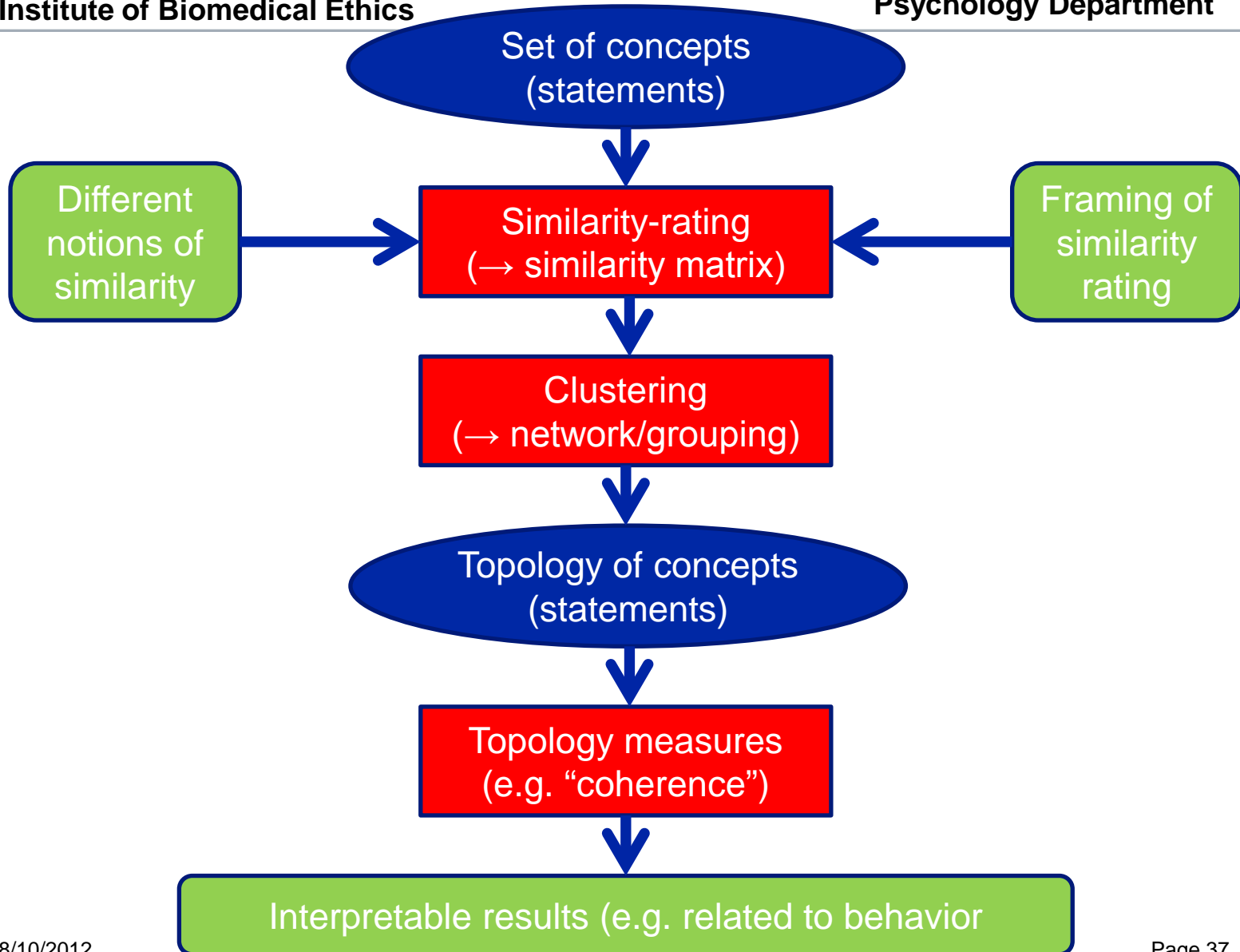


**Psychology Department**



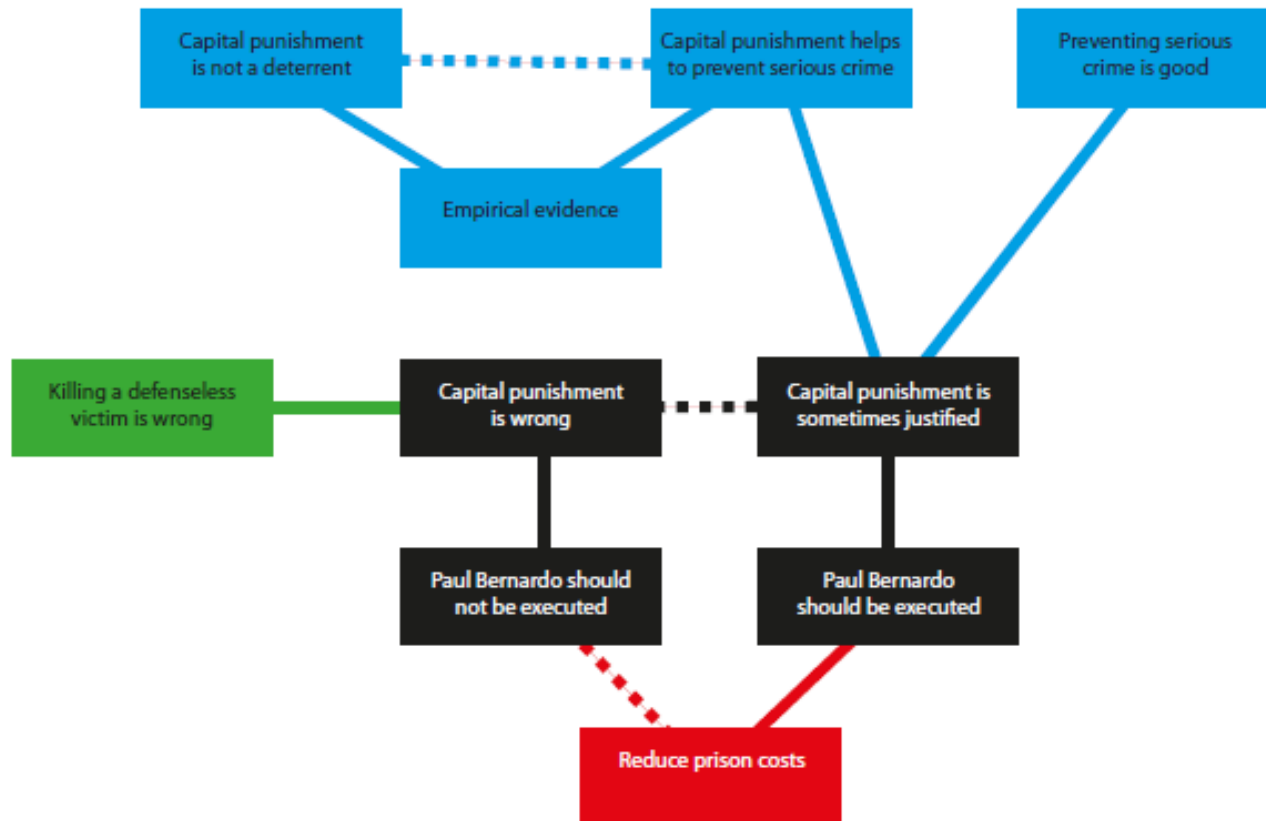
# A novel understanding how “reasons work” (measuring the “space of reasons” and its topopogy)







# An exemplification using Thagard's example





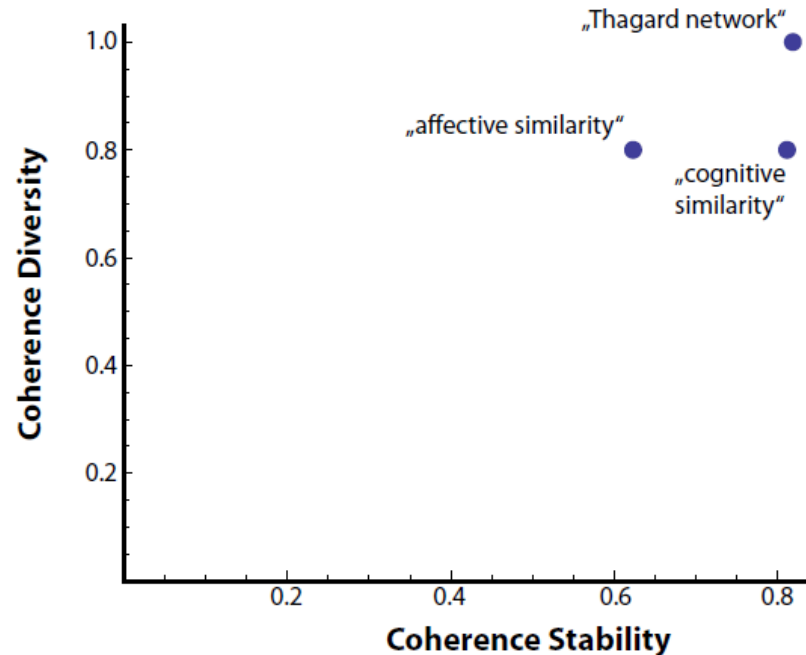
## “Cognitive” and “affective” similarity

### Cognitive cluster:

“Capital punishment helps to prevent serious crimes”,  
“Preventing serious crime is good”, “Capital punishment is sometimes justified”, “reduce prison costs”, “execute Paul Bernardo”

### Affective cluster:

“Capital punishment is not a deterrent”, “Preventing serious crime is good”, “killing a defenseless victim is wrong”, “capital punishment is wrong”, “execute Paul Bernardo”





## Methodological setup for similarity assessment: Ongoing “map of science” study

We want to have a similarity assessment task that is:

- Suitable for web-interface
- “Bottom-up” (i.e. not “holistic” like a task that involves, e.g., having all concepts printed on paper and let people sort on tables”
- Robust for order-effects (i.e. we want to give the subject the freedom to stop the survey whenever he/she likes).

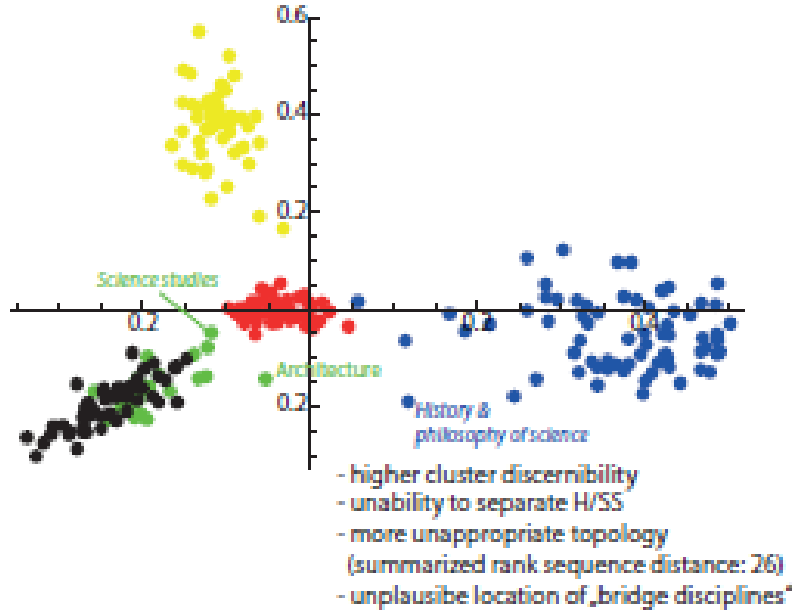




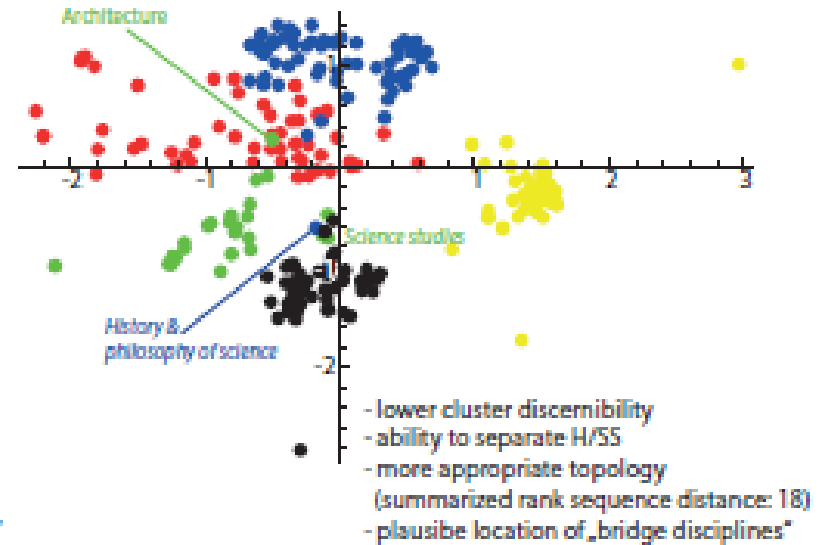


# Some preliminary results (also with respect to visualization: superparamagnetic agent maps)

Multidimensional scaling



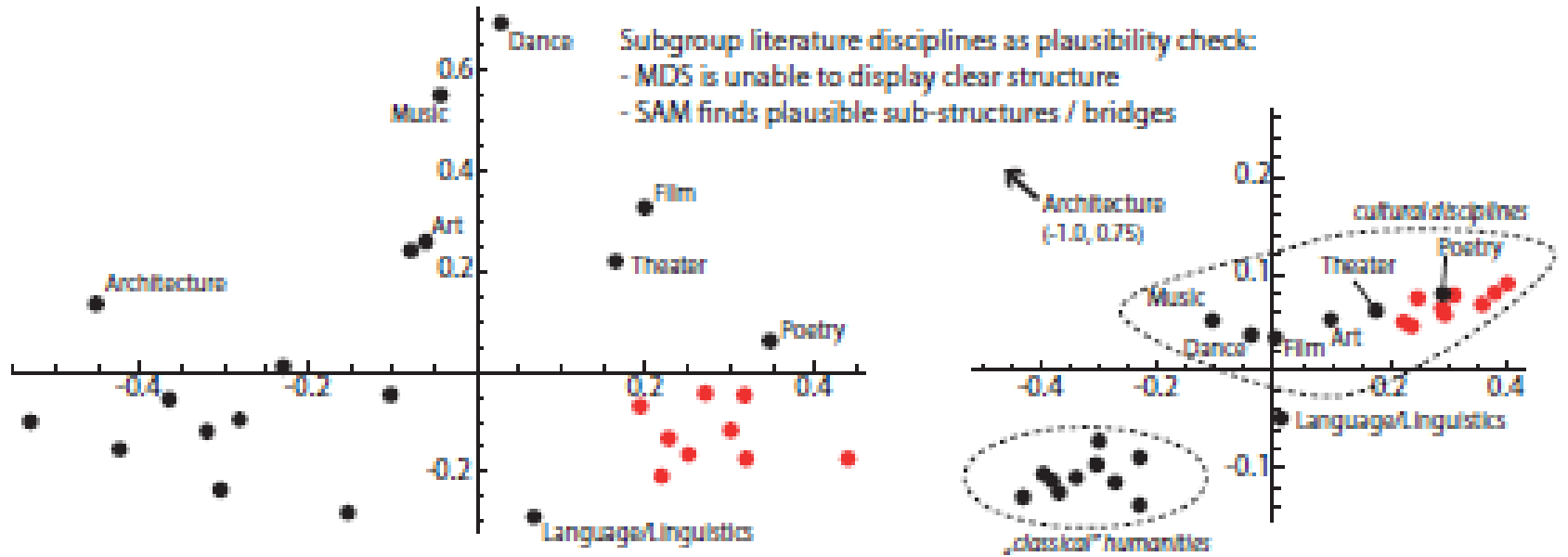
Superparamagnetic agent map





# Some preliminary results (also with respect to visualization: superparamagnetic agent maps)

## Comparison MDS and SAM for Humanities disciplines





## Modeling moral hypocrisy

The model implements the conceptual idea of moral hypocrisy “*(...) avoid the cost of being moral while maintaining the appearance of morality (...).*” by distinguishing two different types of agent-states:

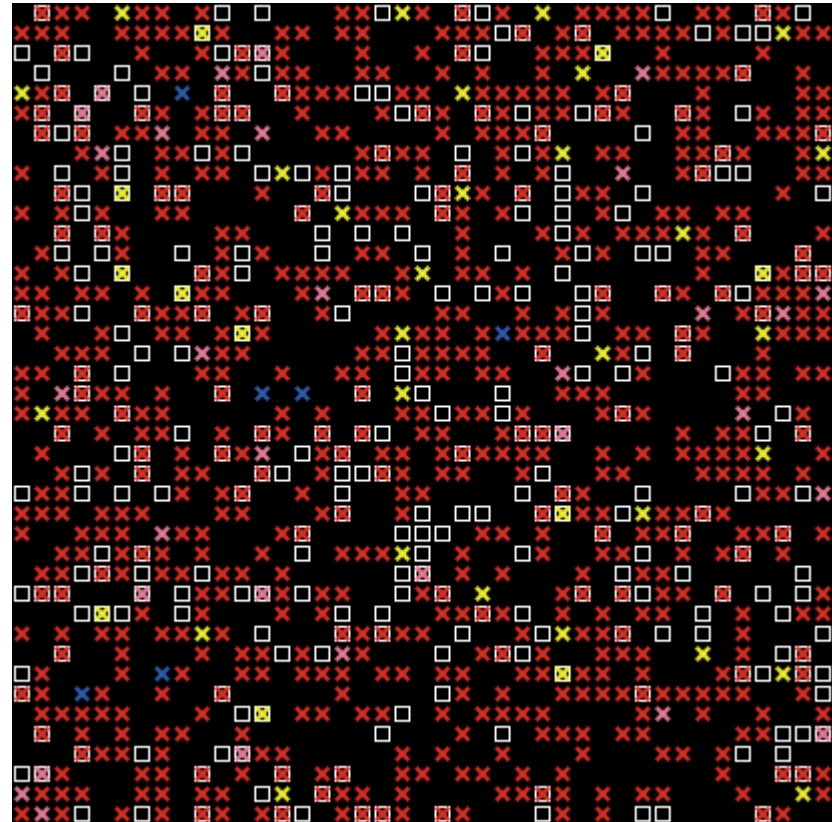
- The **reputation** of the agent (either morally good, G, or bad, B).
  - Model parameter  $p(r)$ : set-up probability for good reputation ( $p(r) = [0,1]$ )
- Its **disposition to act** toward temptations (either to be tempted, T, or to resist a temptation, R).
  - Model parameter  $p(t)$ : set-up probability for being tempted ( $p(t) = [0,1]$ )

This offers four different behaviors to the agents:

- Appearing good and resist a temptation (GR; “good guys”, blue)
- Appearing good but being tempted (GT; “hypocrites”, yellow)
- Appearing bad and being tempted (BT; “bad guys”, red)
- Appearing bad but resisting temptations (BR; “inconsistent guys”, pink).

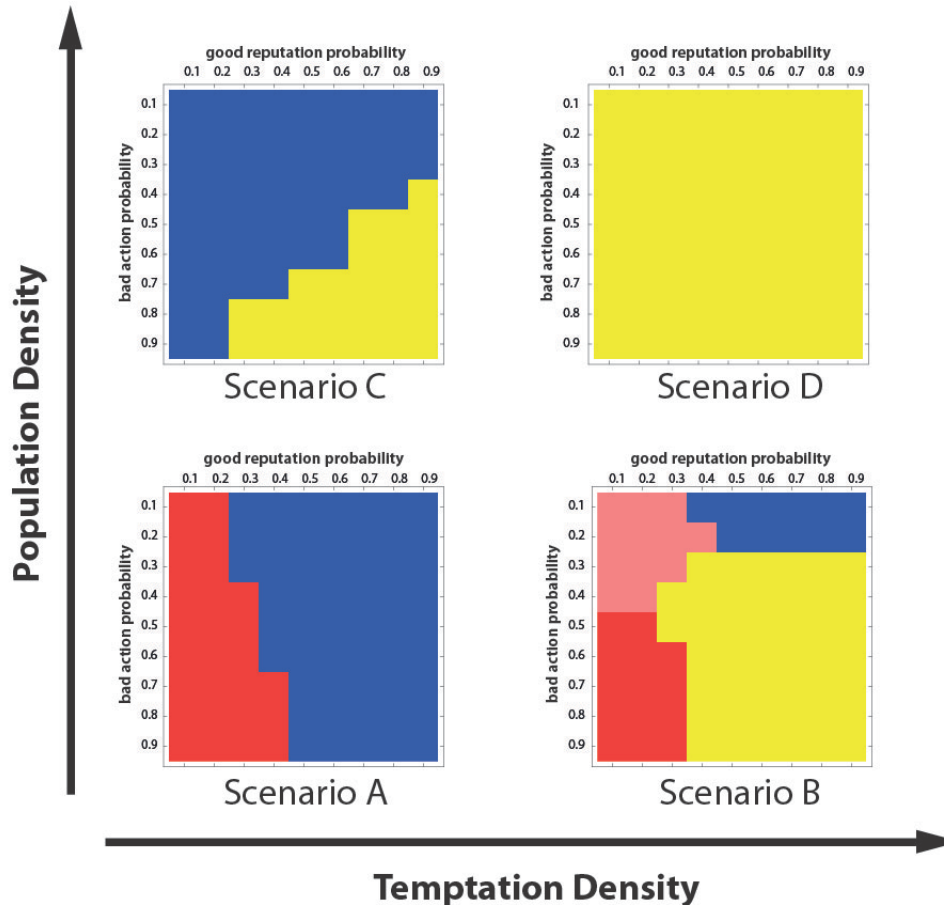
## How the model works

- a) It randomly distributes agents and temptations and assigns former an initial behaviors according to  $p(r)$  and  $p(t)$ .
- b) It selects an agent  $X$
- c) It calculates the payoff of  $X$
- d) It does a) and b) for each agent chosen in a random order
- e) It changes the behavior of each agent to the behavior of its best performing neighbor
- f) It applies the strategy (1-11), checks whether stop condition g) applies and if not goes back to b).
- g) It stops when the model reaches a quasi-stable state (no significant population size changes)



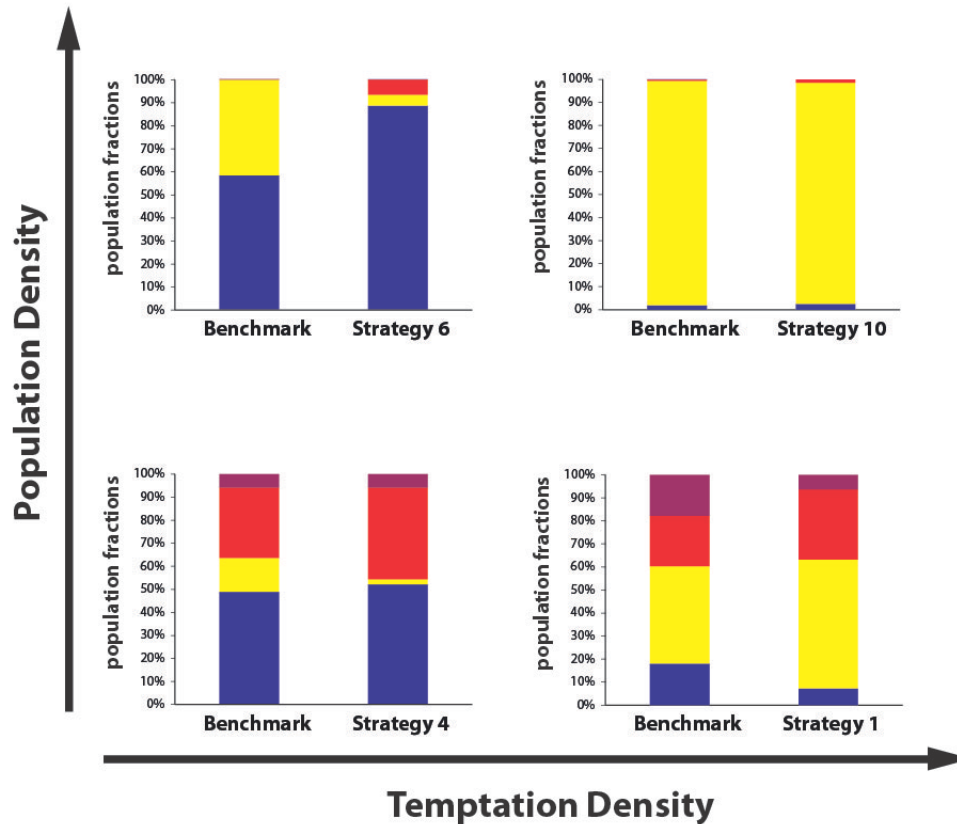


# Paradigmatic scenarios – Majorities (Benchmark)





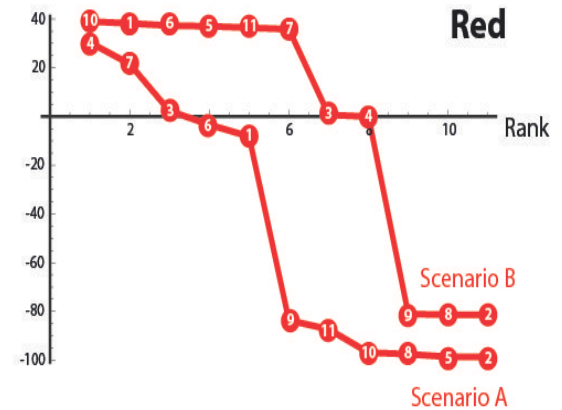
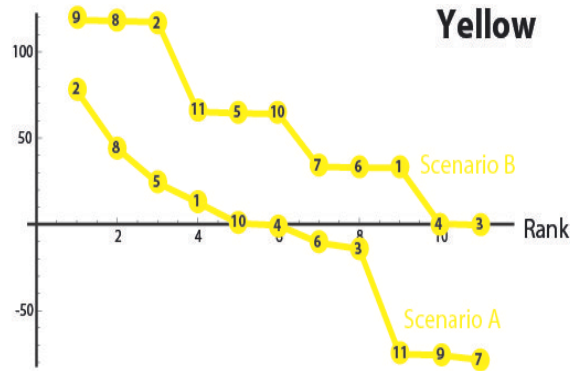
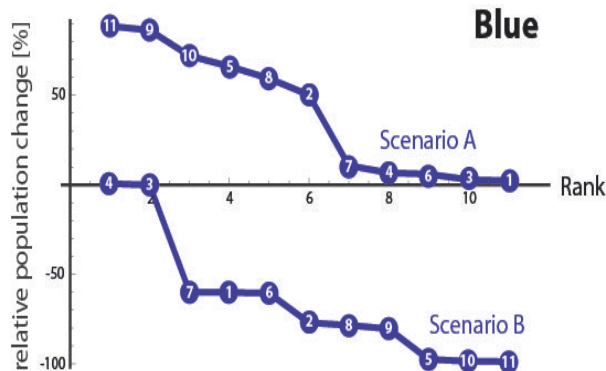
# Result 1-A: Scenario parameters are the main determinants of population distributions (no strategy induced majority change)





## Result 1-B: Strategy rankings reveal conflicting effects of interventions

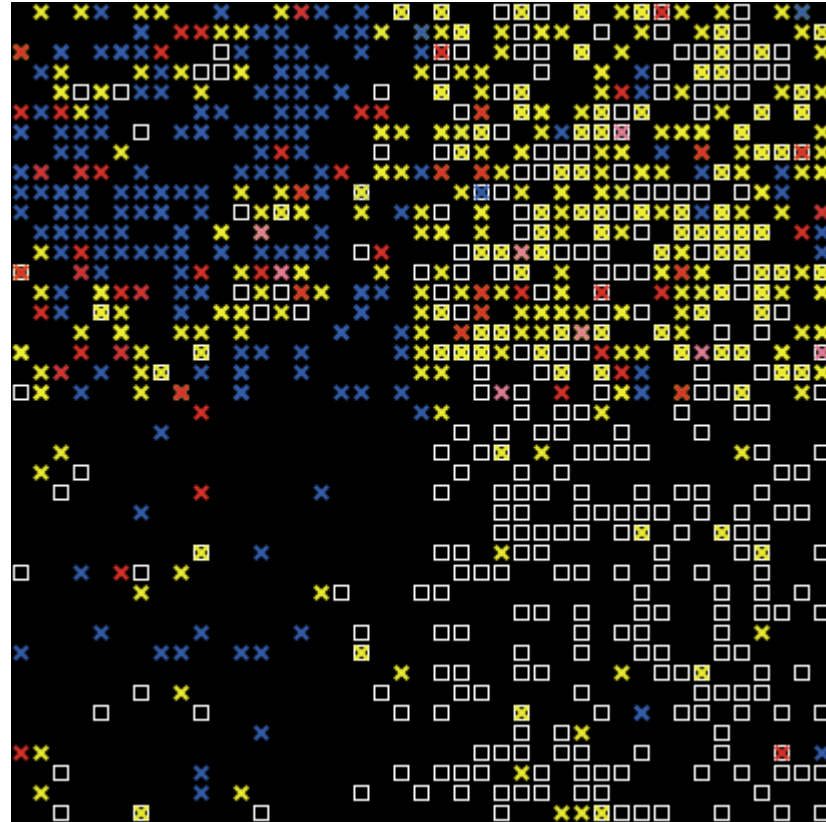
We ranked the strategies according to their ability to increase the population of a specific behavior type relative to the benchmark population size. We display the two sequences for each population with the highest dissimilarity measured by the Kendall Rank correlation (a measure for the similarity of rankings).





## Including all four basic scenarios in one model

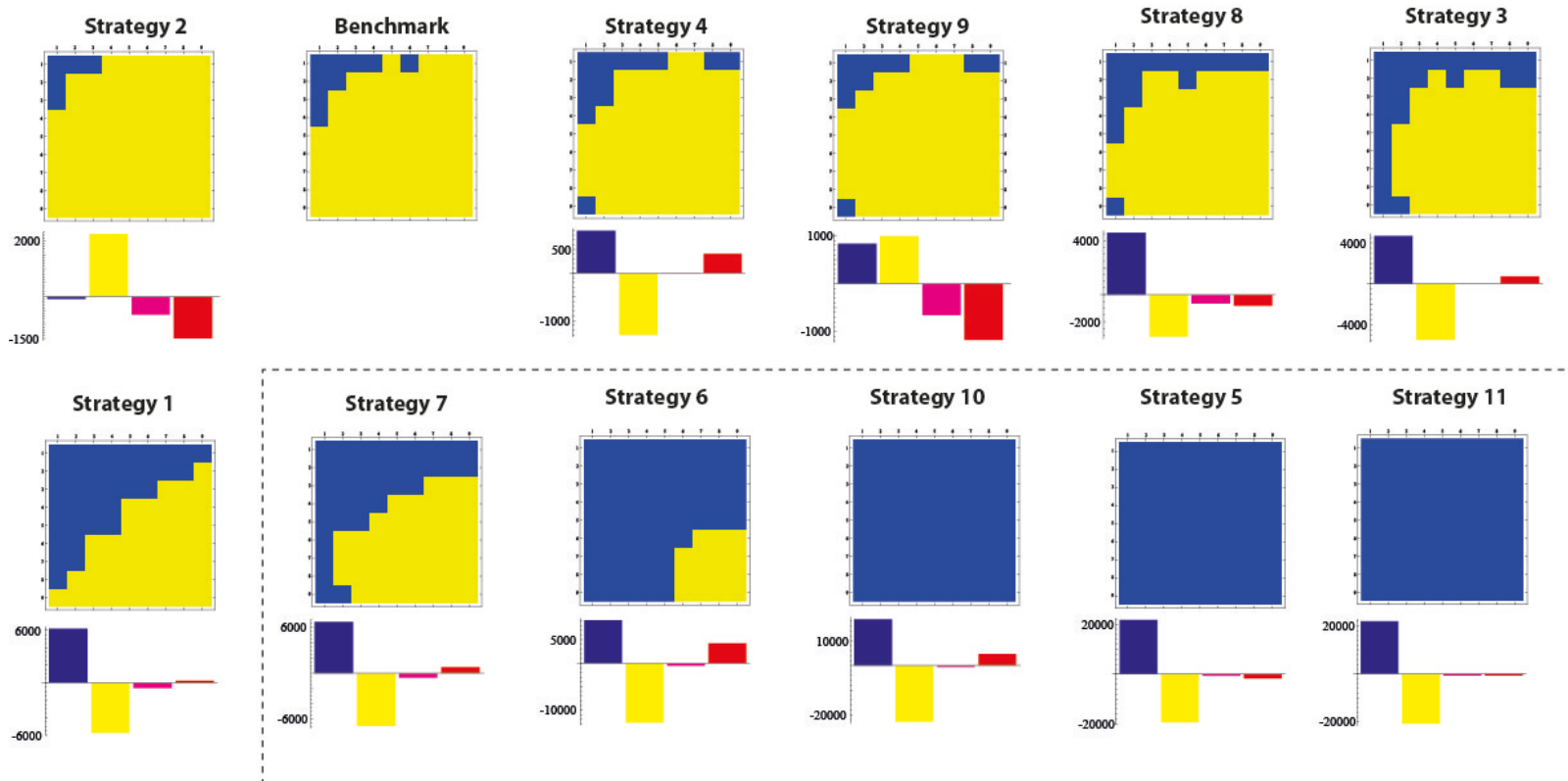
The model now has spatial structure with respect to the probability of distributing agents and temptations such that the four main scenarios are present simultaneously.





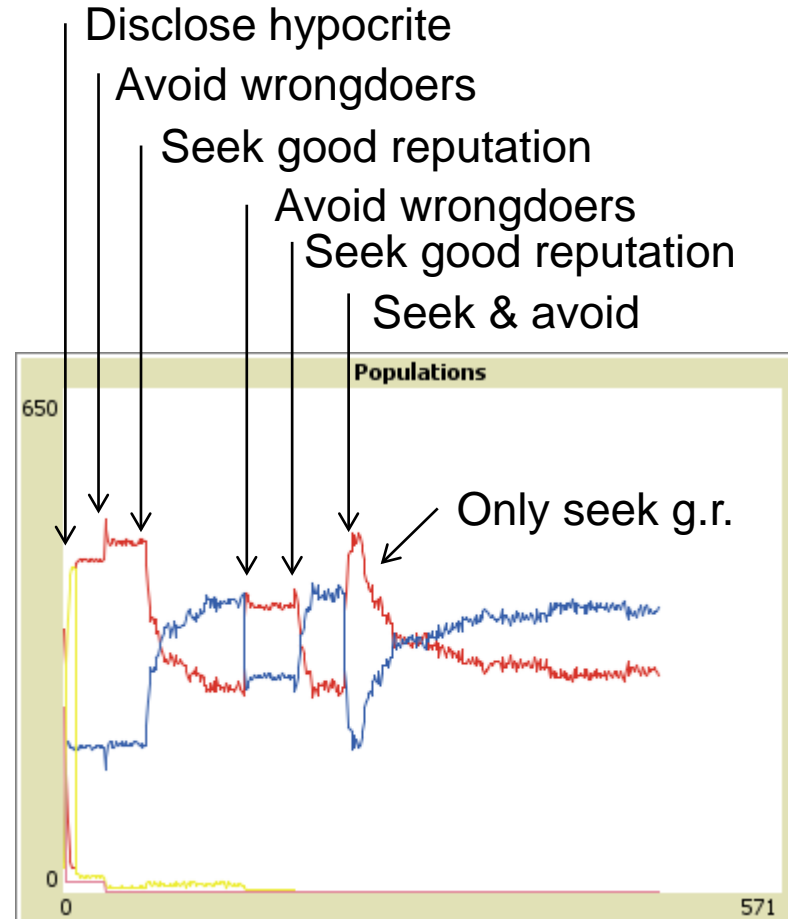
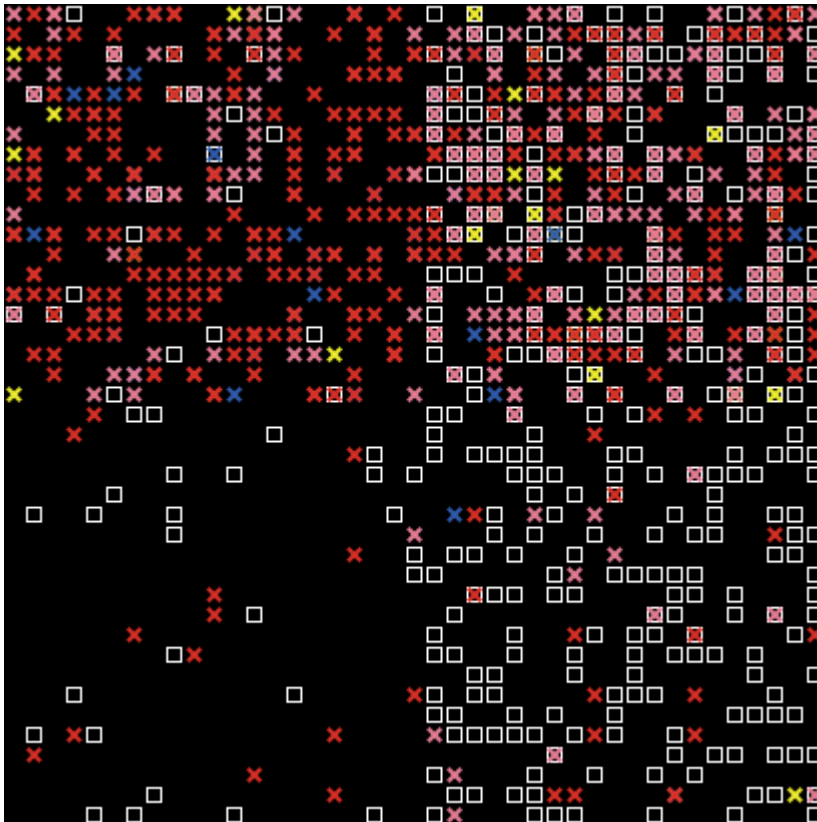


# Result: Scenario-diversity allows to defeat moral hypocrisy for some strategies (majority change)





# Dynamics – preliminary example





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**Thank you!**