Public Health and Safe Communities Require Open Societies

Brain Health Alliance
Guardians 2025 Conference
October, 9, 2025

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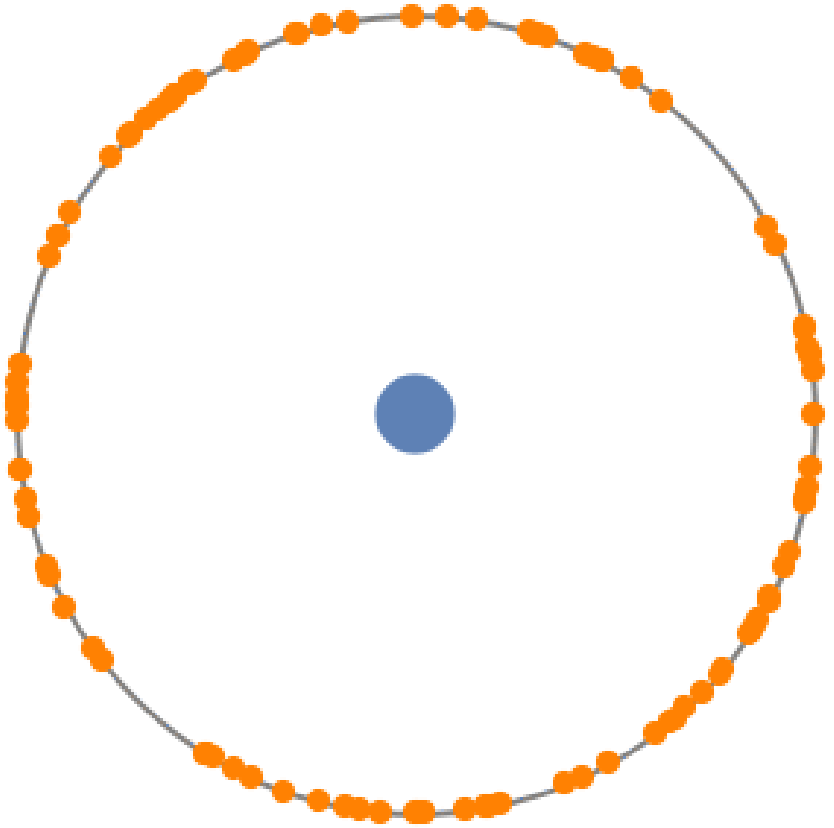
Overview

- motivation
- concepts
- data
- model
- results
- conclusion

Politics

Science

Yoshiki Kuramoto (*1940)



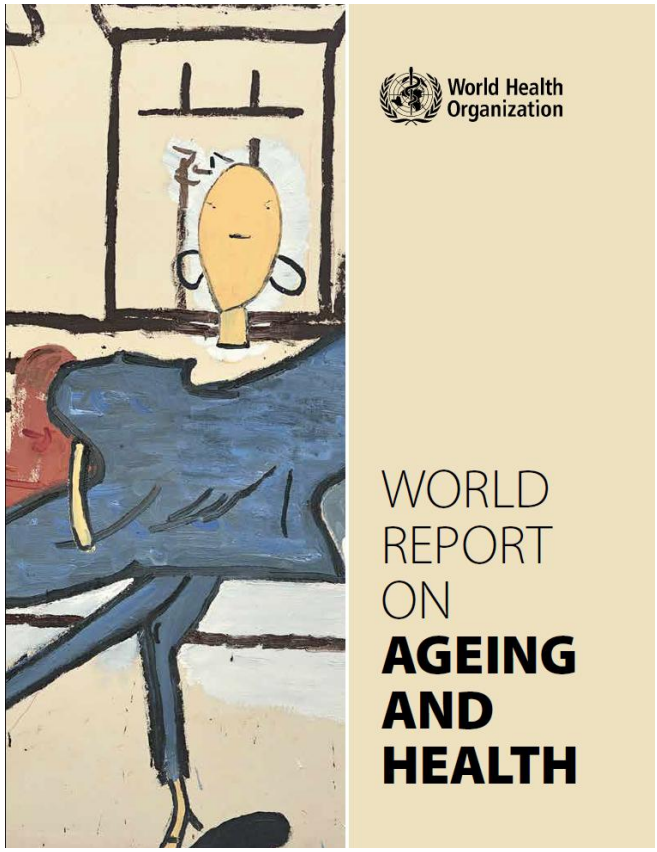
Kuramoto model (1975)

Public Health

Public health is the science and the art of preventing disease, prolonging life, and promoting physical health and efficiency through organized community efforts for the sanitation of the environment, the control of community infections, the education of the individual in principles of personal hygiene, the organization of medical and nursing service for the early diagnosis and preventive treatment of disease, and the development of the social machinery which will ensure to every individual in the community a standard of living adequate for the maintenance of health.

Winslow (1920, p. 30)

Healthy Aging

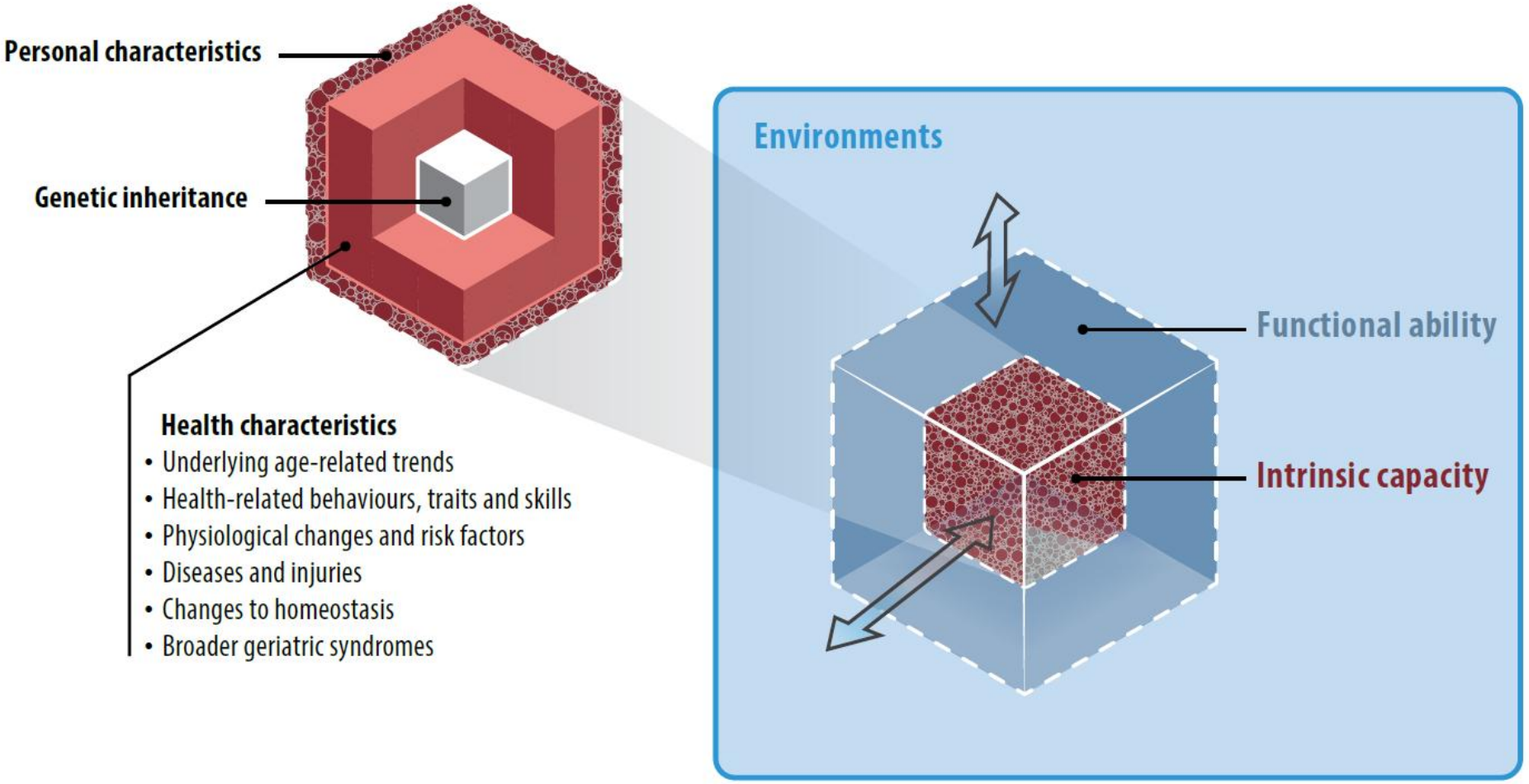


In setting out this framework, the report emphasizes that healthy ageing is more than just the absence of disease. For most older people, the maintenance of **functional ability** has the highest importance. The greatest costs to society are not the expenditures made to foster this functional ability, but the benefits that might be missed if we fail to make the appropriate adaptations and investments. The recommended societal approach to population ageing, which includes the goal of building an age-friendly world, requires a transformation of health systems away from disease-based curative models and to-wards the provision of integrated care that is centred on the needs of older people.

Margaret Chan

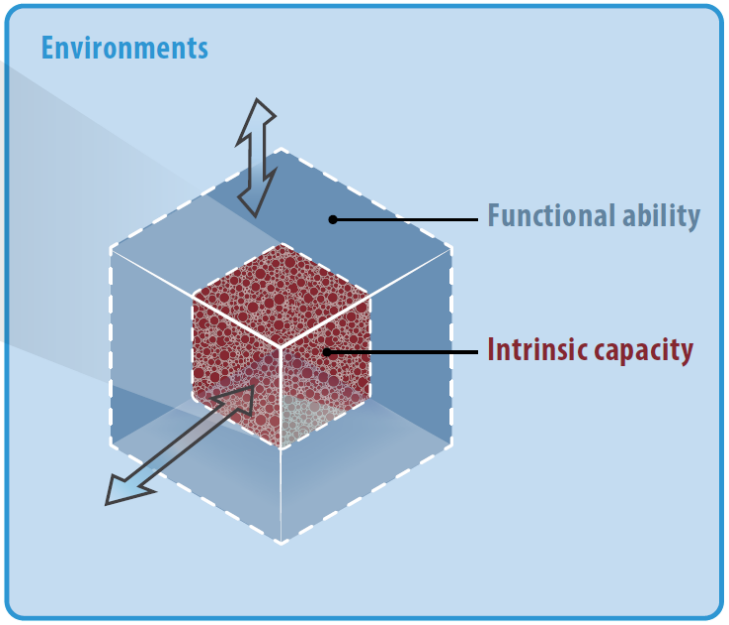
WHO (2015)

Healthy Aging



WHO (2015)

Healthy Aging



This report defines ***Healthy Ageing*** as **the process of developing and maintaining the functional ability that enables well-being in older age.**

Functional ability comprises the health-related attributes that enable people to be and to do what they have reason to value. It is made up of the intrinsic capacity of the individual, relevant environmental characteristics and the inter-actions between the individual and these characteristics.

Intrinsic capacity is the composite of all the physical and mental capacities of an individual.

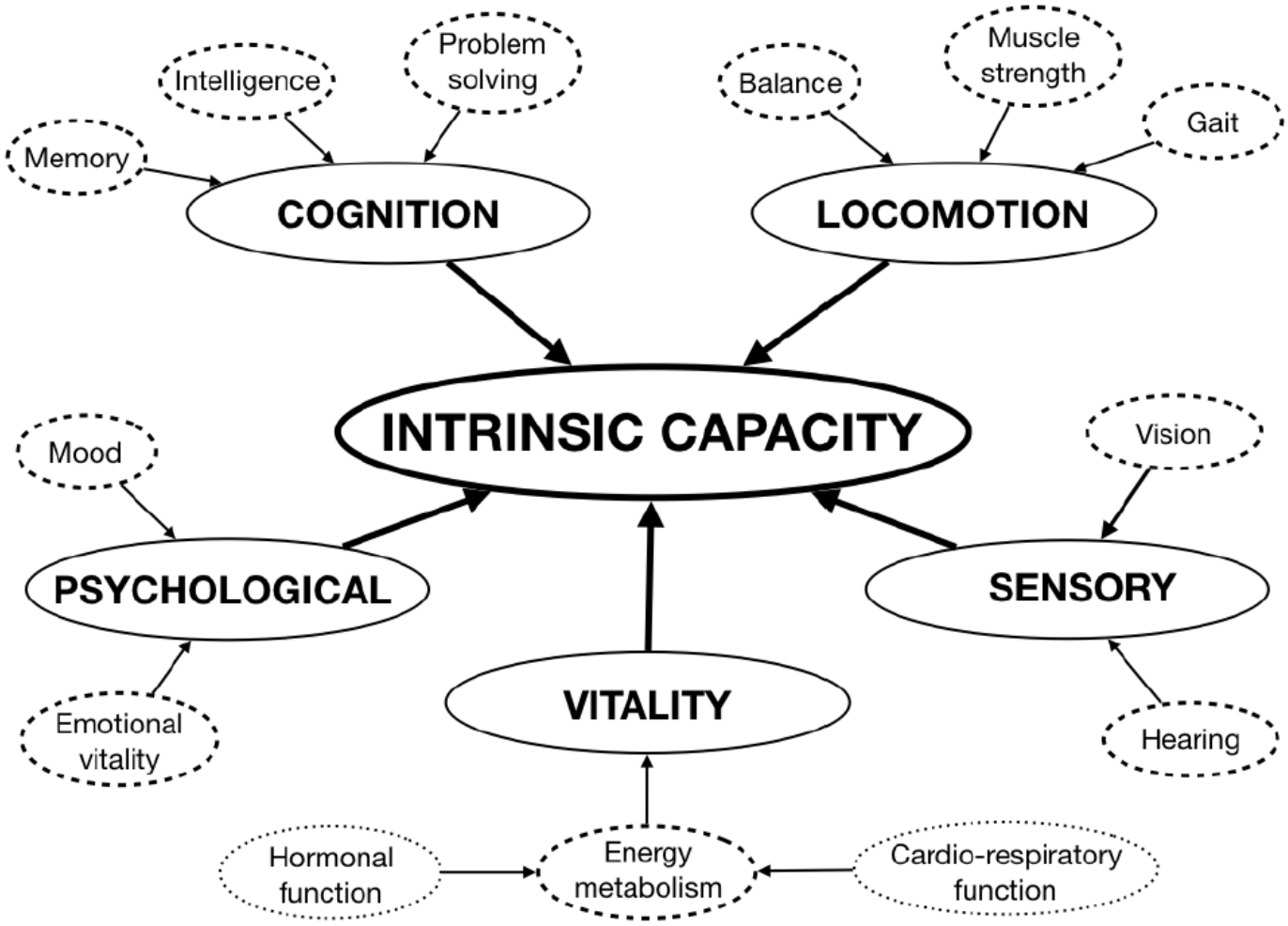
WHO (2015)

Functional Ability

- the possibility of enjoyment
- build and
- maintain relationships
- move around
- security
- contribute
- the potential for personal growth
- learn, grow and make decisions
- meet their own basic needs
- autonomy

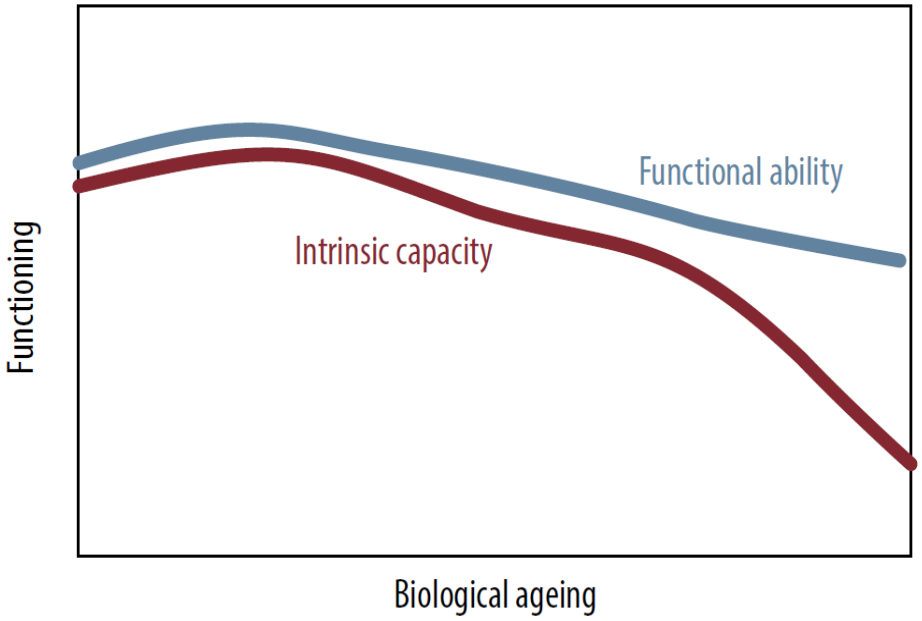
WHO (2015)
Gutierrez Robledo (2019)

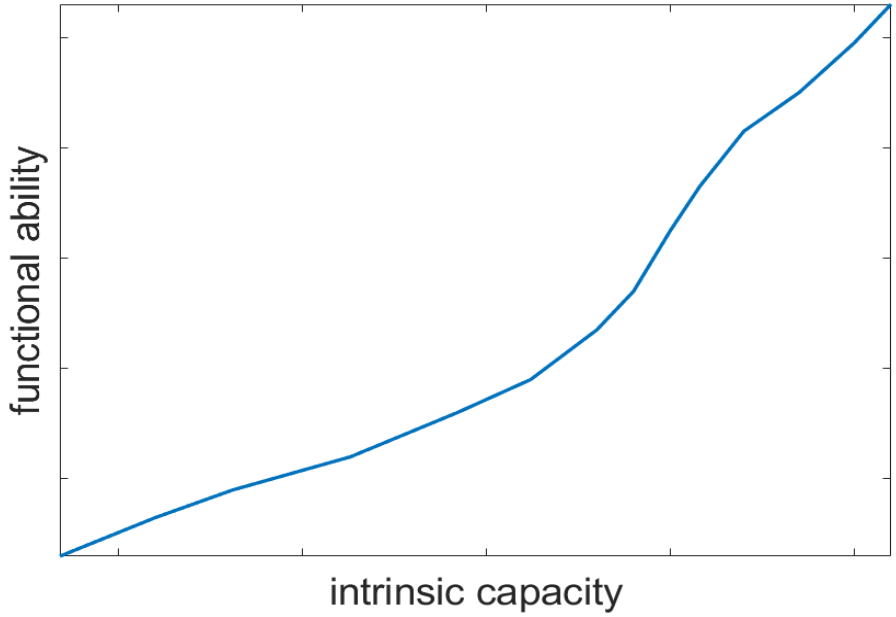
Intrinsic Capacity



Cesari et al. (2018)

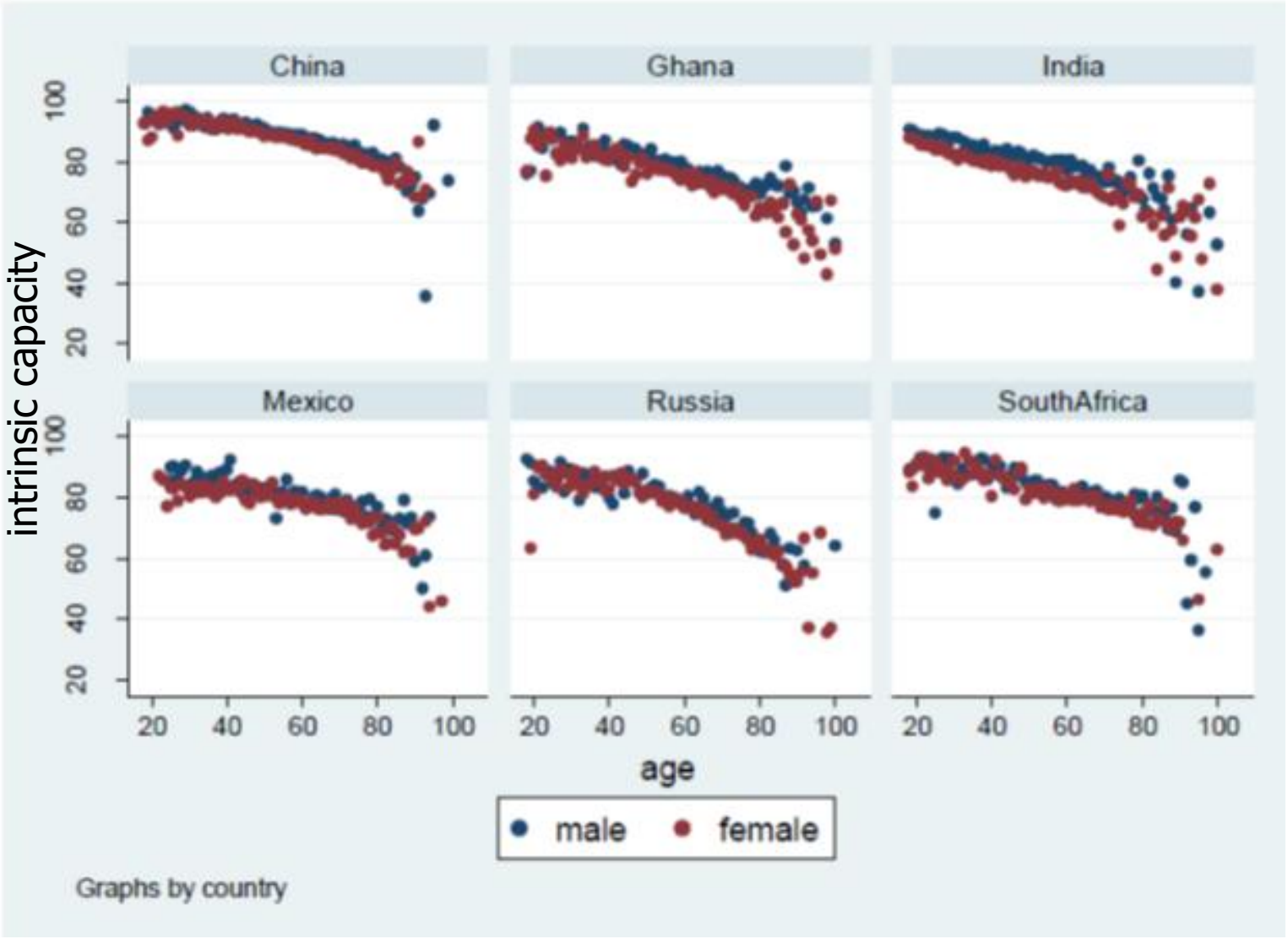
Desire





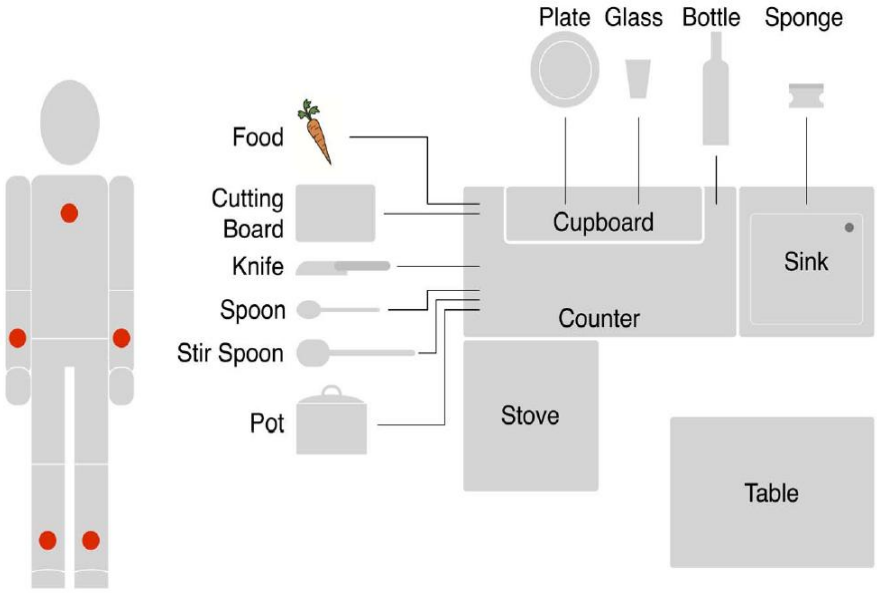
WHO (2015)

Data

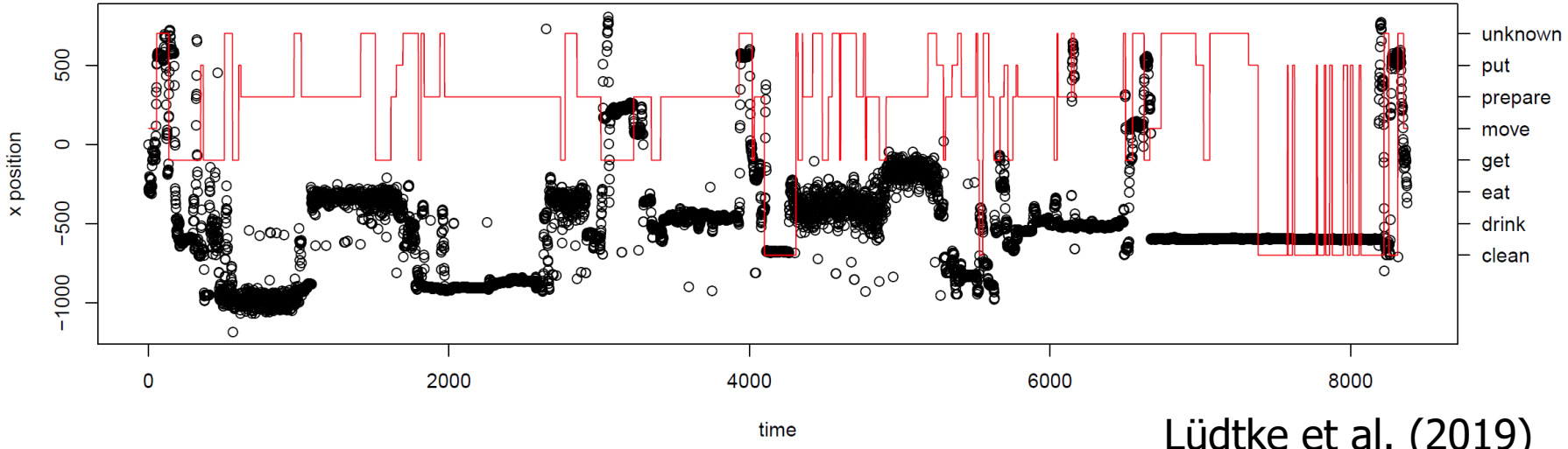


Gutierrez Robledo (2019)

Smart Home

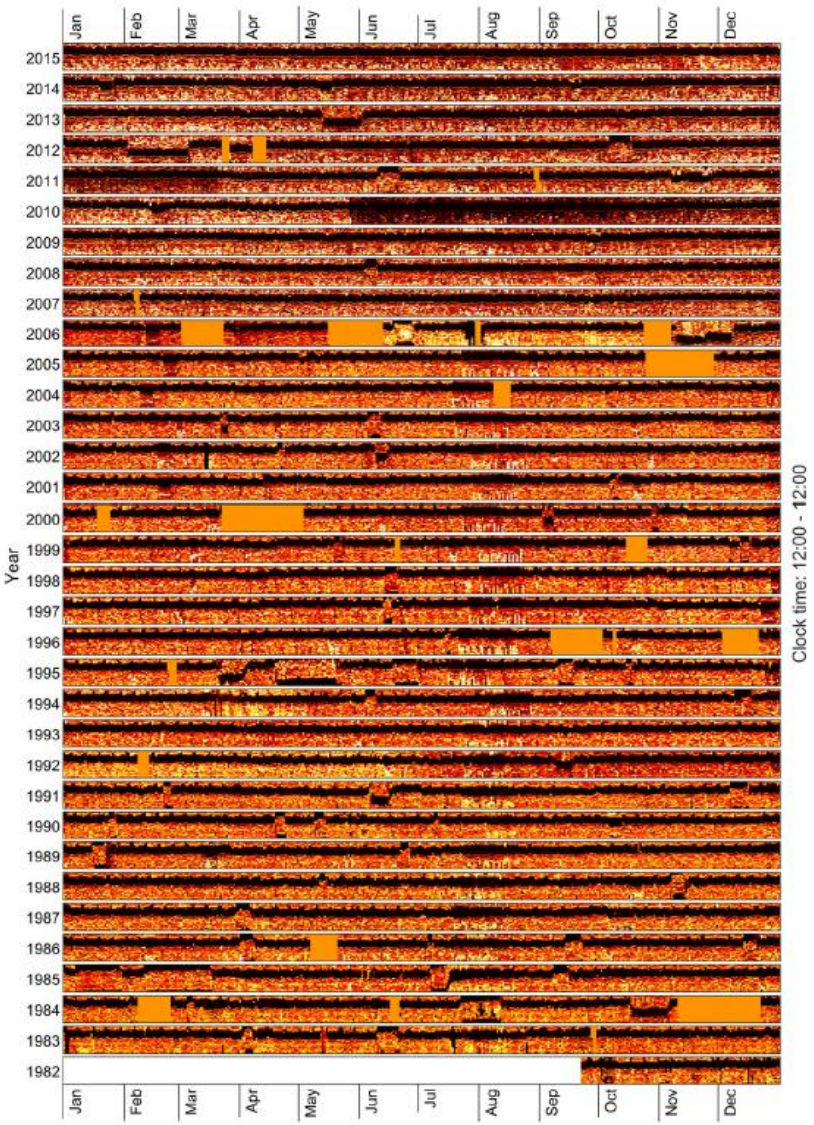


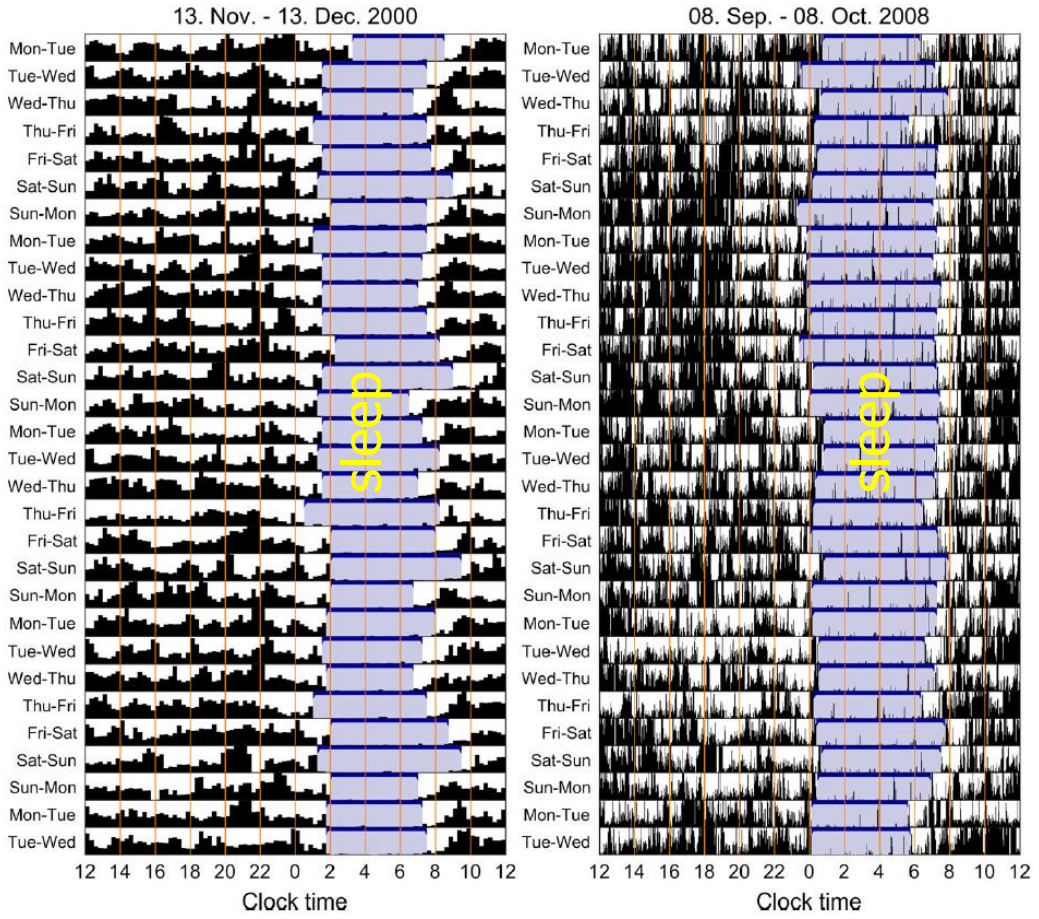
- accelerometer
- smart home environments
- ambient assisted living
- big data
- semantic segmentation



Lüdtke et al. (2019)
Yordanova et al. (2019)

Activity Data





accelerometric actograms

Borbély et al. (2017)

Model

Functional ability comprises the health-related attributes that enable people to be and to do what they have reason to value.

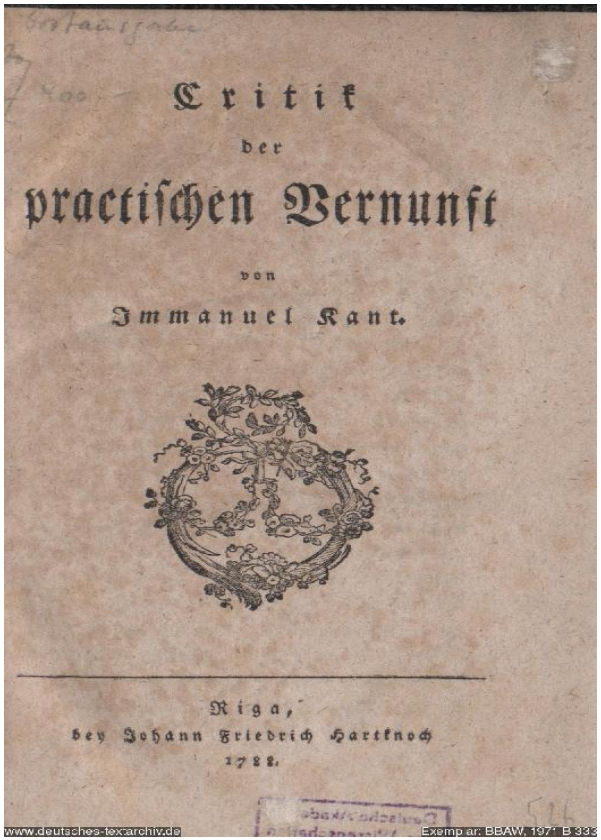
sleep

- relaxation
- continuity
- deepness

wake

- social relationships
- affordances
- synchronization

Ethics



Critique of Practical Reason (1788)

Just because of this every will, even every person's own will directed to himself, is restricted to the condition of agreement with the *autonomy* of the rational being, that is to say, such a being is not to be subjected to any purpose that is not possible in accordance with a law that could arise from the will of the affected subject himself; hence this subject is to be used never merely as a means but as at the same time an end.

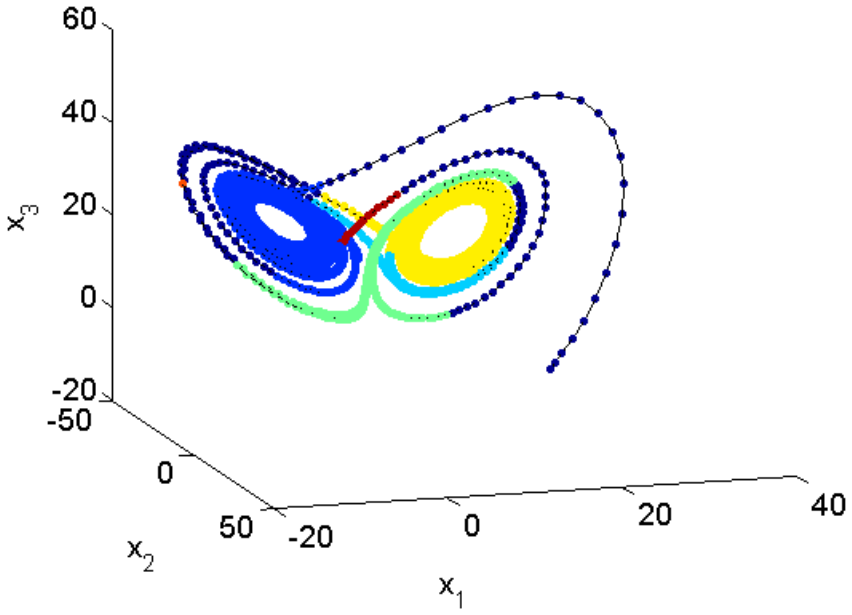
categorical imperative

Kant (2015), 87

Model

dynamical systems

- control parameters
  - control attractor shape
- order parameters
  - indicate attractor shape
- segmentation
  - indicates metastability



Model

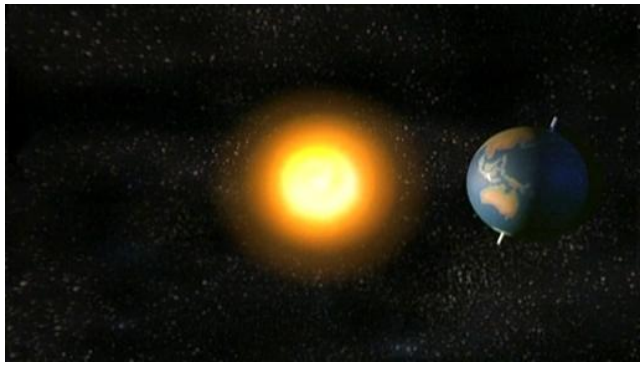
stochastic phase-coupled oscillator (Kuramoto) model

$$\dot{\varphi}_k(t) = \Omega + \sum_j a_{kj} \sin(\varphi_j(t) - \varphi_k(t)) + \frac{1}{c}\eta(t)$$

intrinsic capacity

social network connectivity

day-night cycle



Kuramoto (1975)
Rodrigues et al. (2016)

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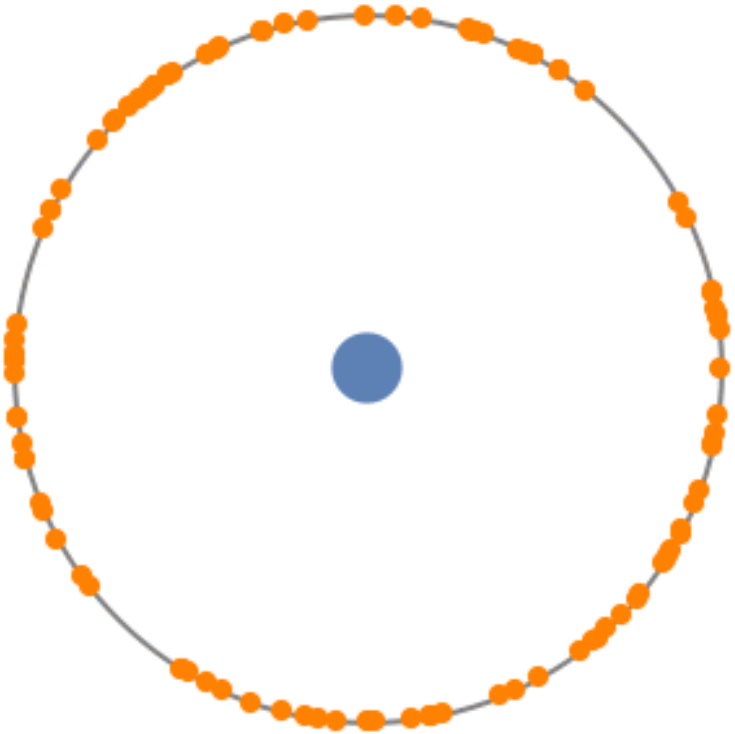
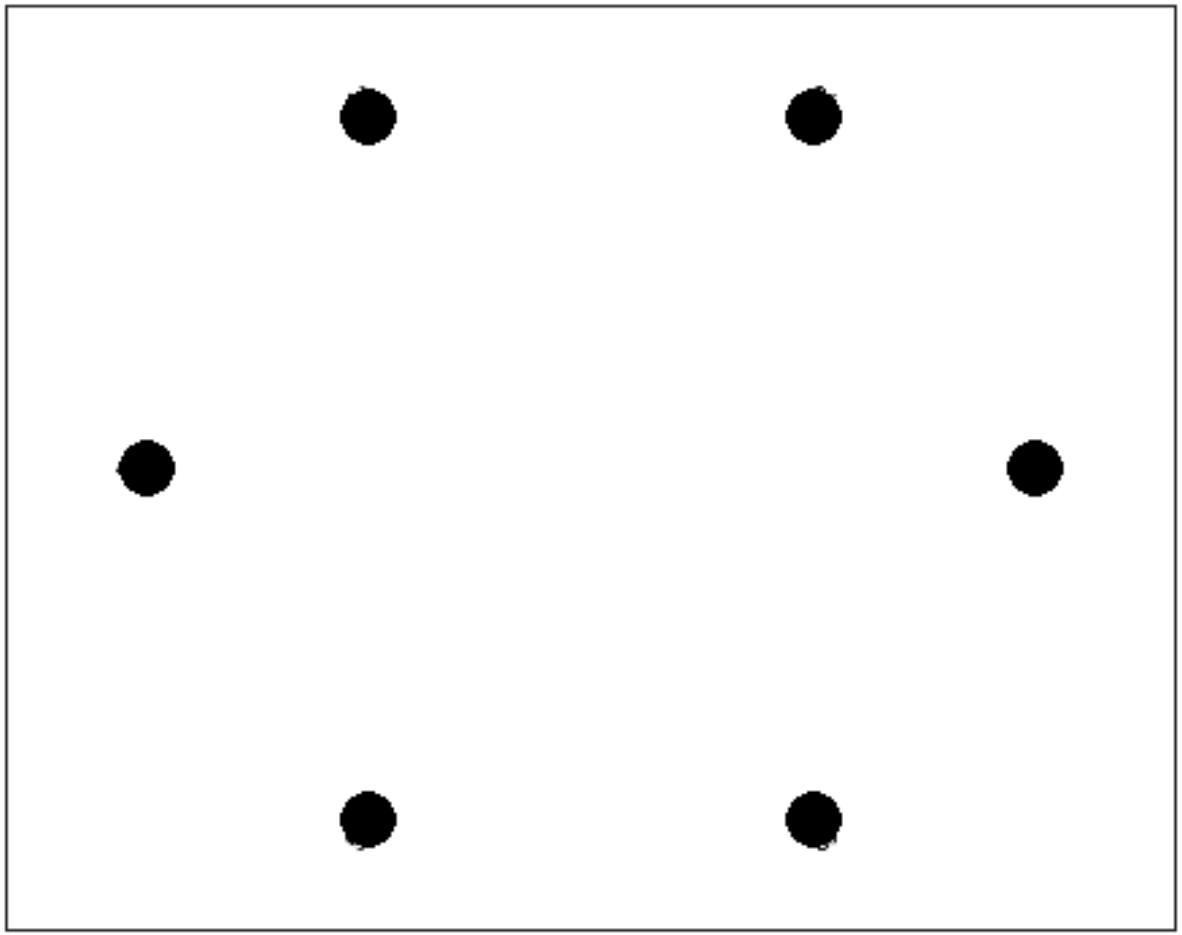


Kuramoto (1975)
Rodrigues et al. (2016)

Social Networks

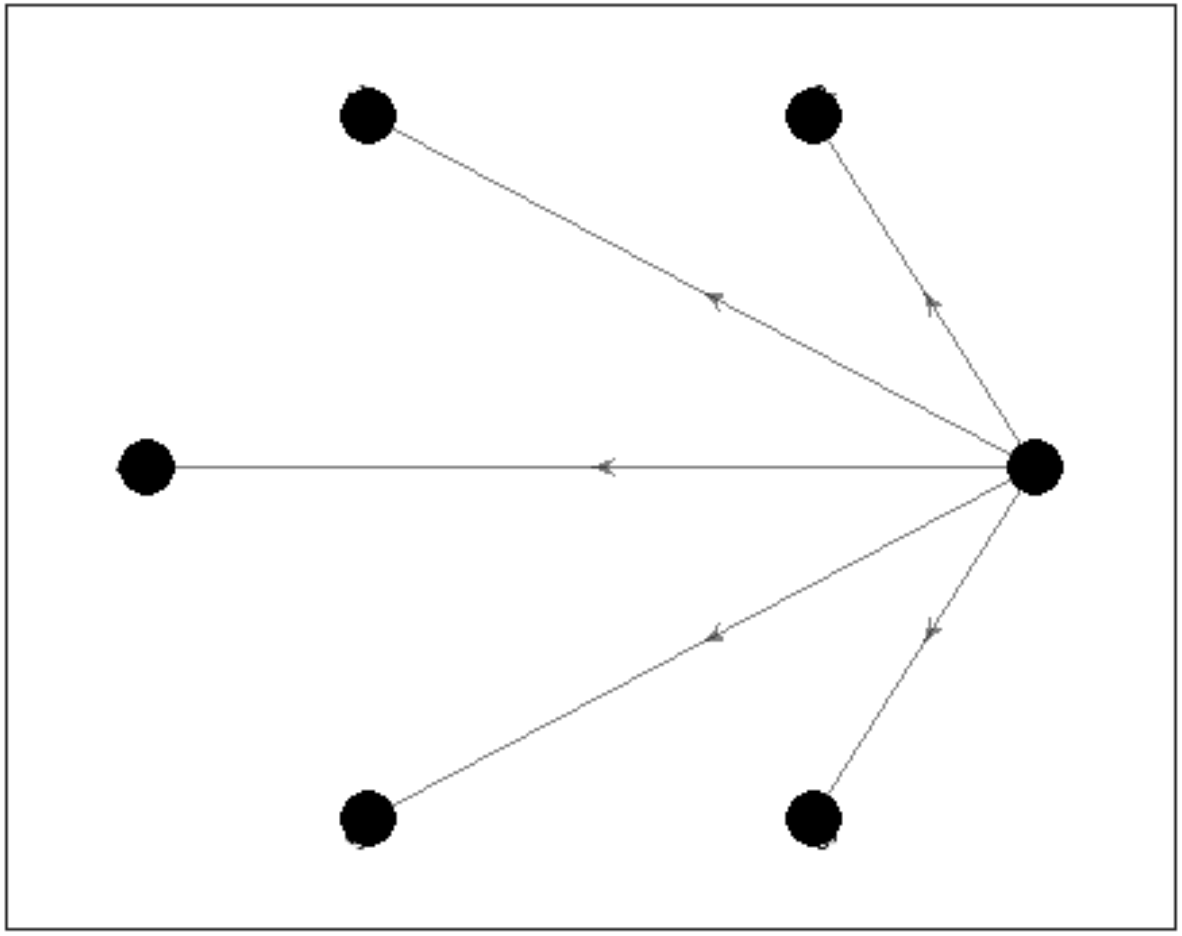


isolation

segregation

Gil (2016)
beim Graben (2016)

Social Networks

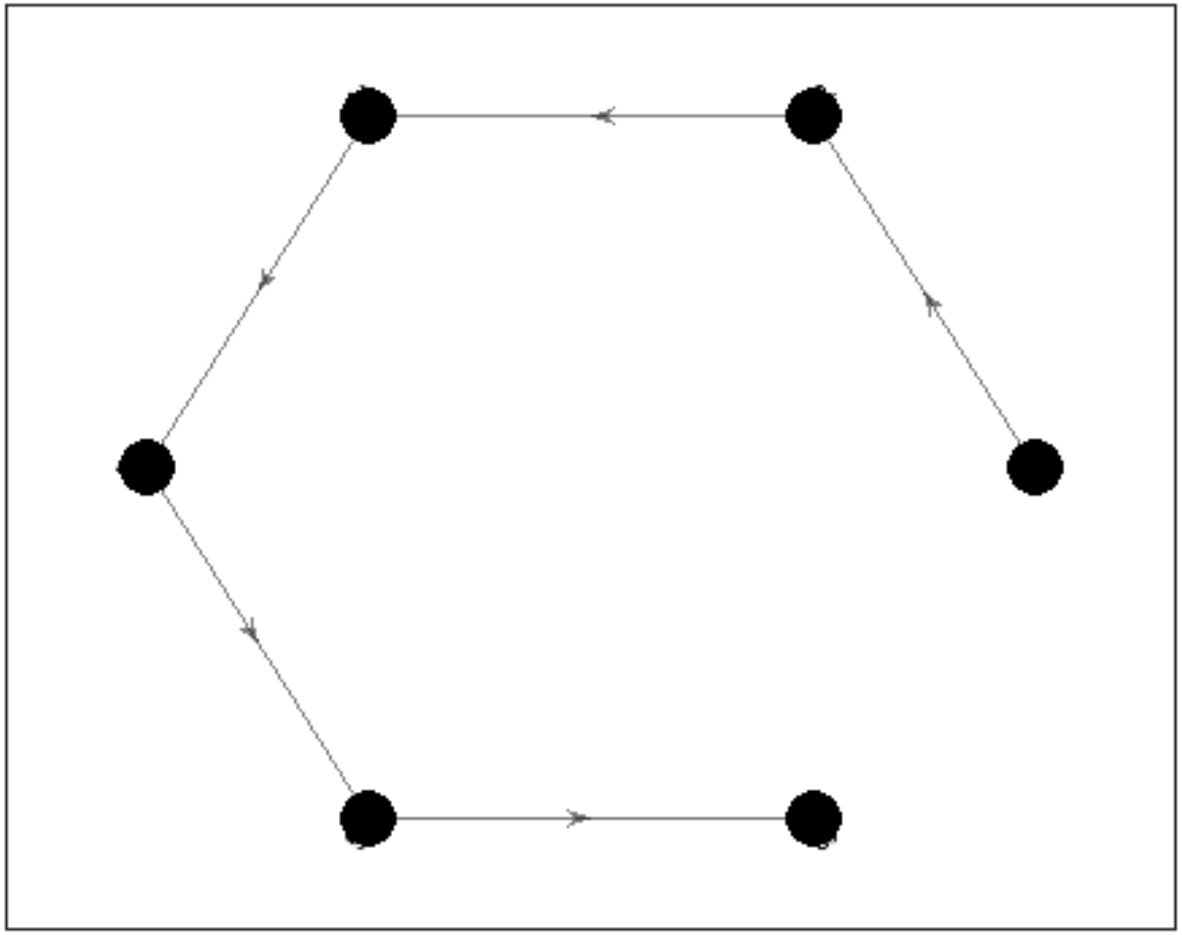


hierarchical

totalitarianism

Gil (2016)
beim Graben (2016)

Social Networks

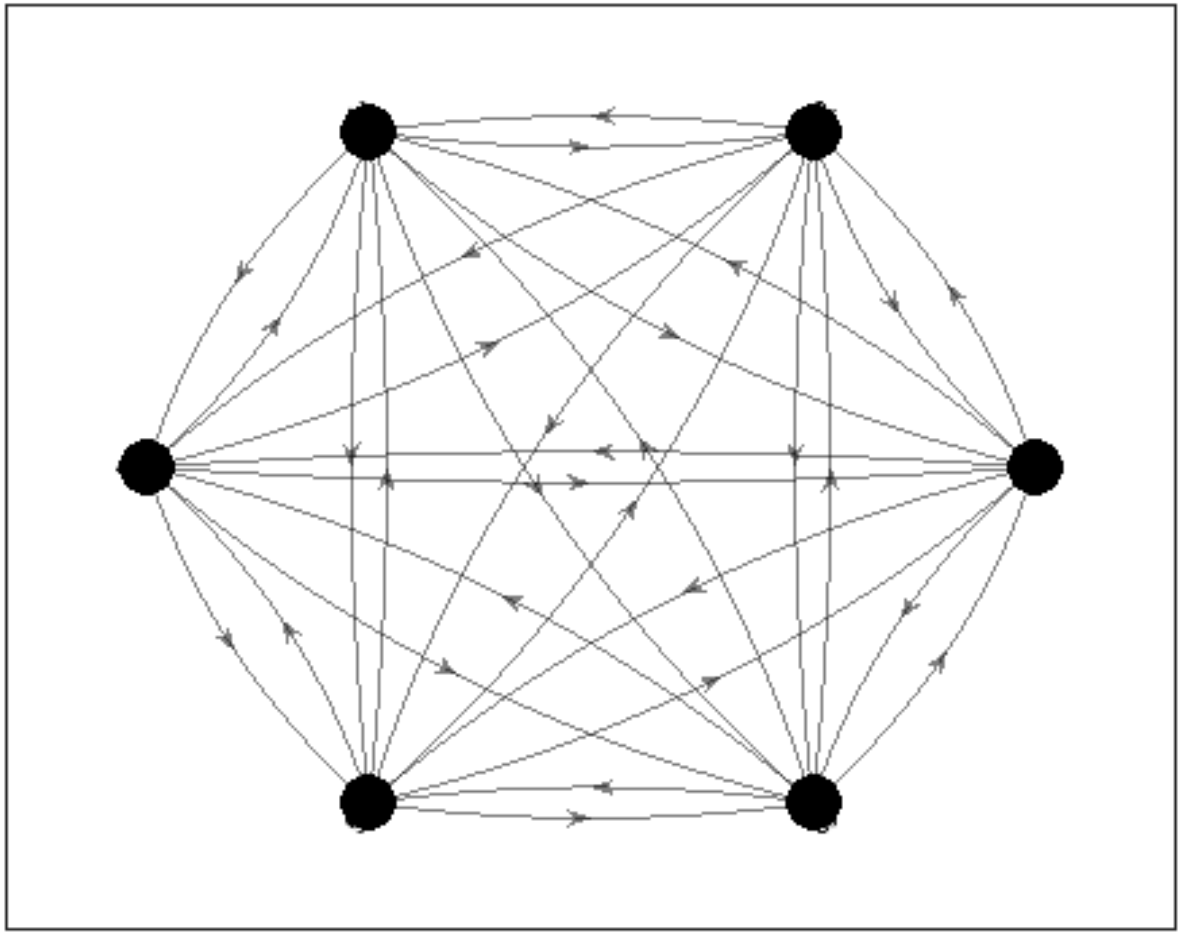


command-obedience-chain

military

Gil (2016)
beim Graben (2016)

Social Networks



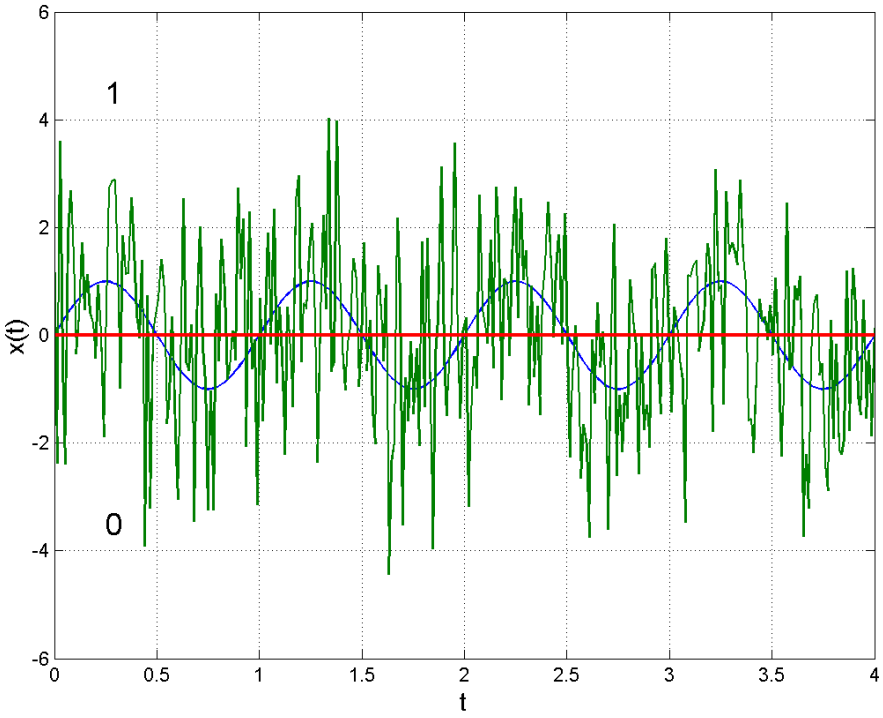
completely connected

open society

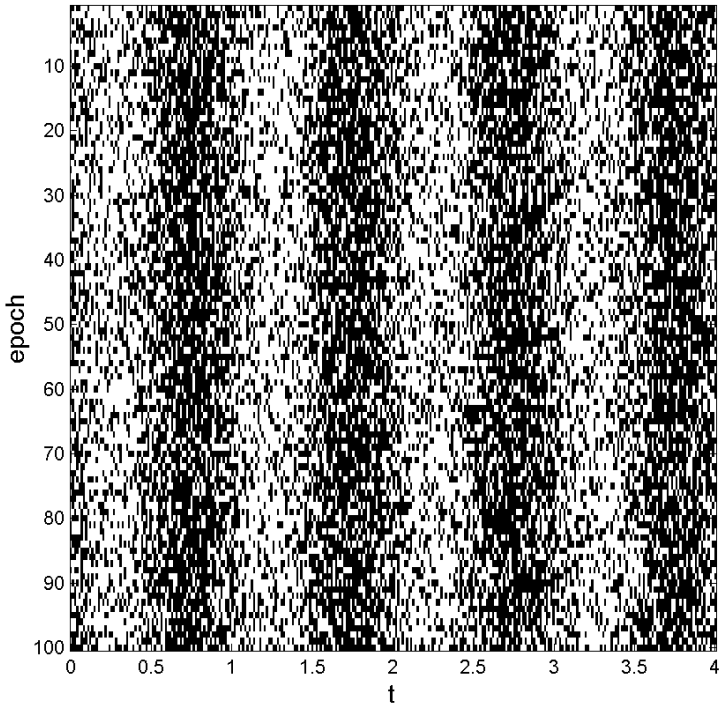
Gil (2016)
beim Graben (2016)

Segmentation

realization



symbolization



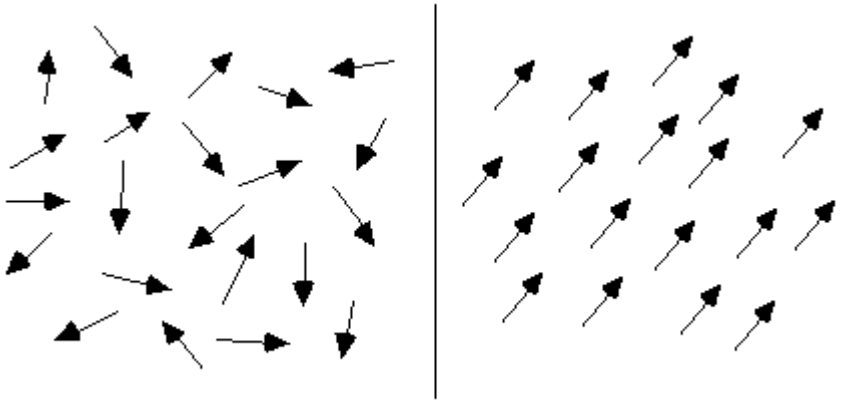
$$y_k(t) = \sin \varphi_k(t)$$

$$s_k(t) = \begin{cases} 0 & : \quad y_k(t) < 0 \\ 1 & : \quad y_k(t) \geq 0 \end{cases}$$

beim Graben (2001)

Order Parameter

"magnetization"



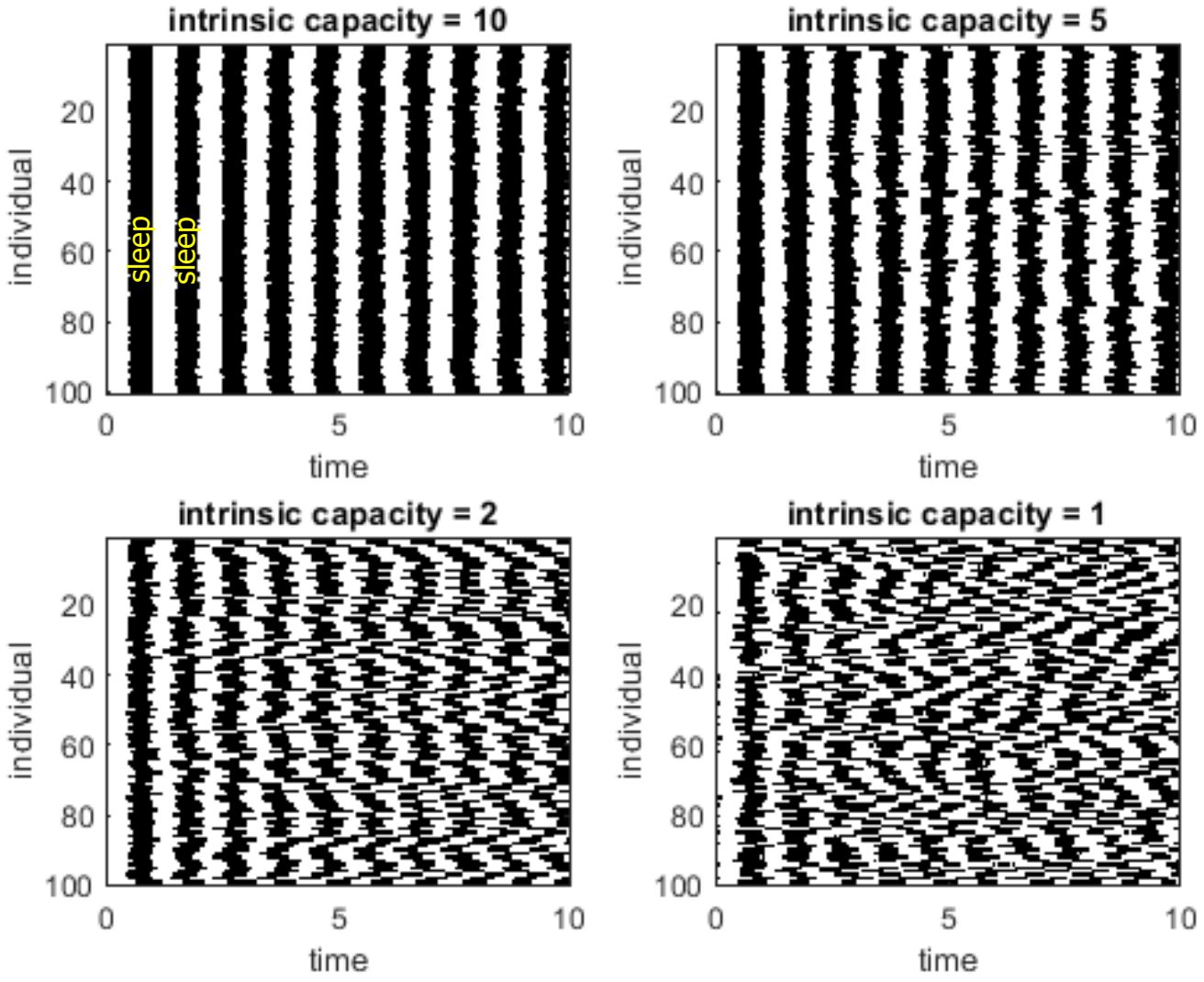
N_0 = # sleeping individuals
N_1 = # waking individuals

$$m(t) = \frac{|N_1(t) - N_0(t)|}{n}$$

$$\boxed{M} = \frac{1}{T}\sum_t m(t)$$

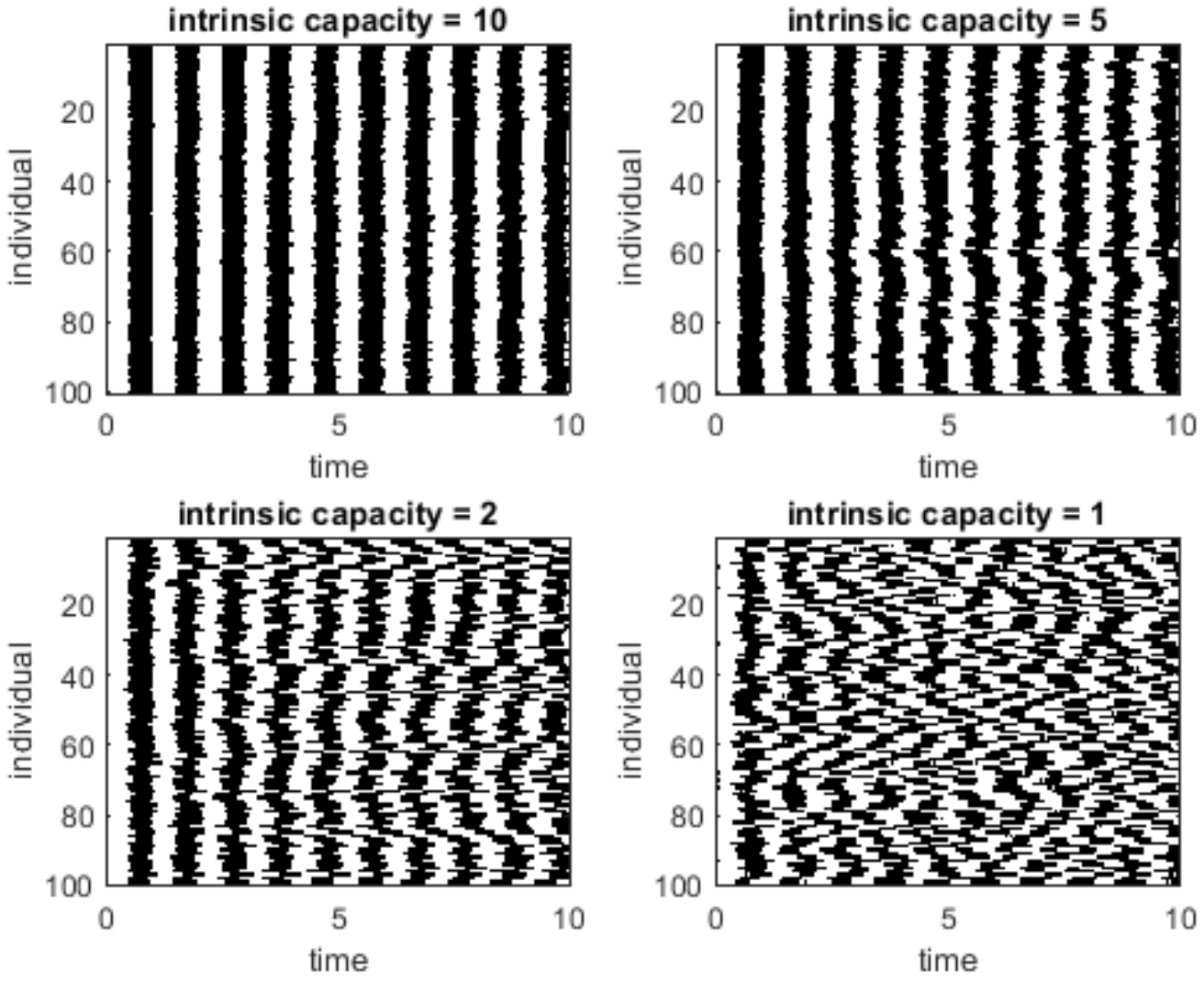
synchronization measures
functional ability

Results



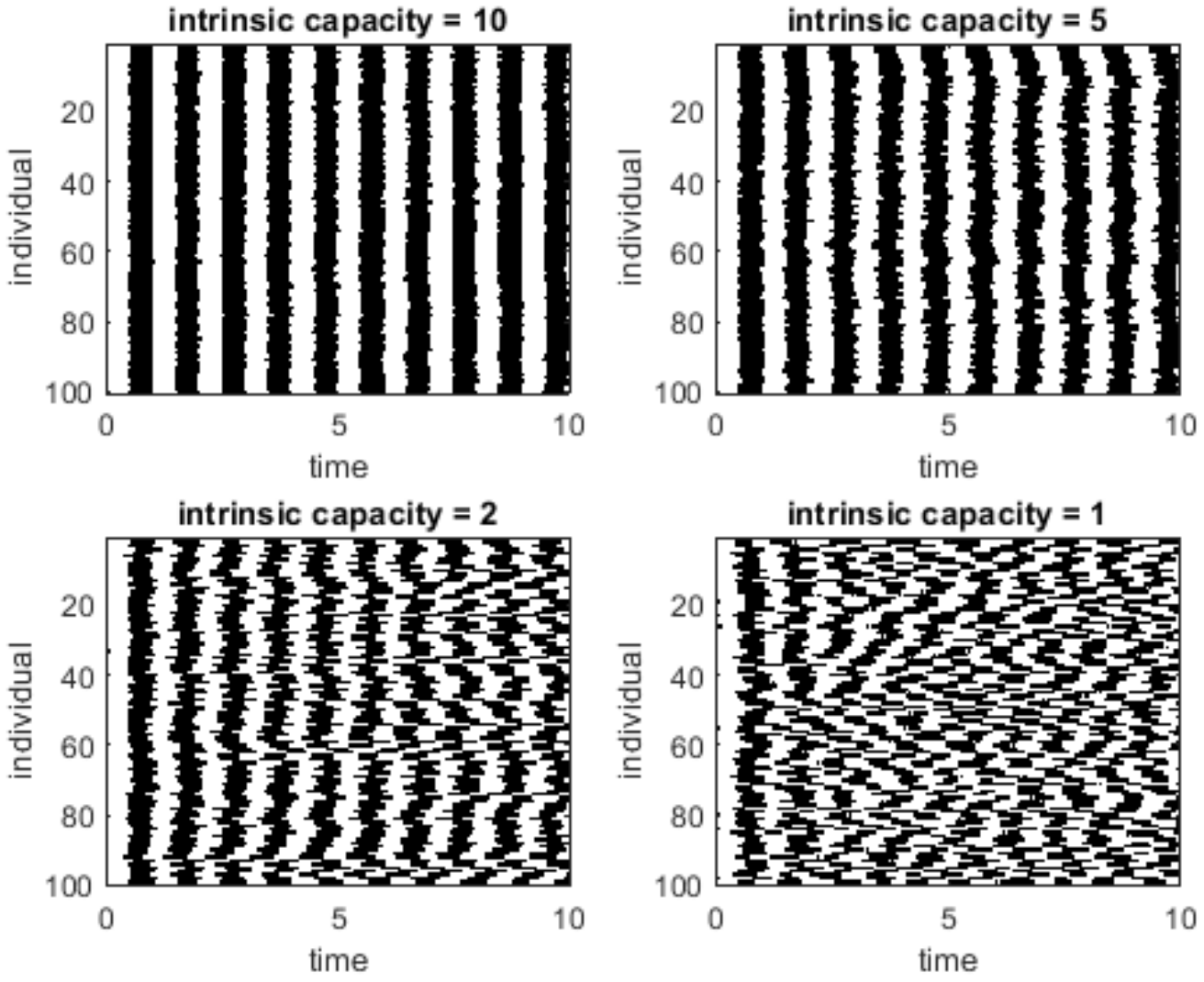
segregation

Results



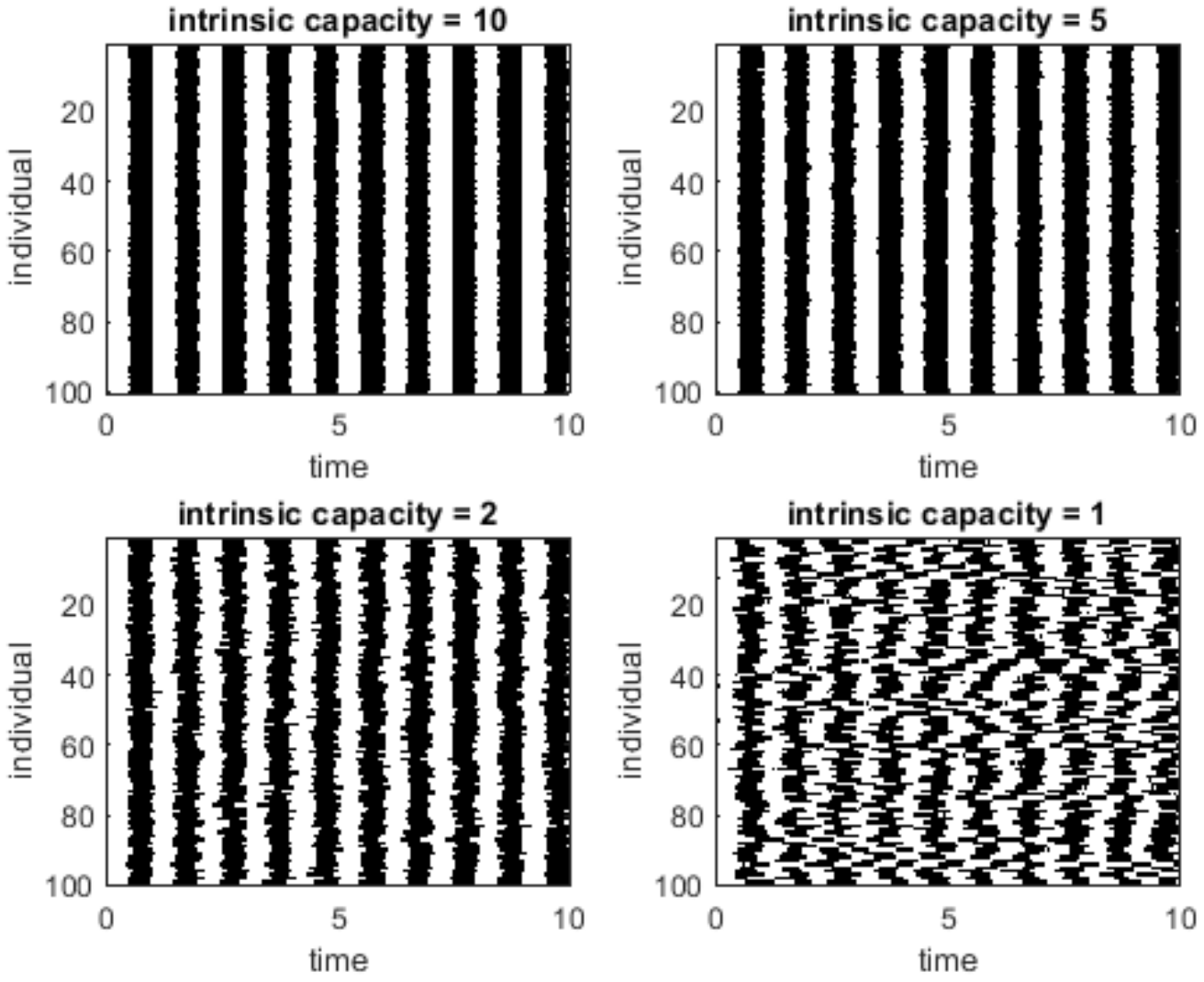
totalitarianism

Results



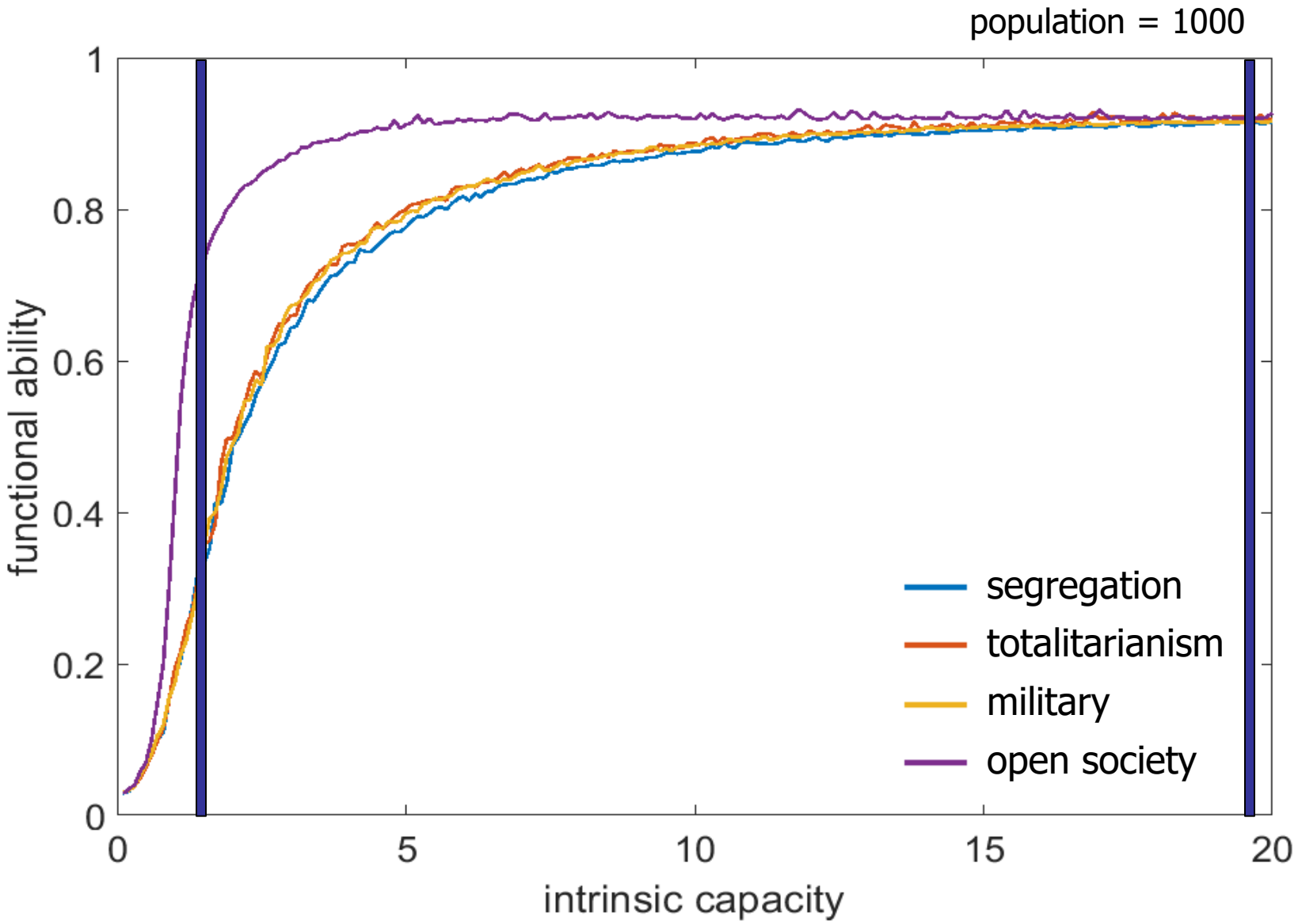
military

Results



open society

Results


population = 1000
functional ability
intrinsic capacity
0
0.2
0.4
0.6
0.8
1
0
5
10
15
20
segregation
totalitarianism
military
open society

Conclusions

- stochastic Kuramoto phase oscillator models of sleep/wake behavior
- intrinsic capacity as control parameter describes individual's capacity to cope with perturbations
- functional ability as order parameter describes individual's ability to synchronize with valuable social affordances
- social network topology is crucial:
  - segregated societies are unstable
  - open societies maintain healthy aging

Acknowledgements

Thank you for your attention!

and Carl Taswell for invitation;

Mike Martin and Steve Boker for inspiration

World Health Organization