



UNIVERSITÀ
DEGLI STUDI
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Introduction to Research

Course for Ph.D. students
A.Y. 2017-18

2. Statistical associations, causal mechanisms, modelling

Federico Bianchi,
GECS - Research Group on Experimental and Computational Sociology,
Department of Economics and Management,
University of Brescia
federico.bianchi@unibs.it



Research projects

- State the (main) research question(s) of your Ph.D. dissertation project.
- What is your *explanandum*?
- What is your hypothetical explanation?
- Mind the time: you have 1 minute!



Problems of D-N model

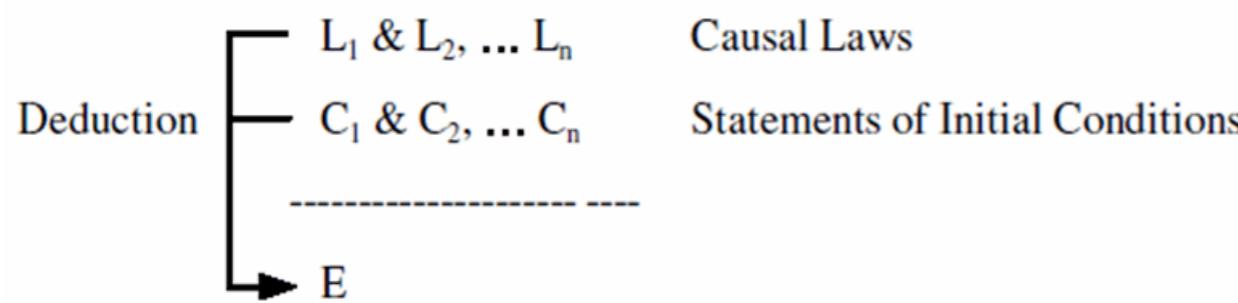
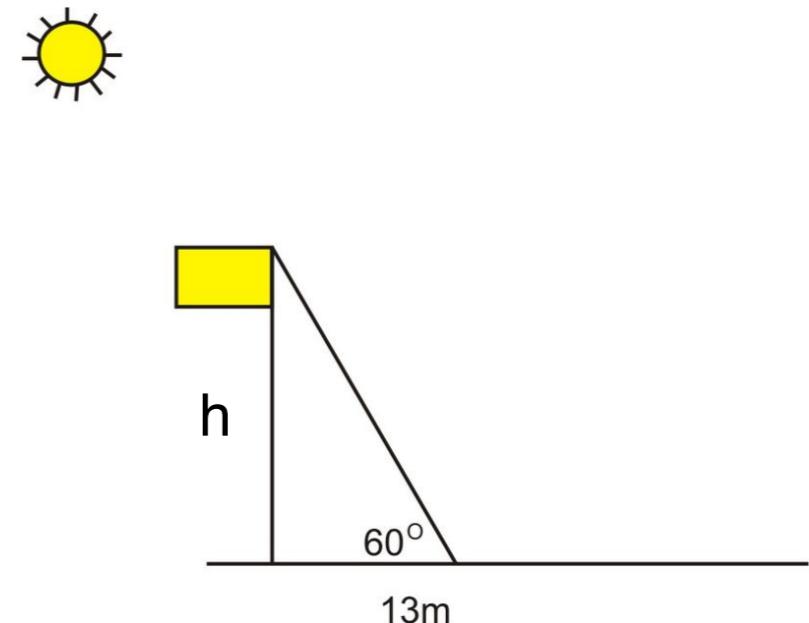


Figure 1. Structure of scientific explanation.



LAW: light propagates rectilinearly

CONDITION 1: angle θ of the sun above the horizon

CONDITION 2: flagpole with height h

EXPLANANDUM: the shadow of the flagpole has length s

LAW: rectilinear propagation of light

CONDITION 1: angle θ of the sun above the horizon

CONDITION 2: shadow of the flagpole with length s

EXPLANANDUM: the flagpole's height is h



Problems of I-S model

L1, L2, L3, L4,...

Statistical laws

C1, C2, C3, C4,...

Conditions

— — — — —

(high probability)

Explanandum



STATISTICAL LAW: strept-infected patients treated with penicillin recover within 5 days with a 80% probability

CONDITION: Mary treated a streptococcus infection by taking penicillin for 5 days

EXPLANANDUM: Mary recovered from the infection within 5 days



Problems of I-S model

L1, L2, L3, L4,...

Statistical laws

C1, C2, C3, C4,...

Conditions

— — — — —

(high probability)

Explanandum



STATISTICAL LAW: strept-infected patients treated with penicillin recover within 5 days with a 80% probability

CONDITION: Mary treated a streptococcus infection by taking penicillin for 5 days

EXPLANANDUM: After 20 days, John HAS NOT RECOVERED from the infection, yet.



Problems of I-S model

L1, L2, L3, L4,...

Statistical laws

C1, C2, C3, C4,...

Conditions

— — — — —

(high probability)

Explanandum



STATISTICAL LAW: patients infected by D and treated with penicillin recover within 5 days with a 15% probability

CONDITION: Jane treated a streptococcus infection by taking penicillin for 5 days

EXPLANANDUM: After 20 days, Jane has recovered from the infection.



Statistical Relevance (SR) model

Explaining a phenomenon E means providing the statistically relevant factors $C_{1, 2, 3, \dots, n}$ within a class (population) A such that:

$$P(E | A.C) \neq P(E | A)$$





Problems of D-N/I-S



What happened to those streptococcus-infected patients who do NOT recover by taking penicillin?



What happened to all those countries with market-based economies which did NOT experience any revolts?



Problems of SR model

The Telegraph

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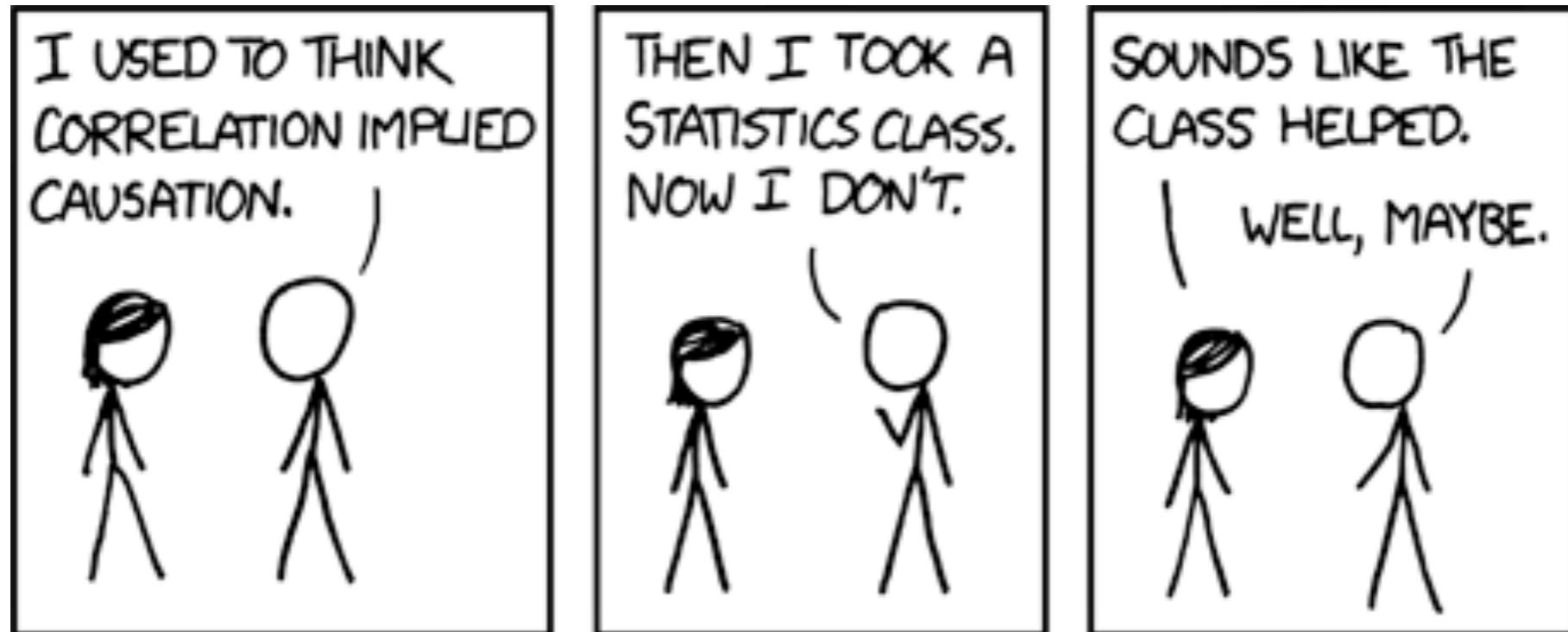
Cows with names produce more milk, scientists say

Cows with names produce more milk than those animals who are not named, scientists have found.

<http://www.tylervigen.com/spurious-correlations>



Problems of SR model



Statistical underdetermination of causal relationships

Post hoc ergo propter hoc



Problems of SR model



How many factors do I need to account for this particular phenomenon?

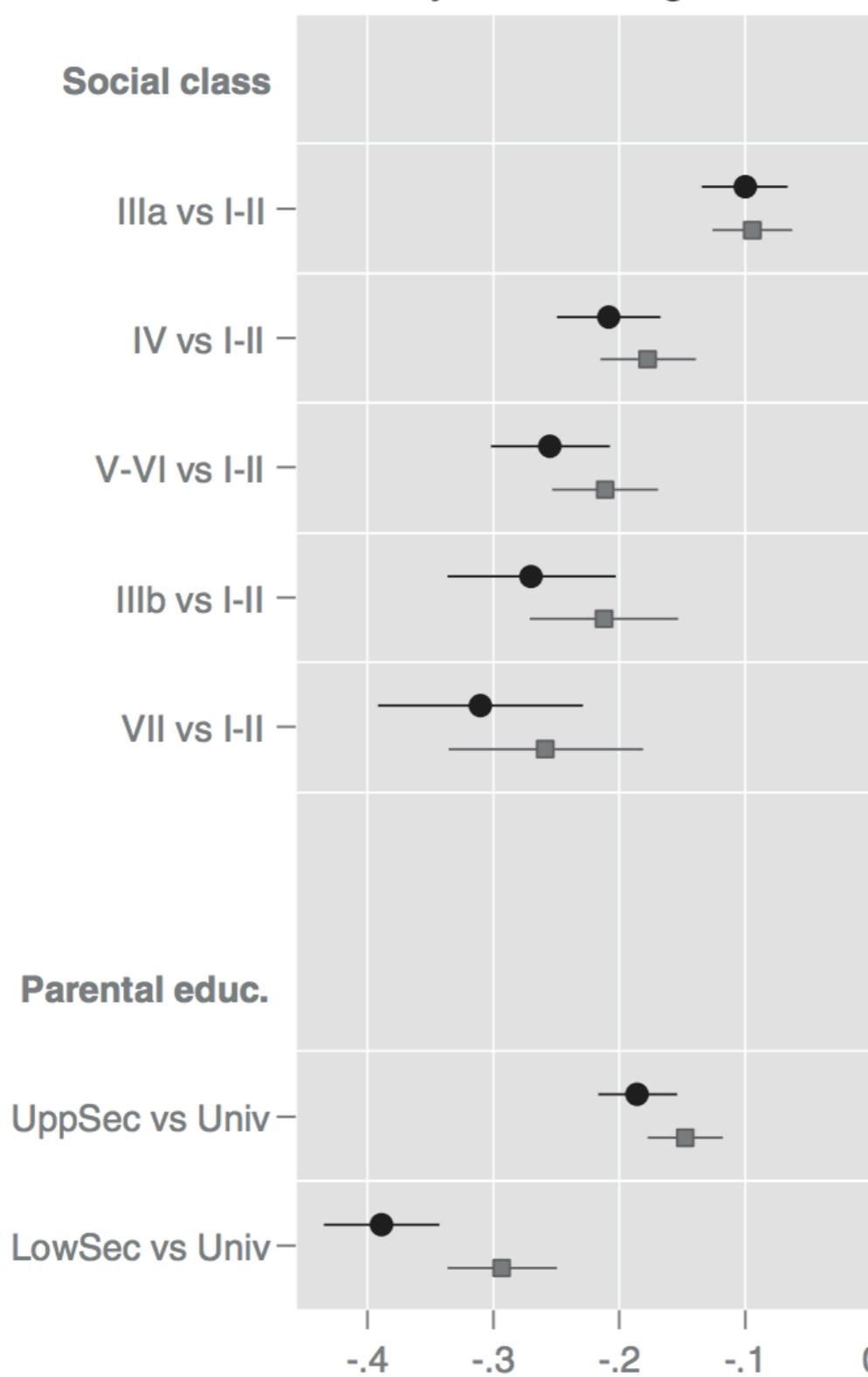
I will always come up with a probabilistic value $P(E) = p$

What does then $1 - p$ account for?



C

Differences in enrolment by social background



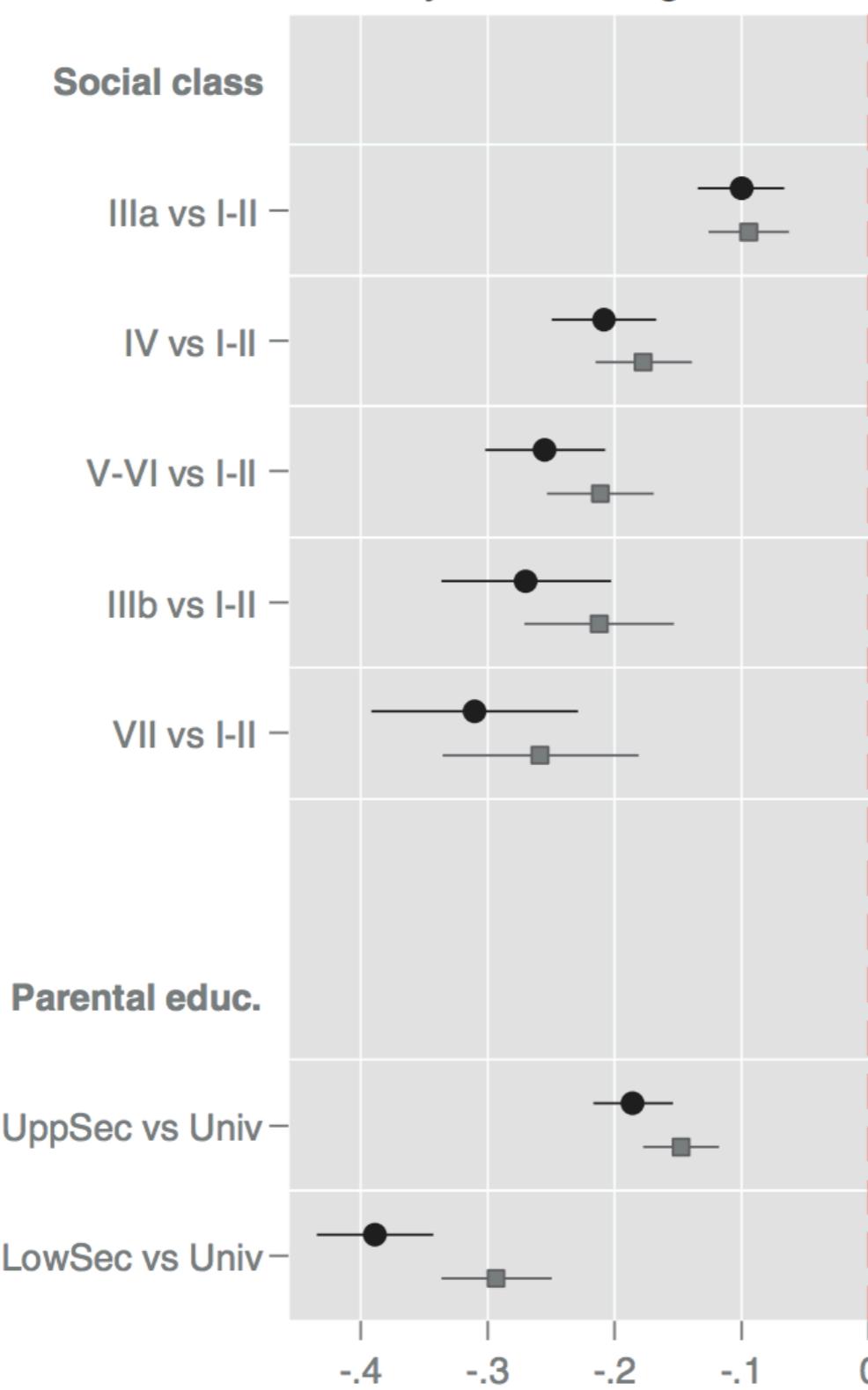
Italian secondary-school students stemming from working-class families are less likely to access university.

WHY?

Barone et al. (2018), copyright Oxford University Press

C

Differences in enrolment by social background

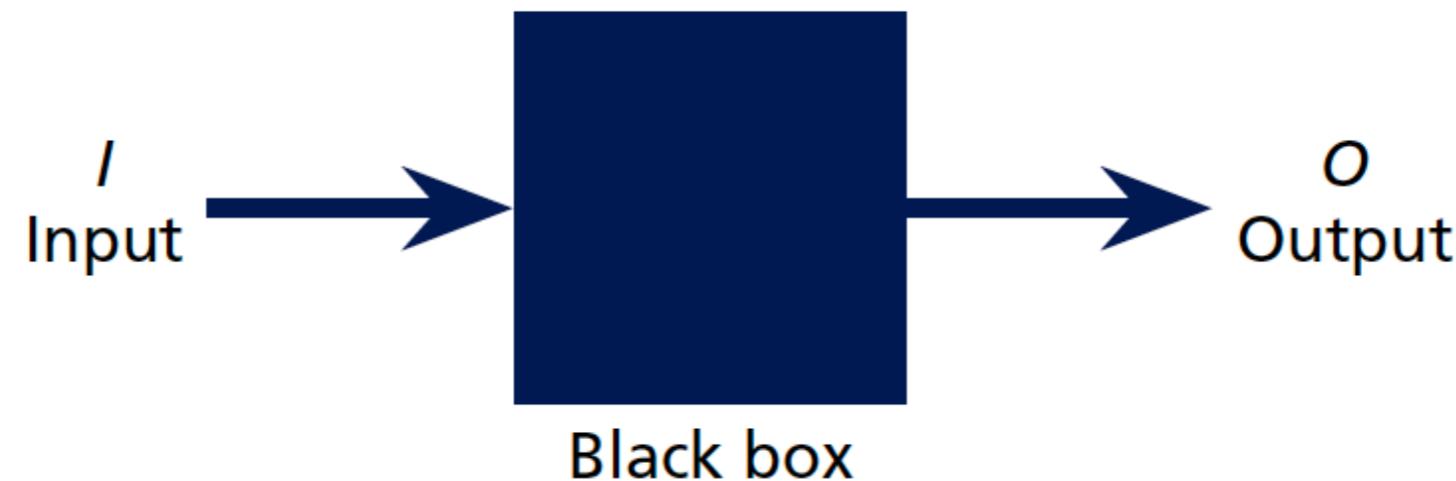


Working-class families, with respect to higher classes:

- Own fewer resources to finance tertiary education fees
- Value less the importance of acquiring a high cultural capital
- Are more risk-averse
- Tend to enroll children in lower-track secondary schools, which then makes it more difficult to access university
- Possess fewer cognitive resources which negatively impact children's cognitive abilities and aspirations during childhood
- Live in neighborhoods where tertiary education is not highly diffused
- Value less the risk of social demotion for their children (being already in the lower strata of society)
- Usually live far from universities, forcing children to bear relocation costs.



Causal mechanisms

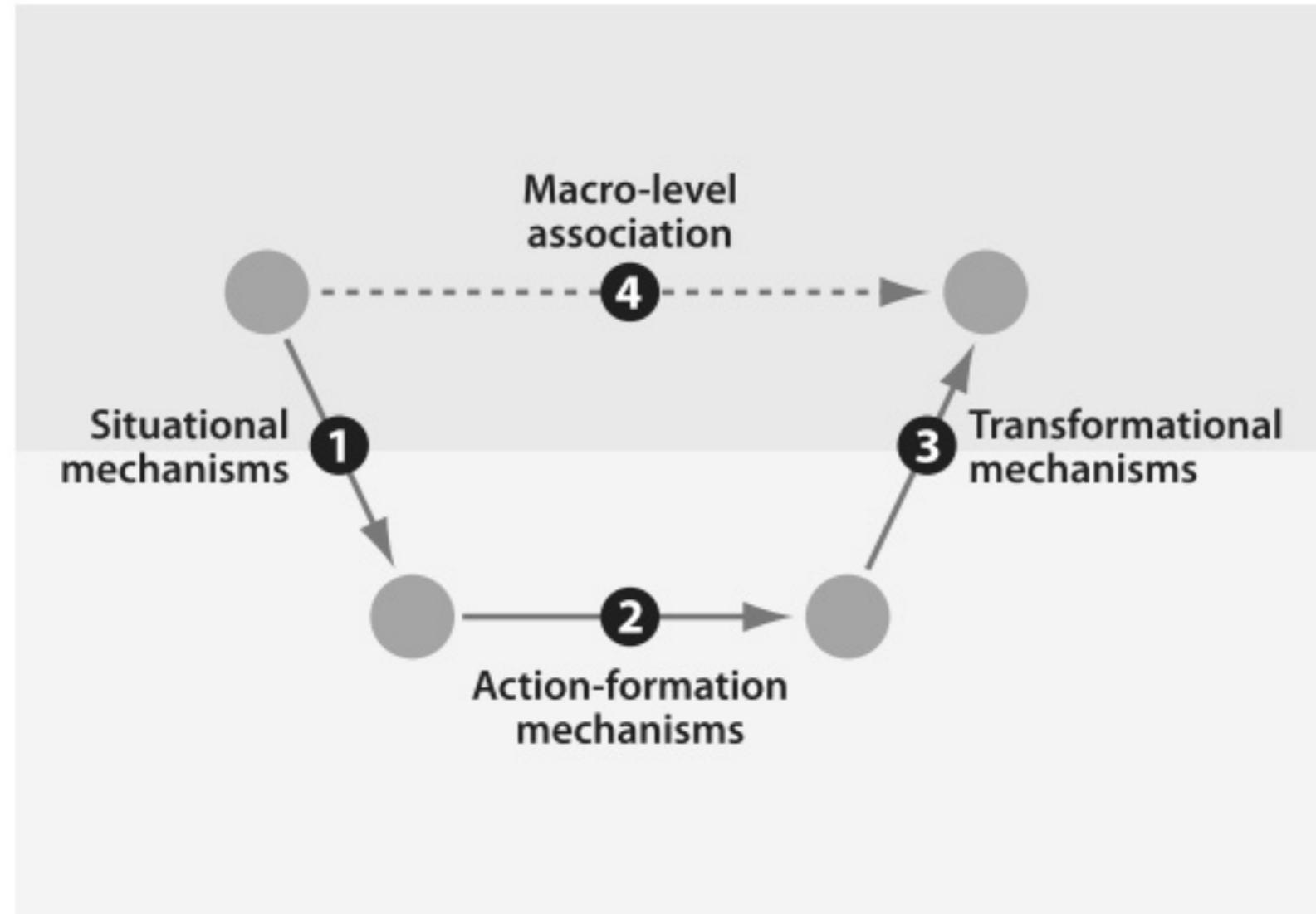


“To explain is to provide a mechanism, to open up the black box and show the nuts and bolts, the cogs and wheels of the internal machinery. A mechanism provides a continuous and contiguous chain of causal or intentional links between the explanans and the explanandum”

Elster (1983)



Social mechanisms



Hedström & Ylikoski (2010), copyright Annual Reviews



John Jones recovered because the chemical structure of penicillin interacted with streptococcus bacteria in such a way that the bacteria fail to reproduce and eventually die.

Joe Smith did NOT recover because the interaction between penicillin and streptococcus bacteria was prevented by the presence of BLPB bacteria which shielded the former.



Unrest in Gezi Park in 2013 might have been caused by the increasing mismatch between young people's expectations about general social conditions developed during a period of rapid economic growth and the policies of a conservative government.

Unrest in other developing countries might have been prevented by a stronger military apparatus, less urbanized society hindering information flows, the absence of organized progressive parties and unions.



Piazza della Loggia

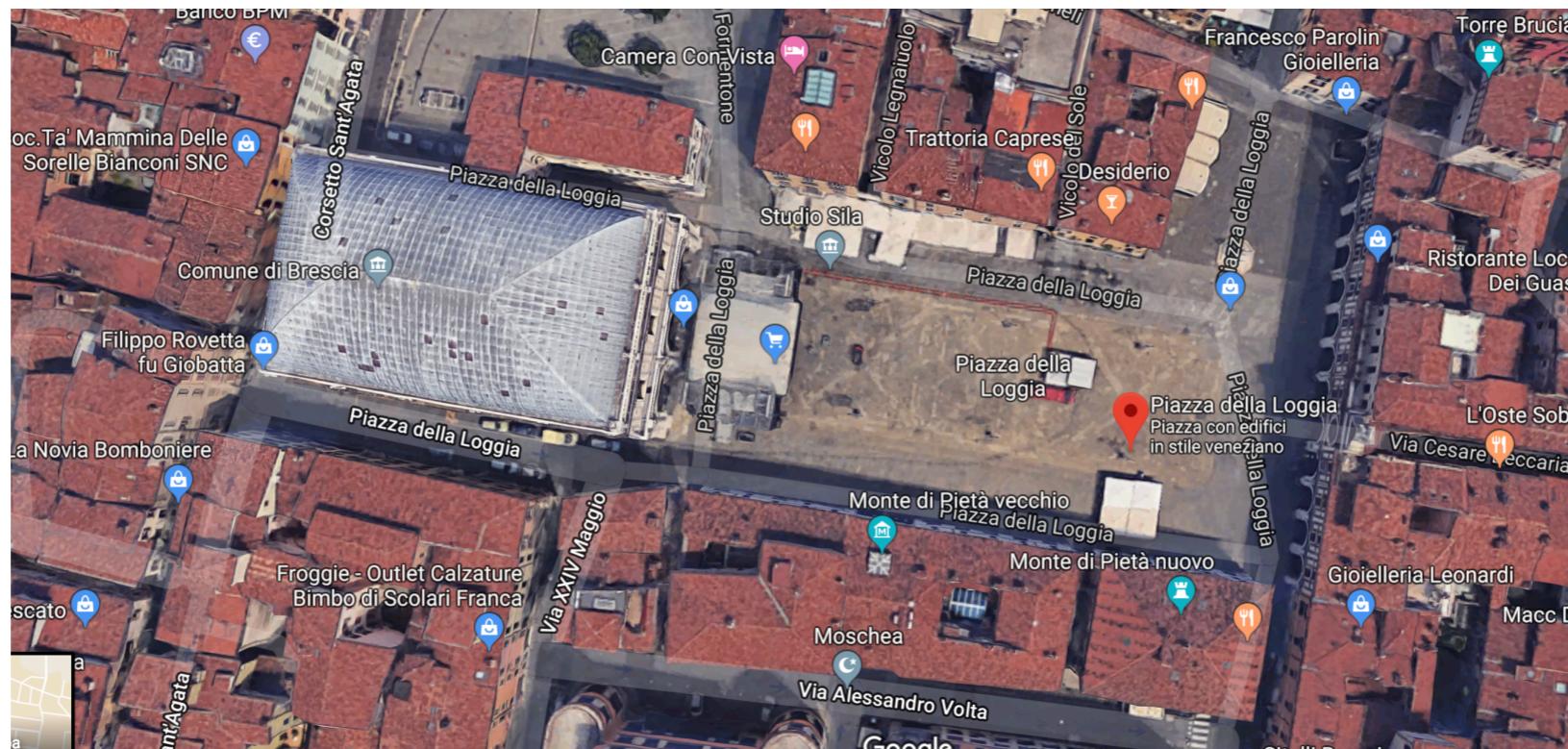
In order to orient myself in Piazza della Loggia, I need a representation of it





Piazza della Loggia

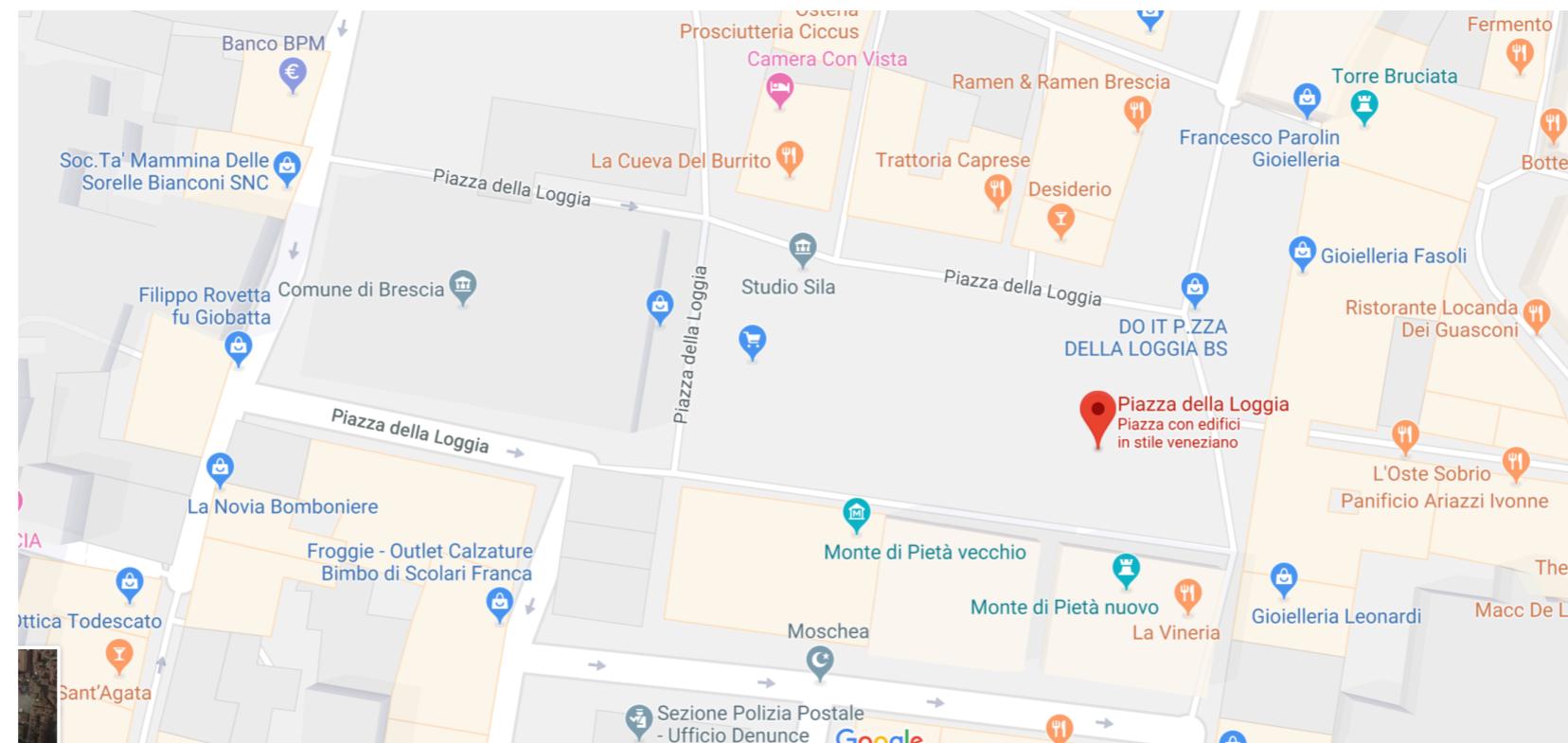
In order to orient myself in Piazza della Loggia, I need a representation of it





Piazza della Loggia

This is what I need!



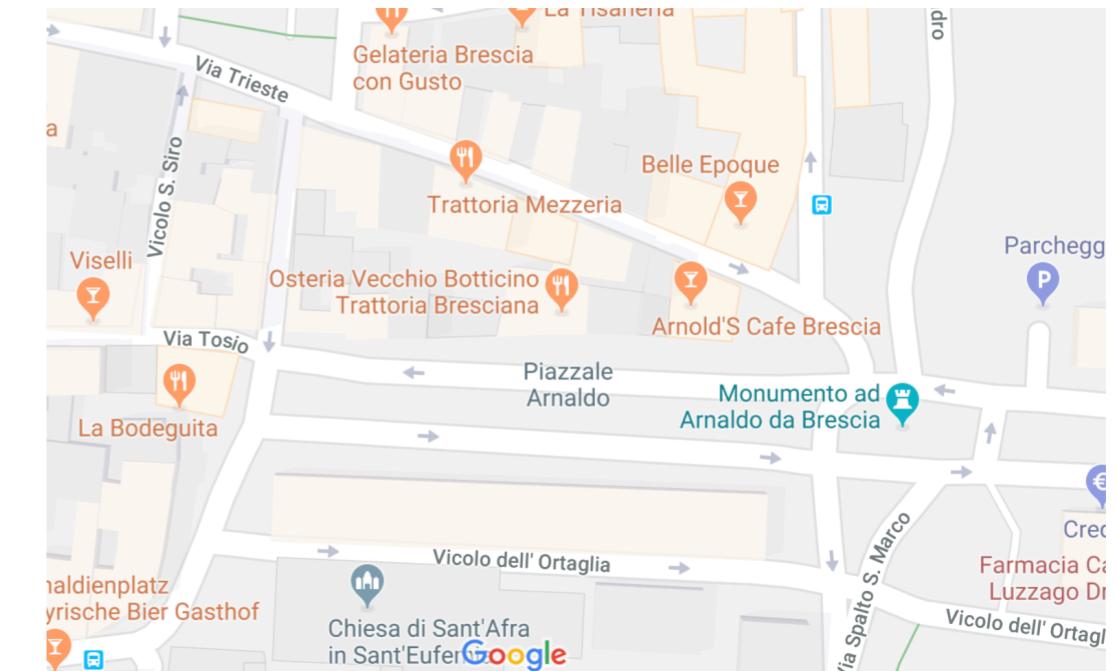
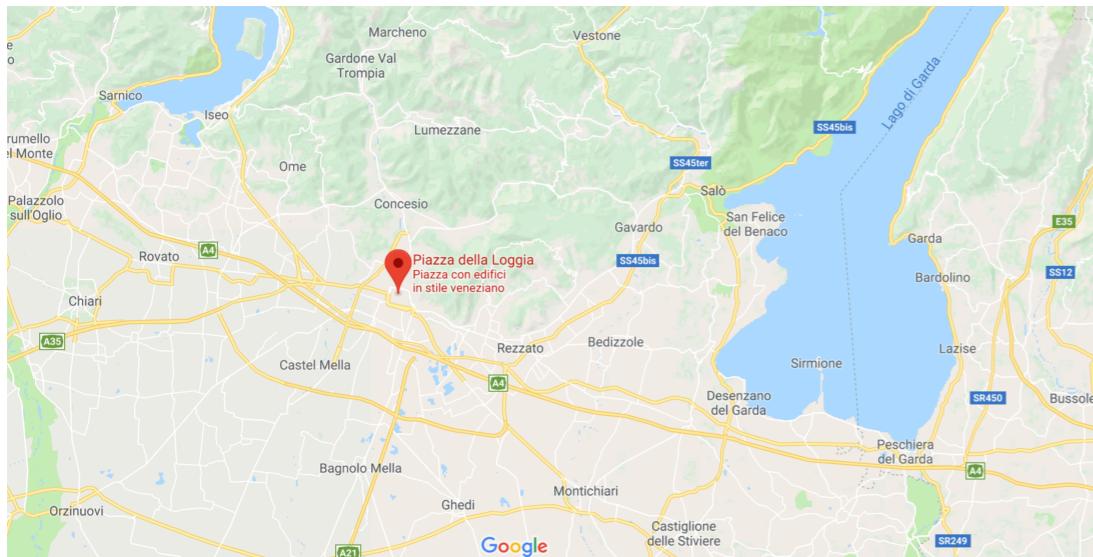


Model

- A model is a theoretical object that is defined and constructed in such a way as to be capable to represent (or stand for) other objects that occupy a portion of the world (representational view of models)
- What a model represents is defined by the researcher (community) (stipulation)
- So, models cannot be true or false. They can be differently similar to other objects (e.g., physical objects)



Not all models are appropriate

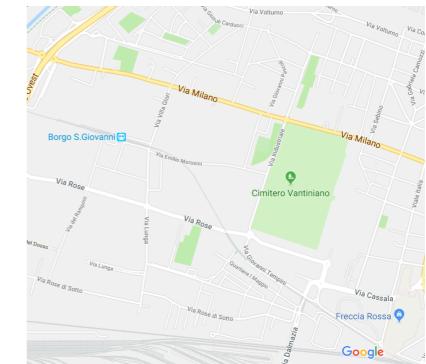
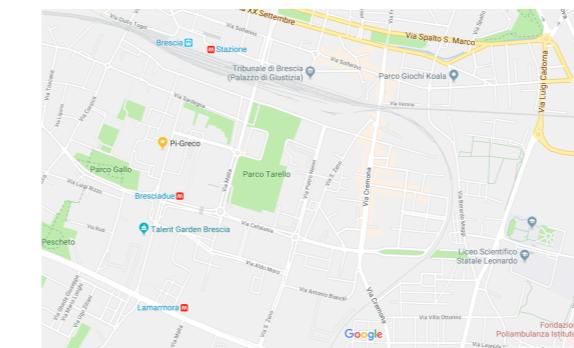
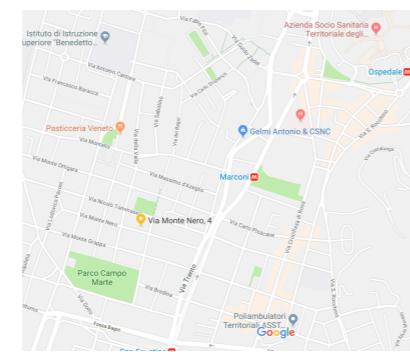


Models can be too abstract

Models can represent another object



Theories and models



Semantic view of theories





Background reading

Woodward, James (2017). "Scientific explanation". In E.N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy*. Fall 2017 Edition.

Metaphysics Research Lab, Stanford University. <https://plato.stanford.edu/archives/fall2017/entries/scientific-explanation/>, Sections 1-3.

Psillos, Stathis (2007). *Philosophy of Science A-Z*. Edinburgh: Edinburgh University Press. Entries: "Model", "Semantic view of theories".

Elter, Jon (2007). *Explaining Social Behavior. More Nuts and Bolts for the Social Sciences*. New York, NY: Cambridge University Press, pp. 32-51.