

THEORY



IMAGINATION & UNDERSTANDING

OUR COMMON TASK

Jacob G. Foster

Department of Sociology, UCLA

@Institute for Advanced Study, March 2020

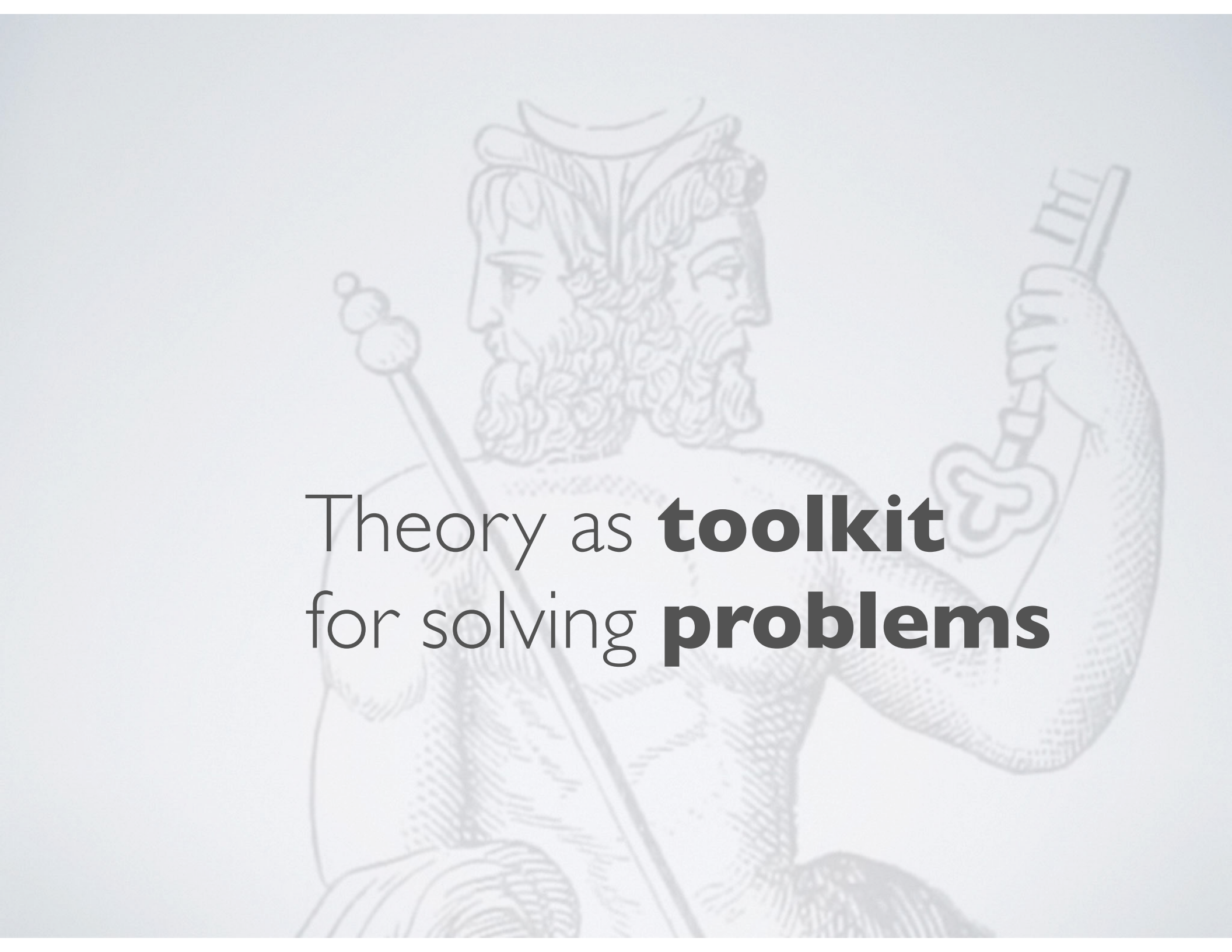


Drawing Theories Apart

The Dispersion of
FEYNMAN DIAGRAMS
in Postwar Physics



DAVID KAISER



Theory as **toolkit**
for solving **problems**

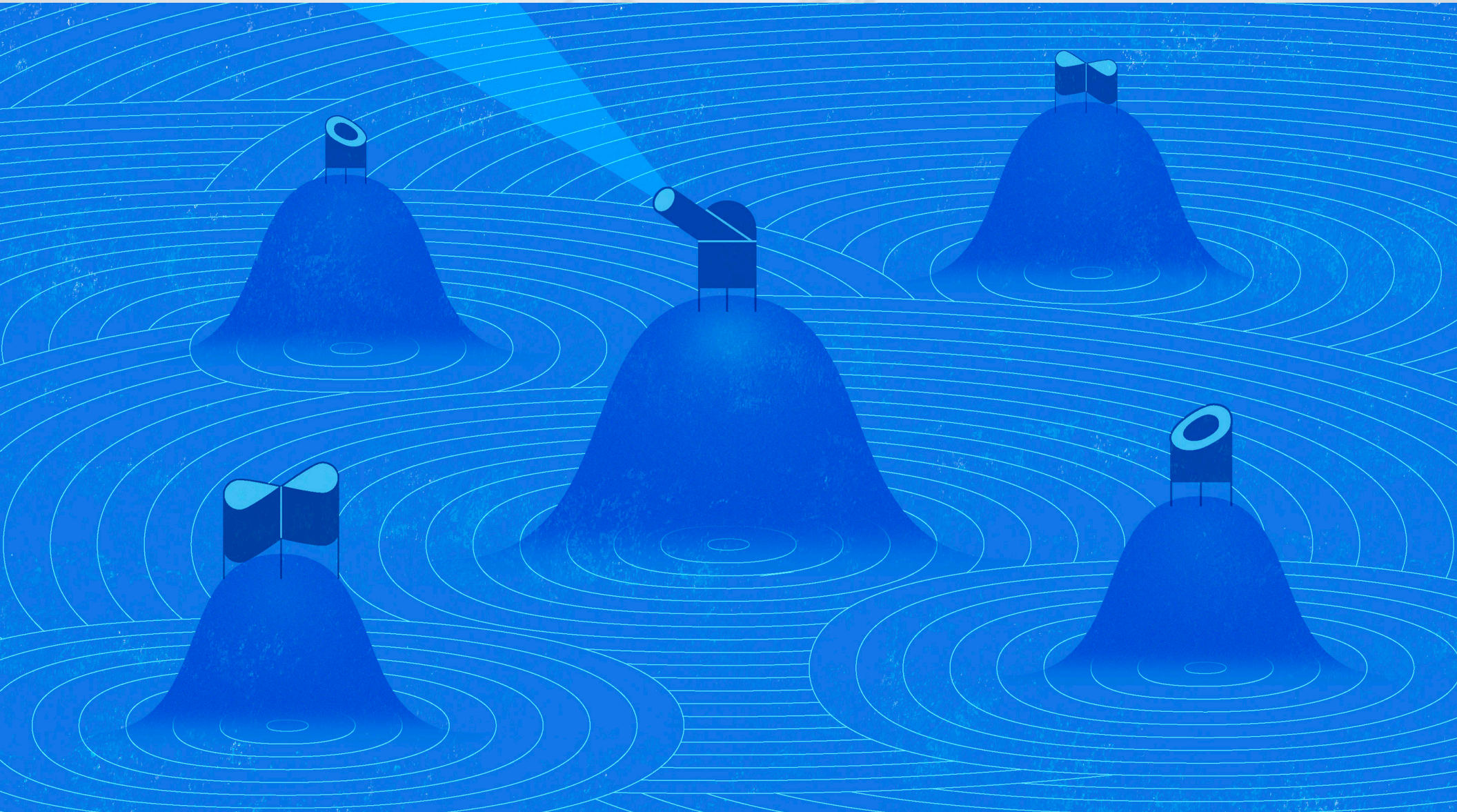
imagination

understanding



imagination

understanding



Quanta

imagination

understanding



un•der•stand•ing /,ʌndə'stændɪŋ/

beyond the Potter Stewart approach:



un•der•stand•ing /,ʌndəˈstændɪŋ/

Understanding of a phenomenon is associated with the ability to give satisfactory **answers** to arbitrary, reasonable **questions** about it.

un•der•stand•ing /,ʌndəˈstændɪŋ/

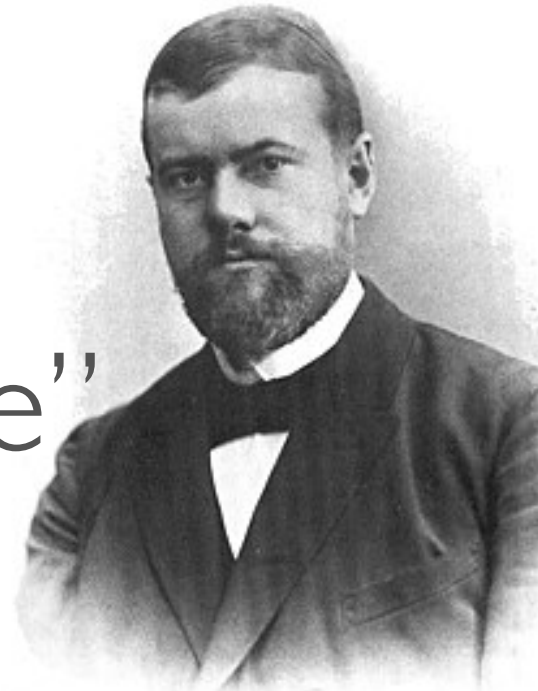
Understanding of a phenomenon is associated with the ability to give satisfactory **answers** to arbitrary, reasonable **questions** about it.

“Erotetic”

un•der•stand•ing /,ʌndə'stændɪŋ/

Understanding of a phenomenon is associated with the ability to give satisfactory **answers** to arbitrary, reasonable **questions** about it.

consistent with “interpretive”
understanding (*verstehen*)



un•der•stand•ing /,ʌndəˈstændɪŋ/

Understanding of a phenomenon is associated with the ability to give satisfactory **answers** to arbitrary, reasonable **questions** about it.

easy to think of ways of quantifying
how satisfactory?
how many questions?

OUR COMMON GROUND

Computation: "Procedures for arriving at adaptive decisions based on approximate and noisy information"

-David Krakauer



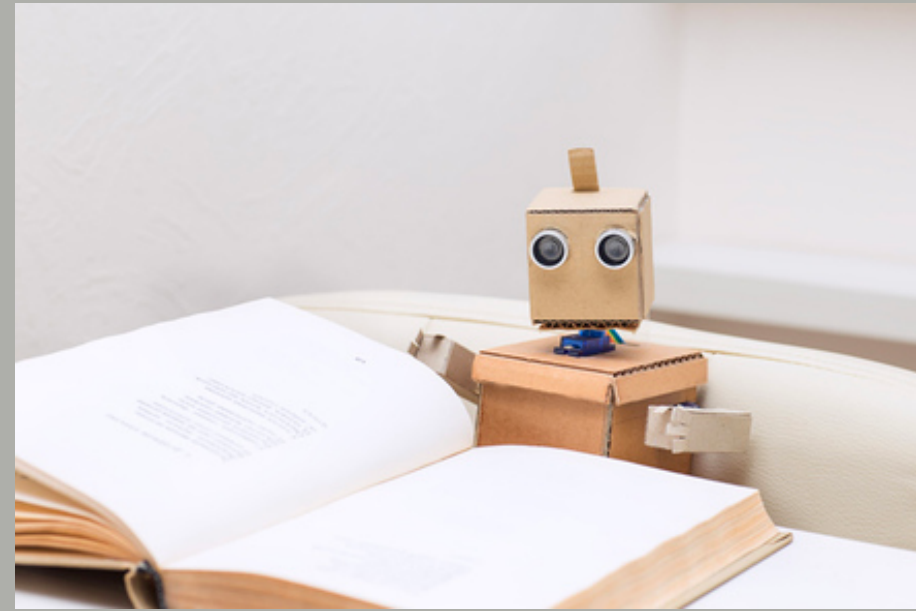
EVEN BETTER

Computation: “the evolution process of some environment by a sequence of ‘simple, local’ steps”

-Avi Wigderson

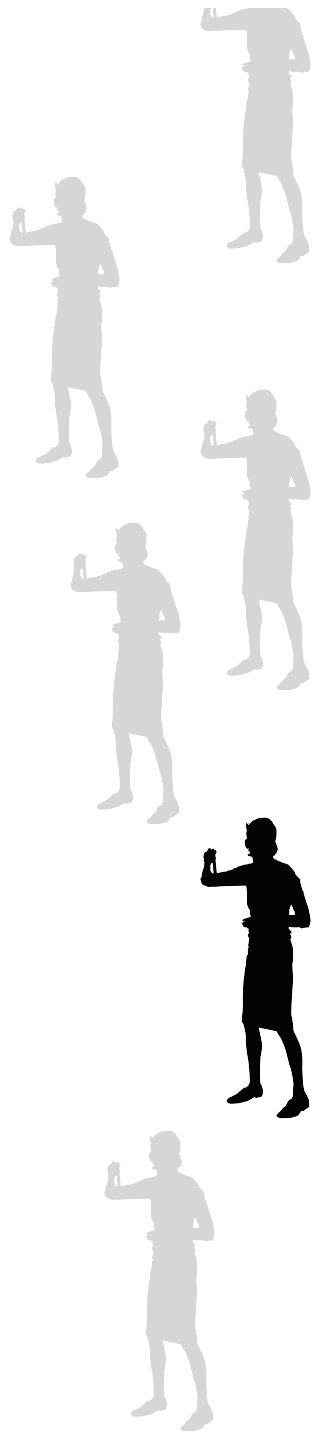


Two examples

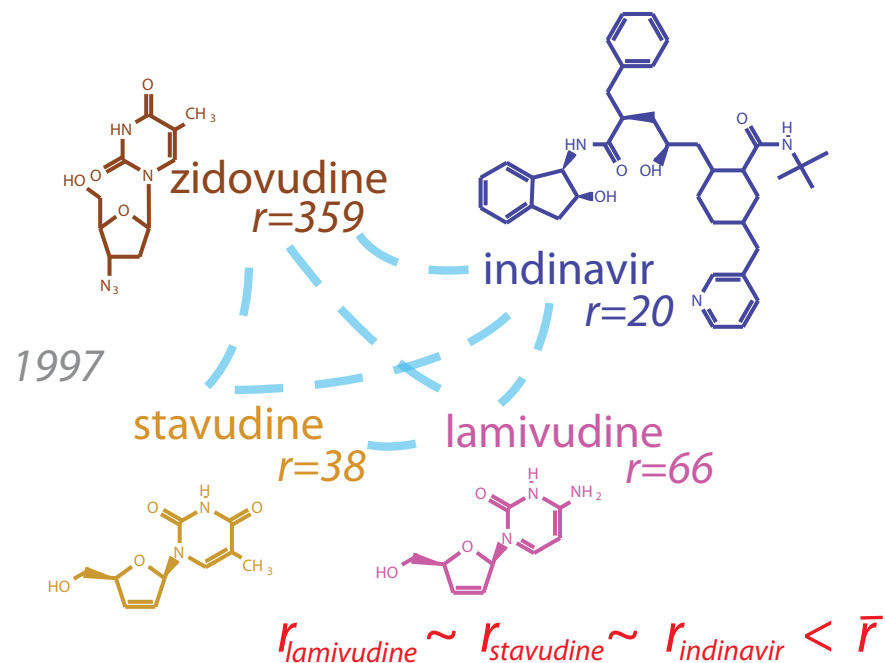
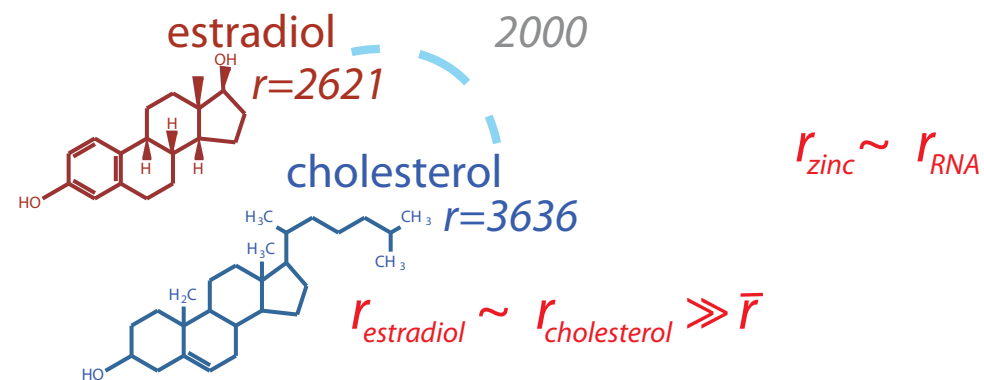


Two examples





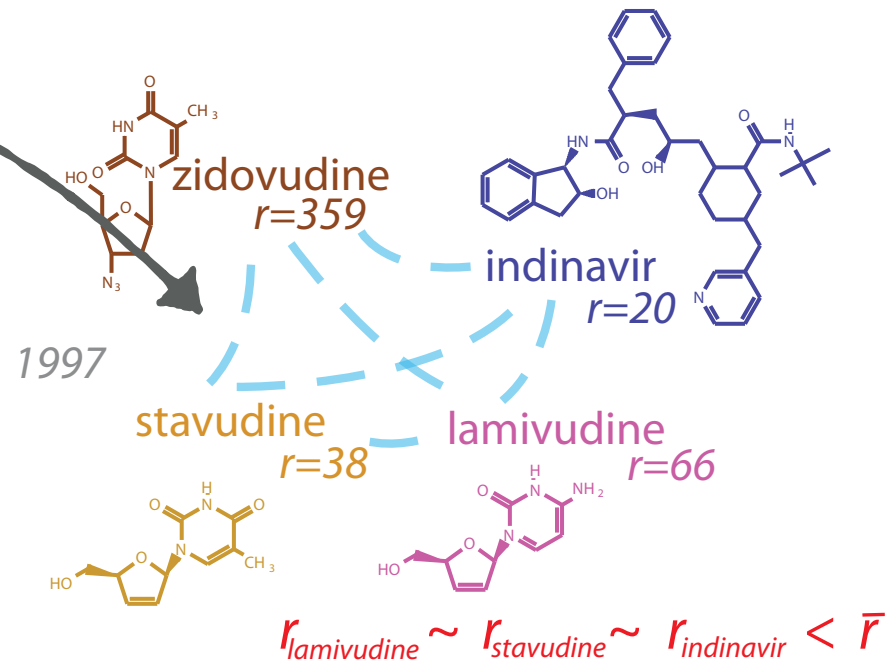
Reputation



Research Claims



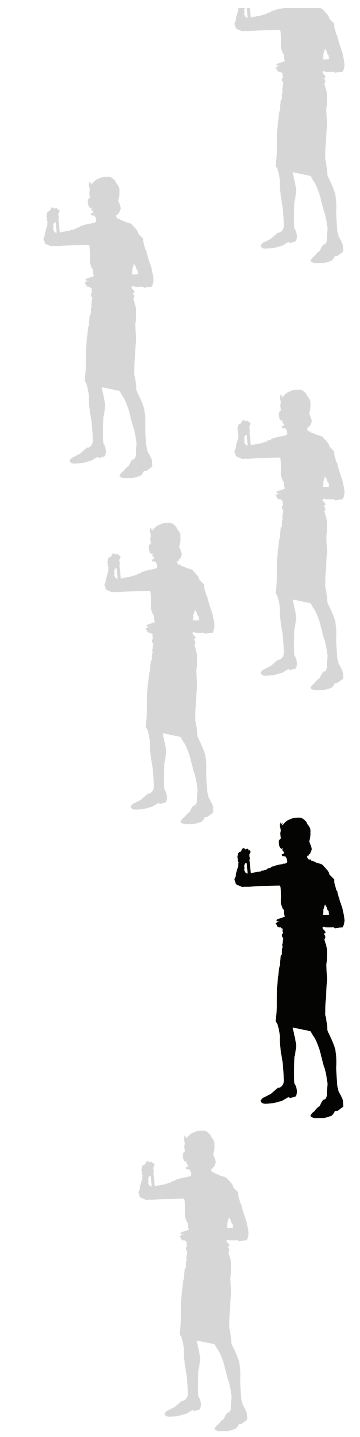
$$r_{\text{estradiol}} \sim r_{\text{cholesterol}} \gg \bar{r}$$



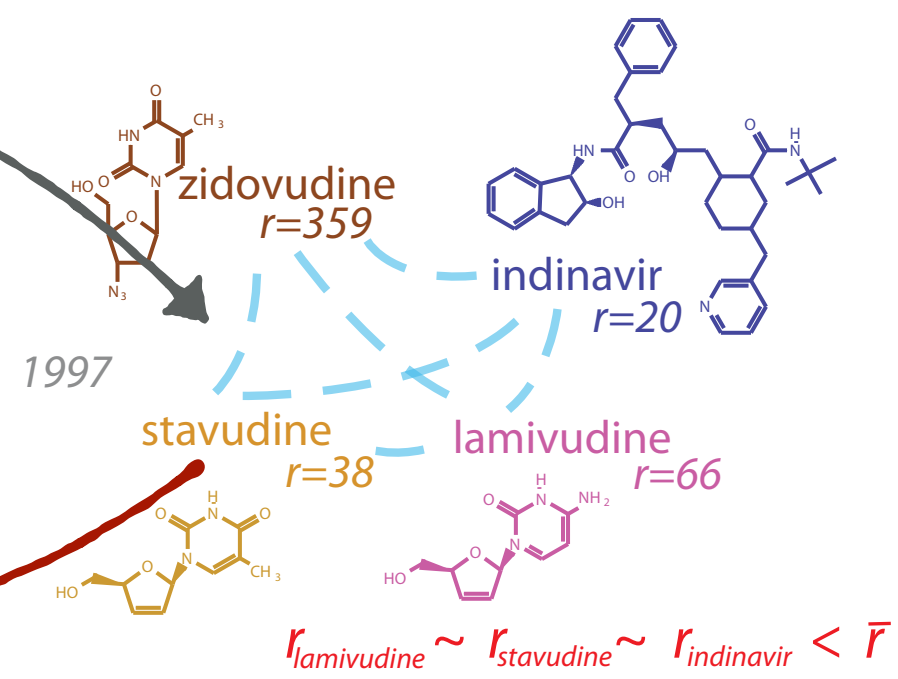
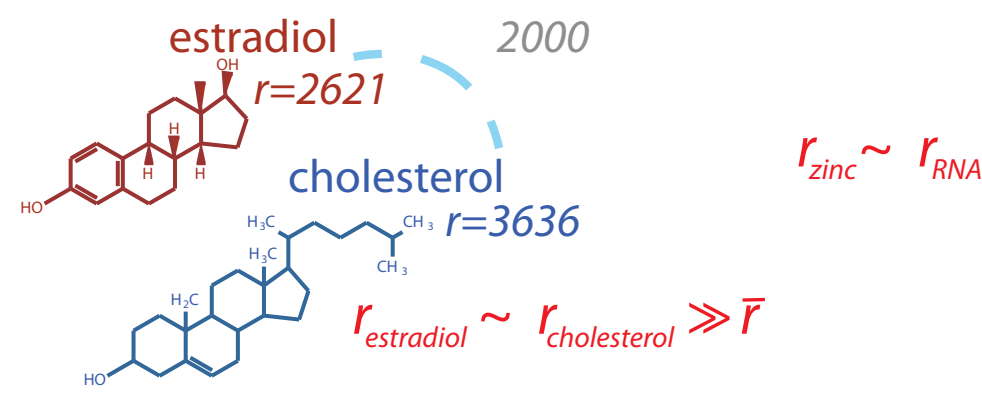
$$r_{\text{lamivudine}} \sim r_{\text{stavudine}} \sim r_{\text{indinavir}} < \bar{r}$$

Reputation

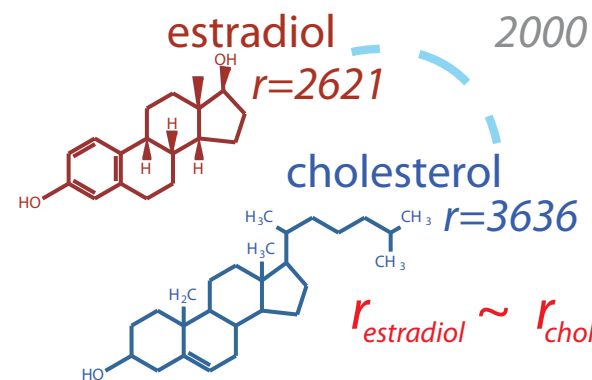
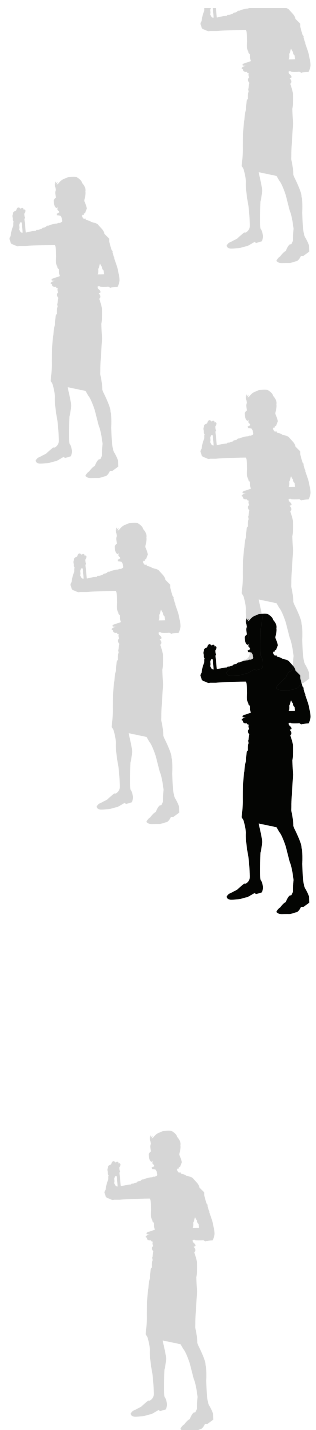
Research Claims



Reputation

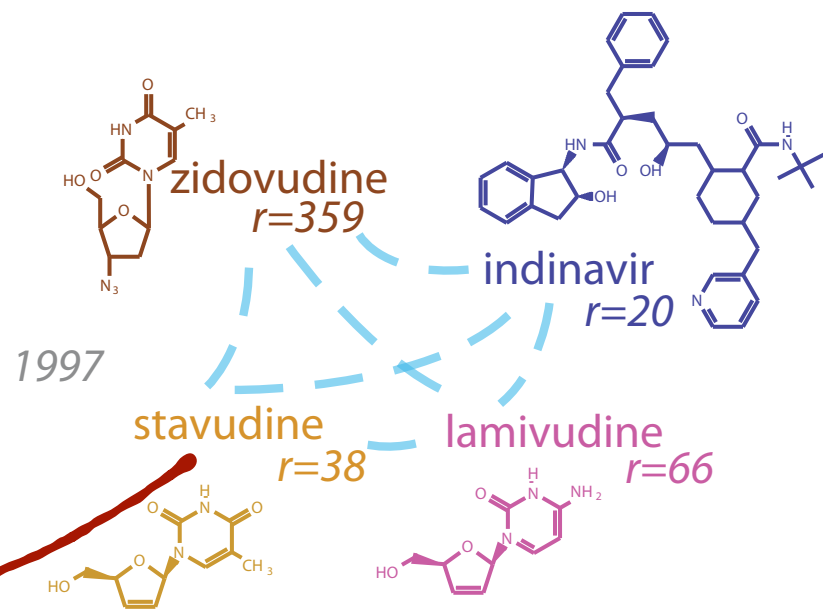


Research Claims



$$r_{\text{zinc}} \sim r_{\text{RNA}}$$

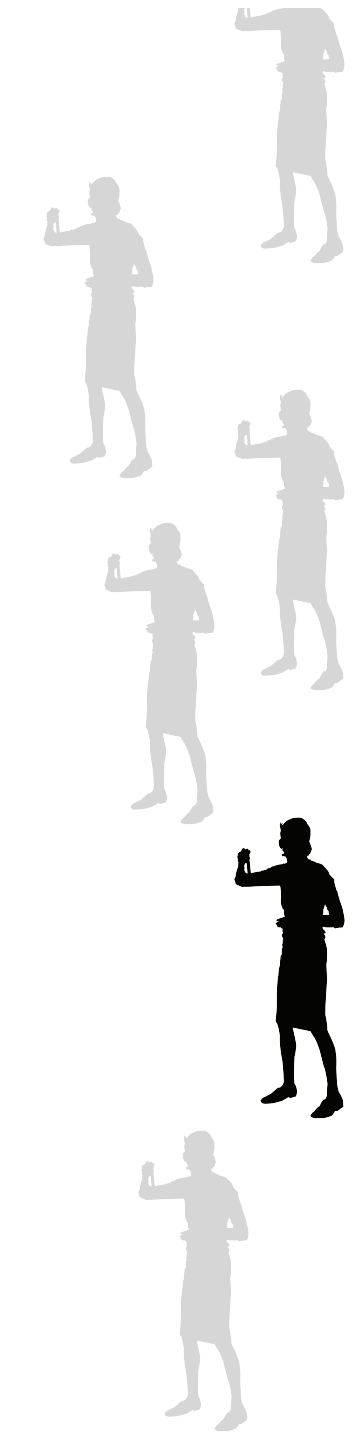
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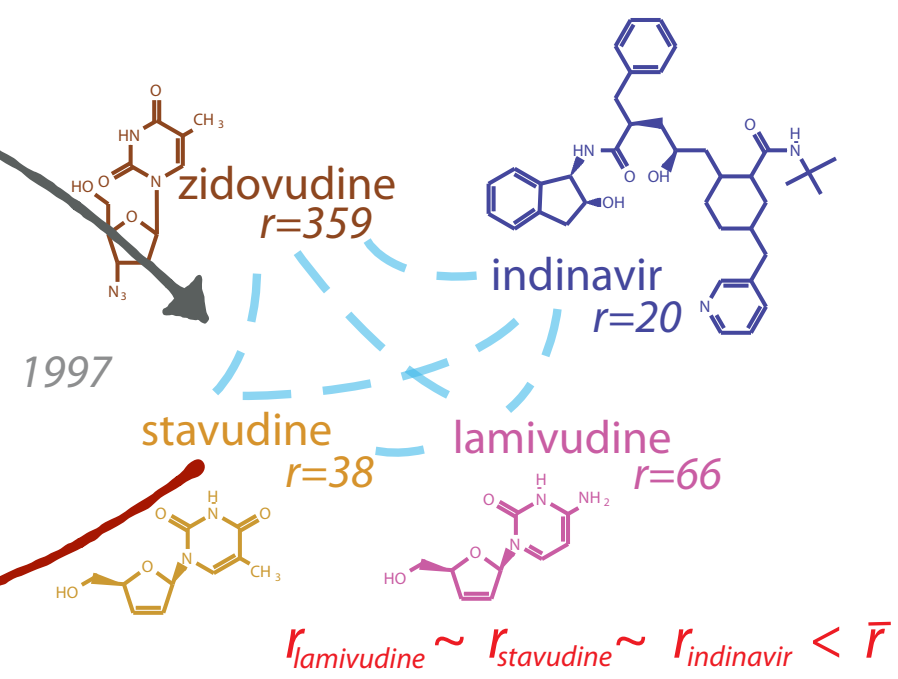
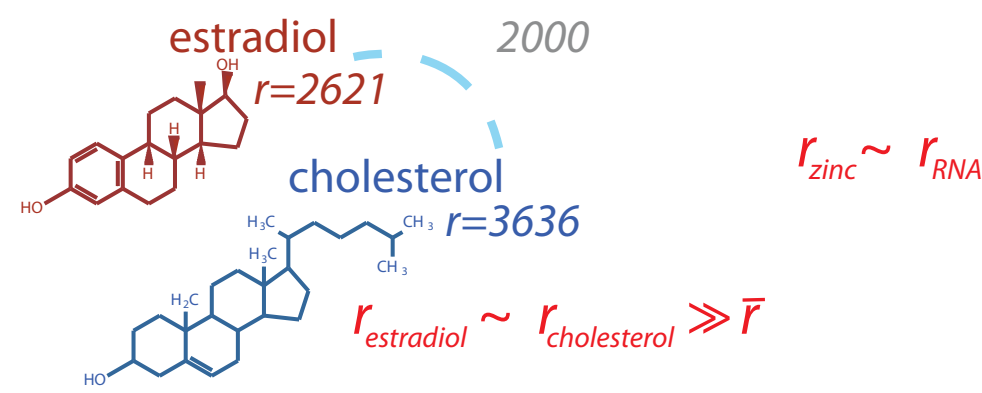
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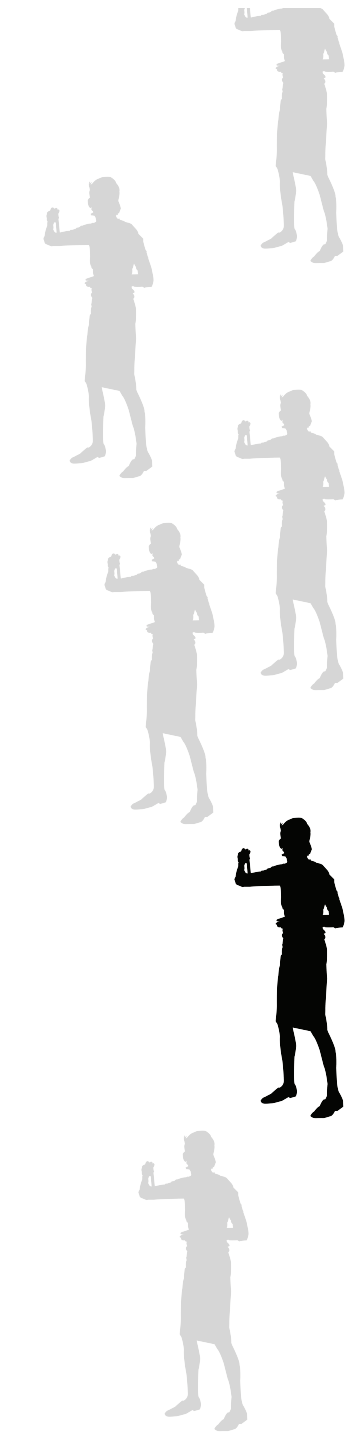
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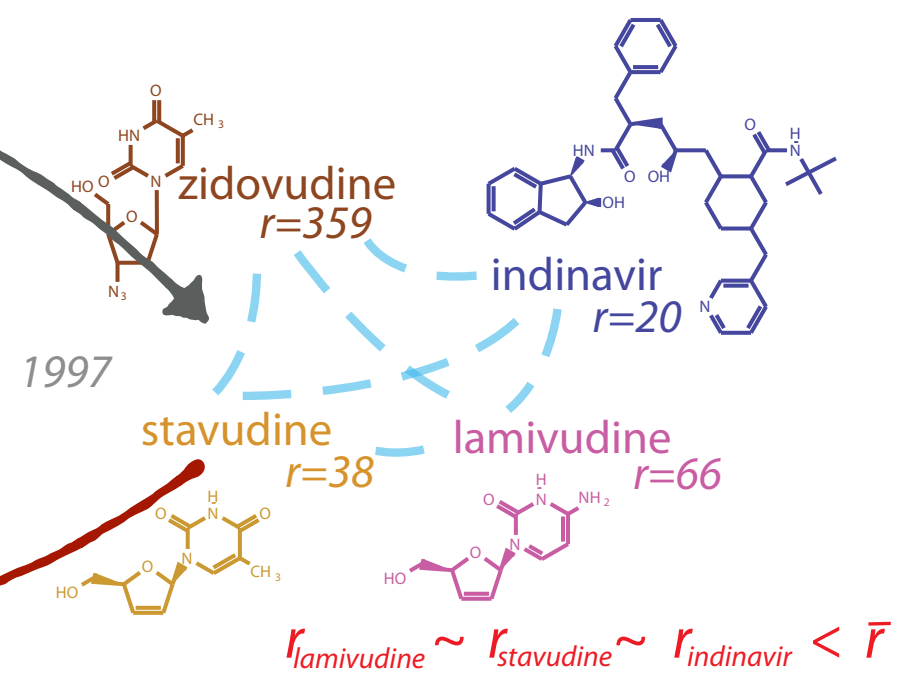
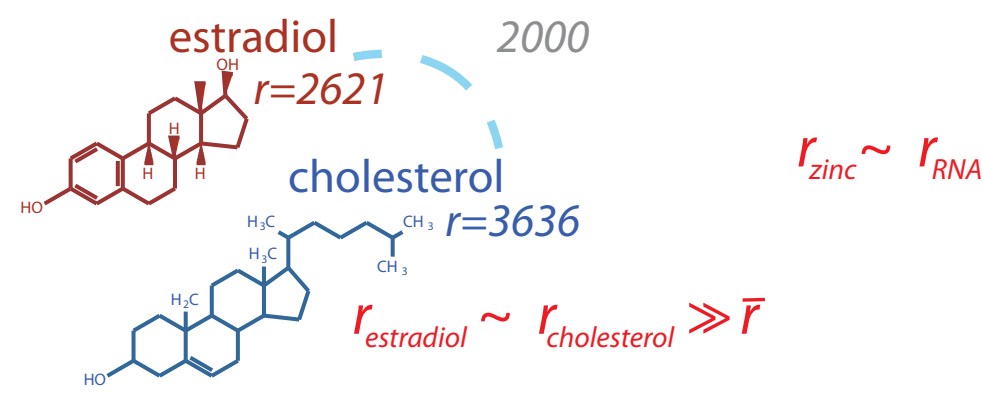
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Research Claims



Reputation

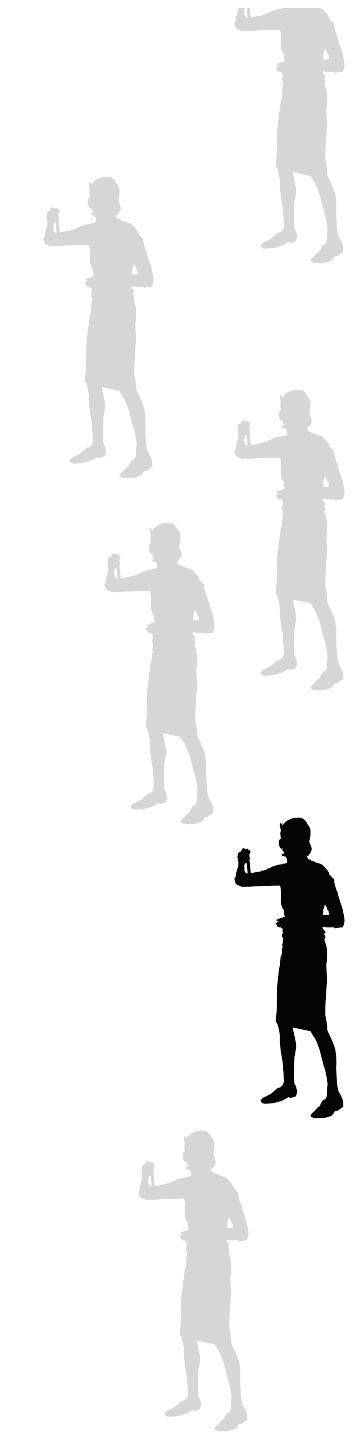


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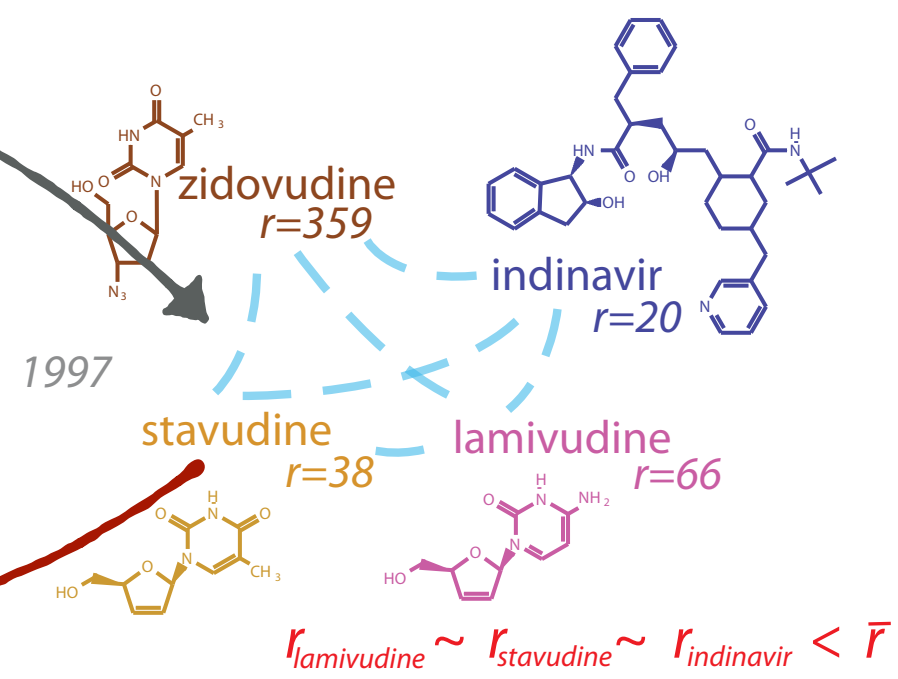
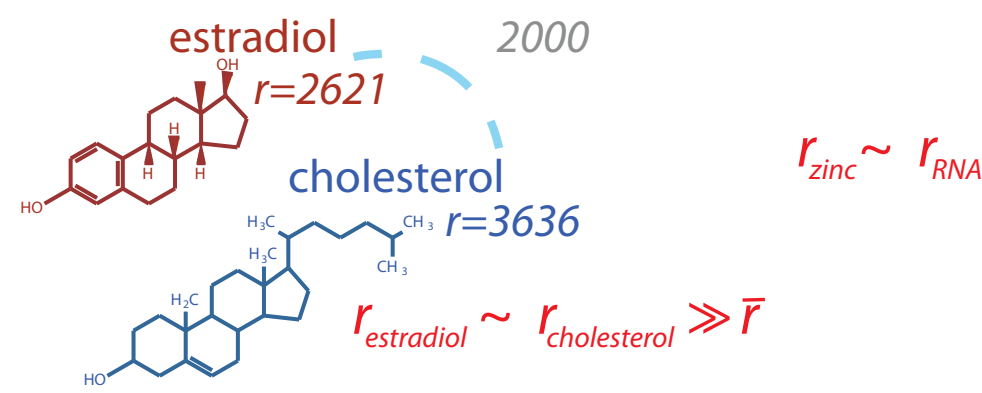
INDUCTION

*Processes of Inference,
Learning, and Discovery*

JOHN H. HOLLAND
KEITH J. HOLYOAK
RICHARD E. NISBETT
PAUL R. THAGARD



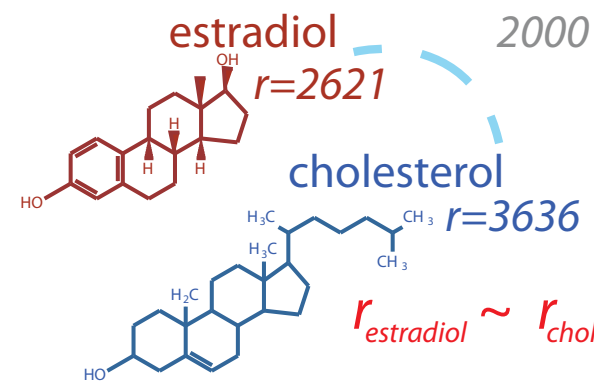
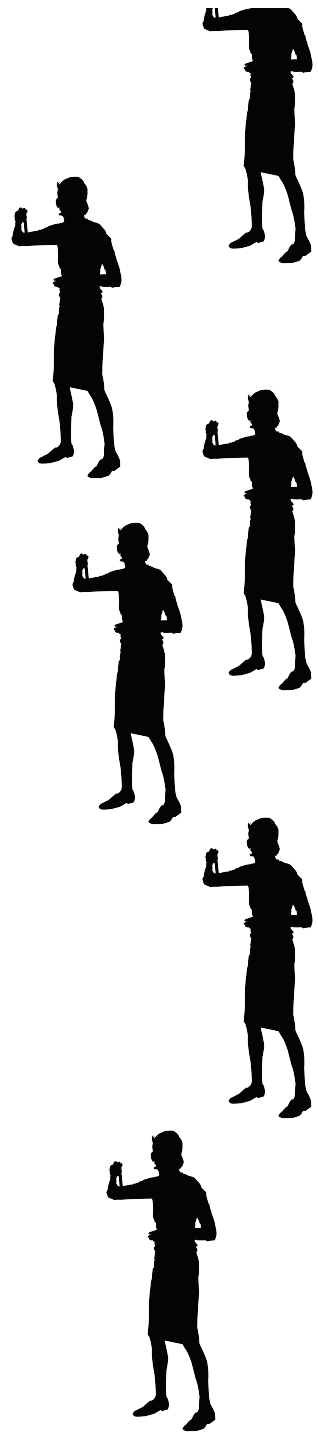
Reputation



Research Claims

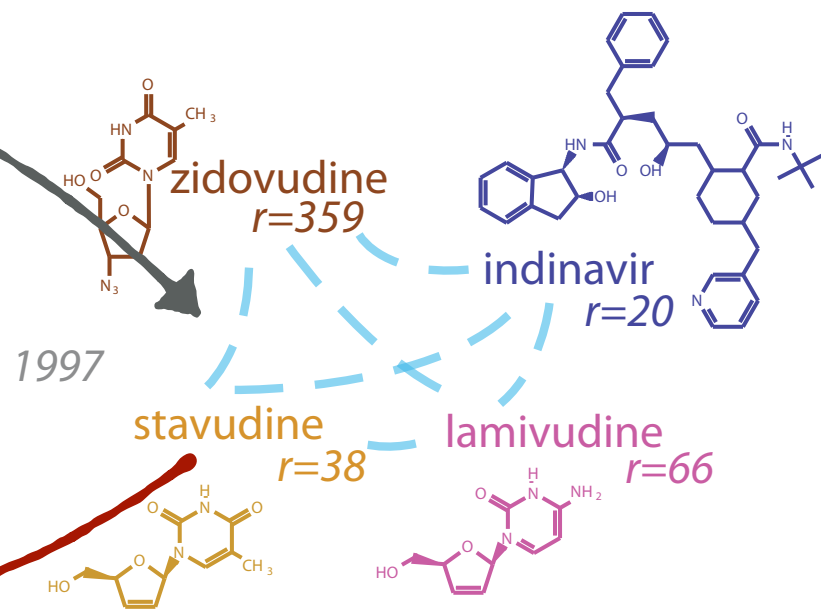
Field ~ Classifier System

$r =$
z



$$r_{\text{zinc}} \sim r_{\text{RNA}}$$

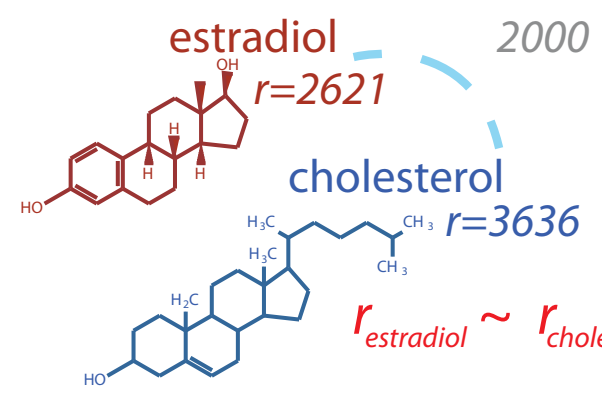
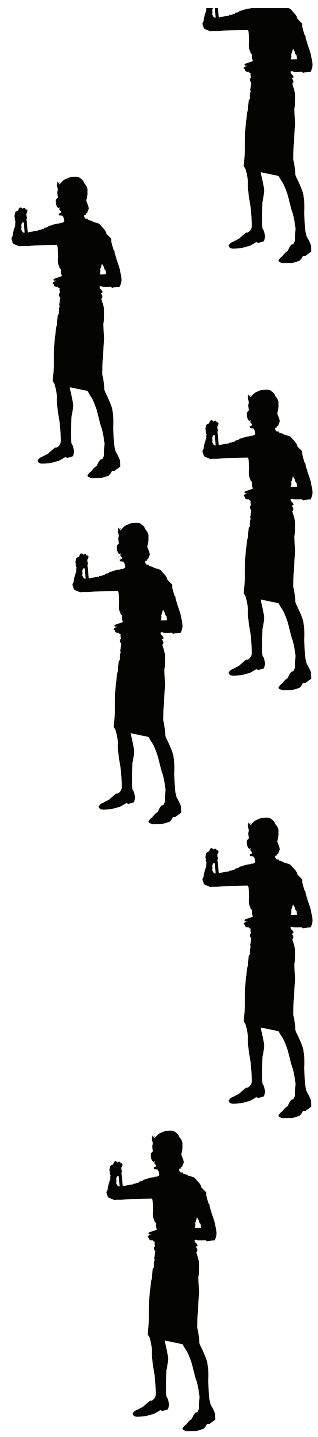
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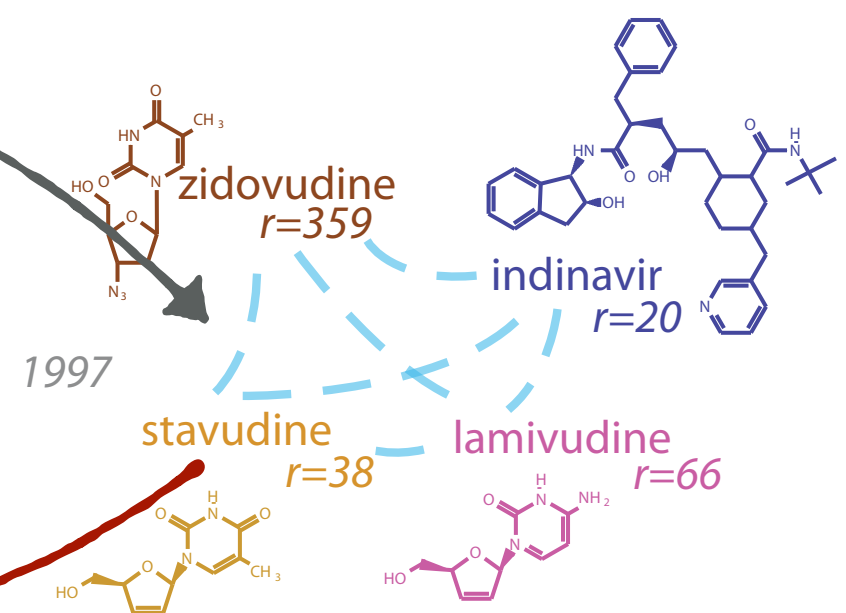
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Reputation

Research Claims



Field ~ Classifier System

social [?]= bad

Field ~ Classifier System



social = essential



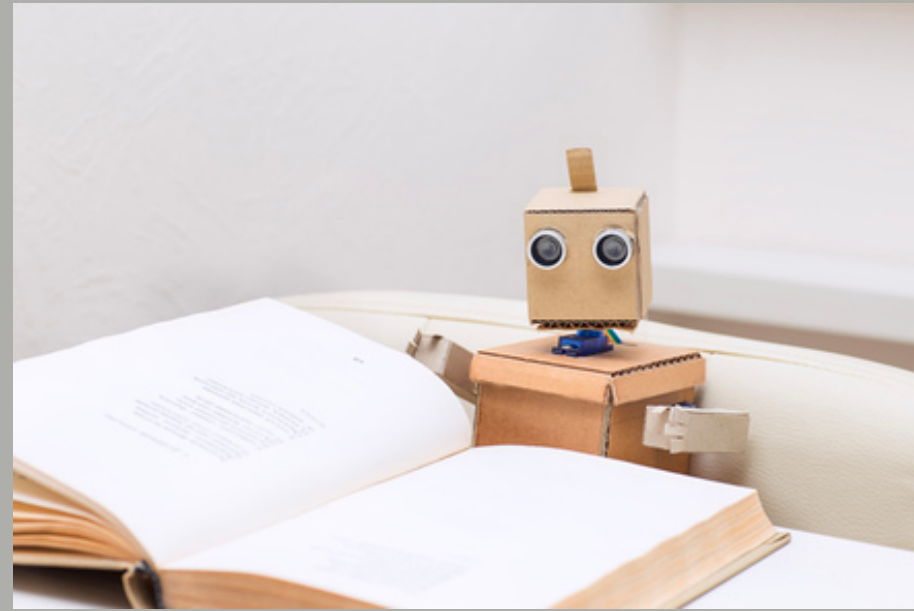
developed in

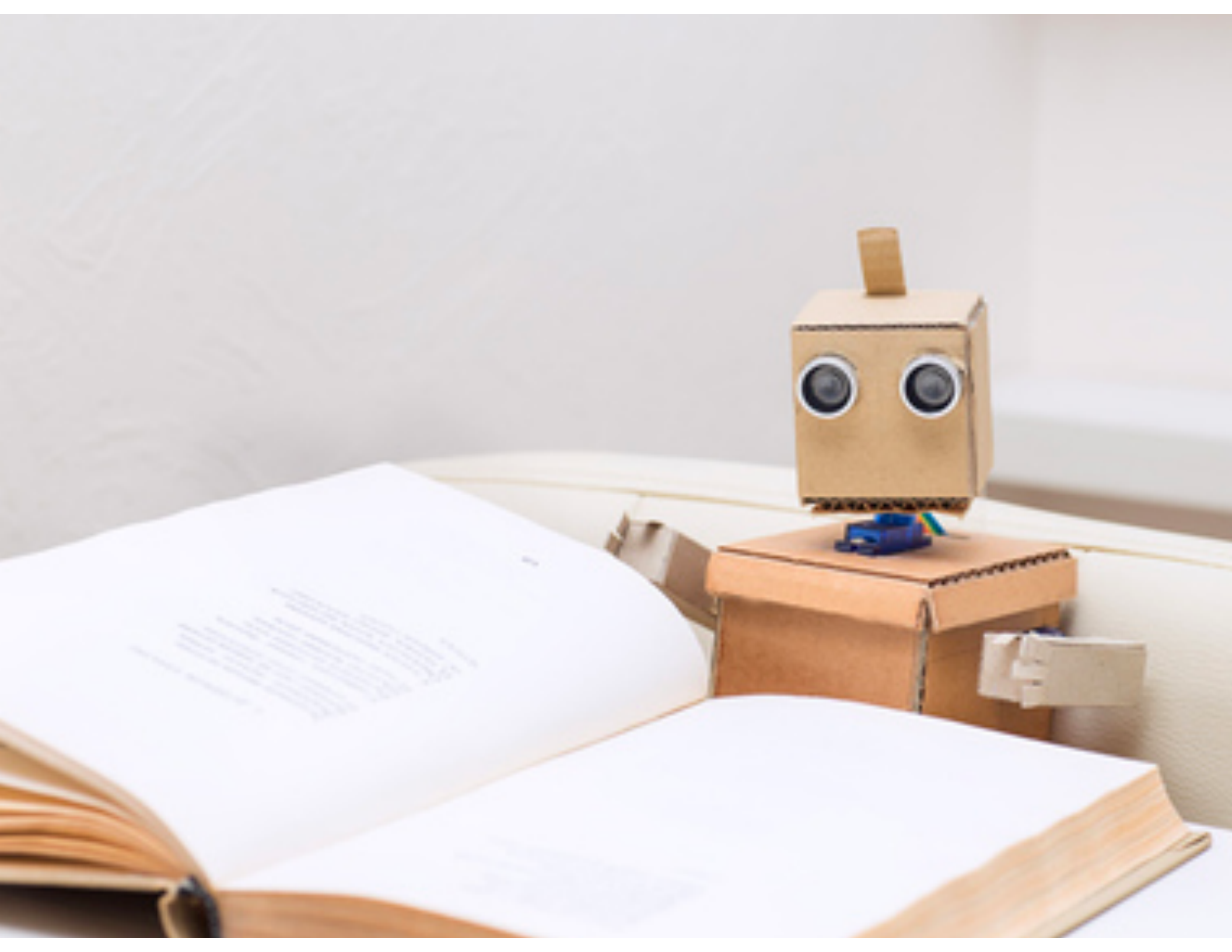
CULTURE AND COMPUTATION

STEPS TO A
PROBABLY APPROXIMATELY CORRECT THEORY OF CULTURE

POETICS 2018

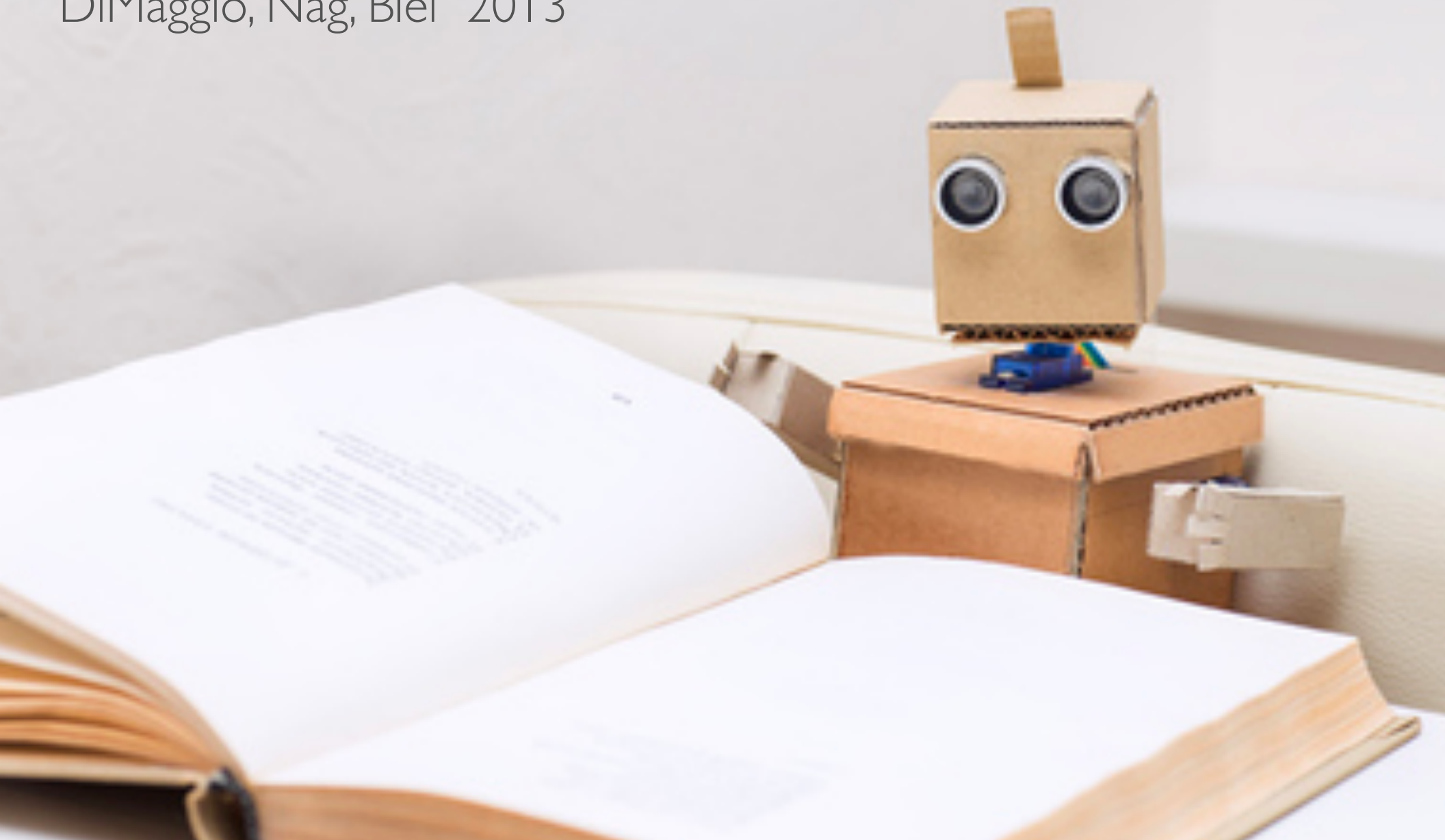
Two examples





topic modeling ~ frames

DiMaggio, Nag, Blei 2013



word embeddings ~ schemata

Arseniev-Koehler & Foster, under review

Preprint: <https://osf.io/preprints/socarxiv/c9yj3/>



un•der•stand•ing /,ʌndəˈstændɪŋ/

word embeddings:

Arora et al., 2016, 2018

From embeddings to topic models

$$\Pr[w \text{ emitted at time } t \mid c_t] \propto \exp(\langle c_t, v_w \rangle)$$



discourse vector does
random walk

MAP of discourse vector
position easy to compute

From embeddings to discourse atoms

learn a **sparse dictionary** for representing the embedding space

$$v_w = \sum_{j=1}^m \alpha_{w,j} A_j + \eta_w$$

few non-zero
↓
atom **error**

Using this correspondence:

$$\Pr[w \text{ emitted at time } t \mid c_t] \propto \exp(\langle c_t, v_w \rangle)$$

each **atom** defines a topic model

So **atoms** allow us to
understand the content of
embedding spaces

“Discourses of Death”

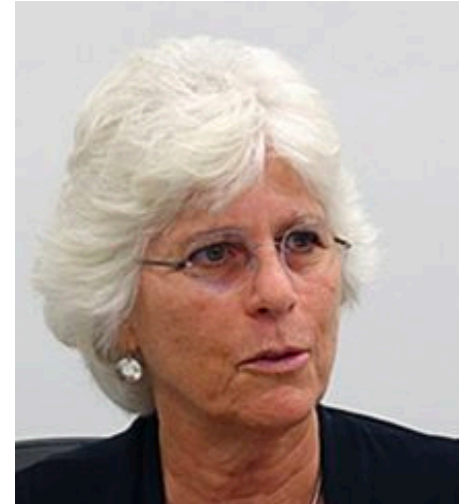
aka how reading theoretical ML
can change your life!



Alina Arseniev-Koehler



Vickie Mays



Susan Cochran

Shameless plug

come see



Alina Arseniev-Koehler

present this work at the “Computational Sociology”
session at the 2020 ASA Meeting in San Francisco

Our data: NVDRS

over 300,000
violent deaths

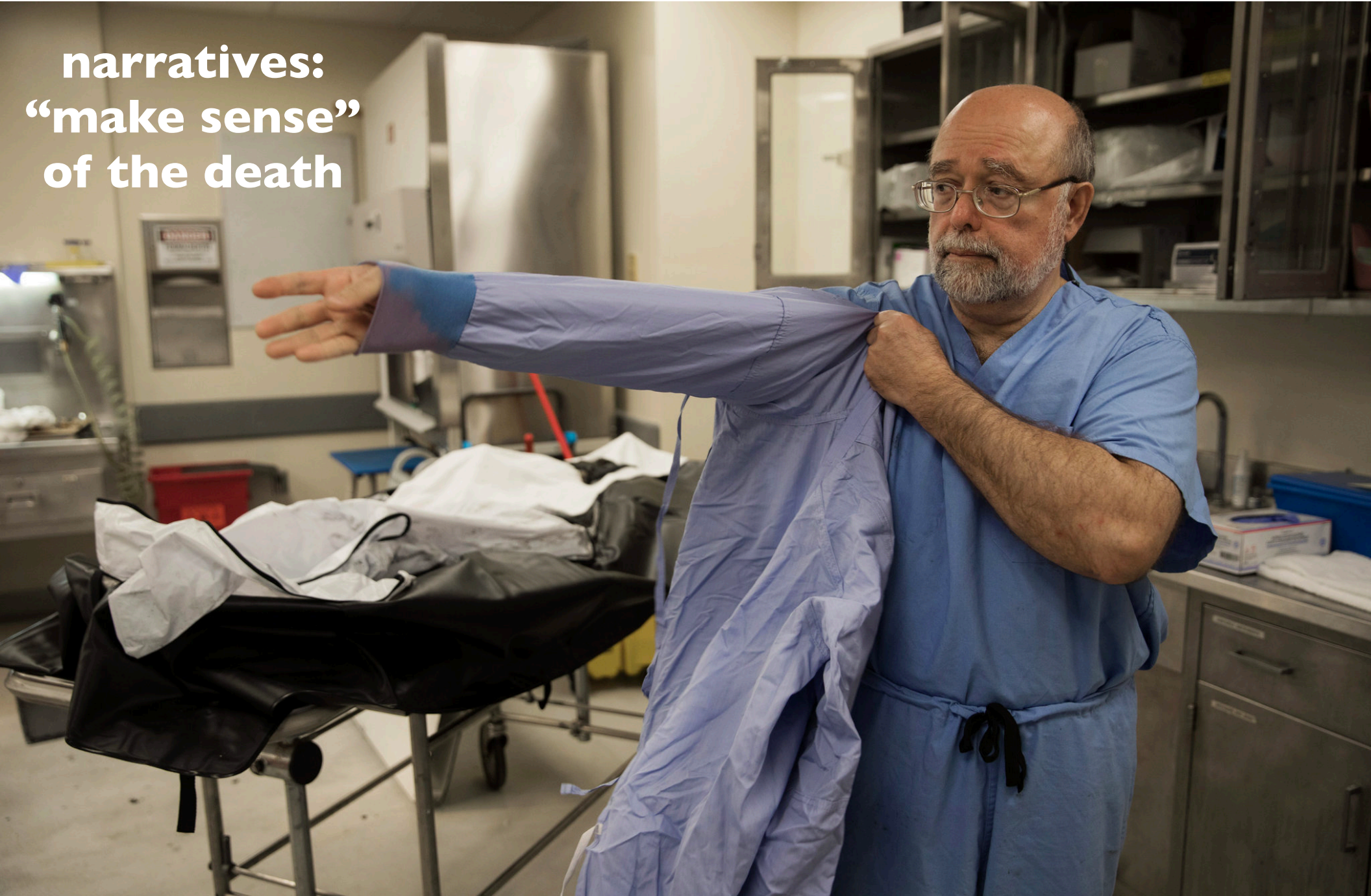
from 2003-2017



NY Times

Our data: NVDRS

narratives:
“make sense”
of the death



Embeddings —> atoms

Building blocks of sense-making around violent death

- Sounds, sights, and smells of death
- Stressors
- Material components of death
- Social actions and interactions
- Social organizations

Sounds, sights, and smells

- **Blood:** coagulated, splatters, smeared, large_puddle, thinning, congealed, saturated, spatters, pools, trail_leading
- **Living conditions:** sparsely_furnished, rents, upon_entering, strewn_throughout, scattered_throughout, cluttered, immaculate, trashed, extremely_dirty, complete_disarray

Stressors

- **Financial/legal:** litigation, lawsuit, legal_issues, civil_lawsuit, criminal_charges, law_suit, civil_suit, court_proceedings, bankruptcy, financial_hardship
- **Cancer:** stage_intravenous, stage_four, ovarian, stage_4, metastatic, malignant, colon, metastic, metastatic_lung, melanoma
- **Romantic:** split_up, tumultuous_relationship, rocky_relationship, disagreement, argued, arguing, verbal_argument, volatile_relationship, frequent_arguments, sexual_relationship

Material components

- **Drugs:** burnt_spoon, crack_pipe, syringe_spoon, spoon, bottle_cap, cooking_spoon, metal_spoon, syringe_cap, spoon_lighter
- **Guns:** semiautomatic_pistol, semiautomatic_handgun, colt_revolver, taurus_revolver, magnum_revolver, derringer, sig_sauer, semiauto_handgun, rugar, special_revolver
- **Notes:** hand_written, typed, notebook_containing, handwritten, farewell, notepad, legal_pad, multi_page, entitled, spiral_notebook

Social organizations

- **Family:** mother, best_friend, father, sister, fiancée, grandmother, niece, fiancé, stepfather, aunt
- **Gangs:** gang, bloods, gang_member, motorcycle_gang, latin_kings, rival_gang, rival, gang_members, drug_dealers, drug_dealer

Dimensions of death

woman

+

female

+

she

+

her

+

herself

+

hers

(/6)

minus

man

+

male

+

he

+

him

+

himself

+

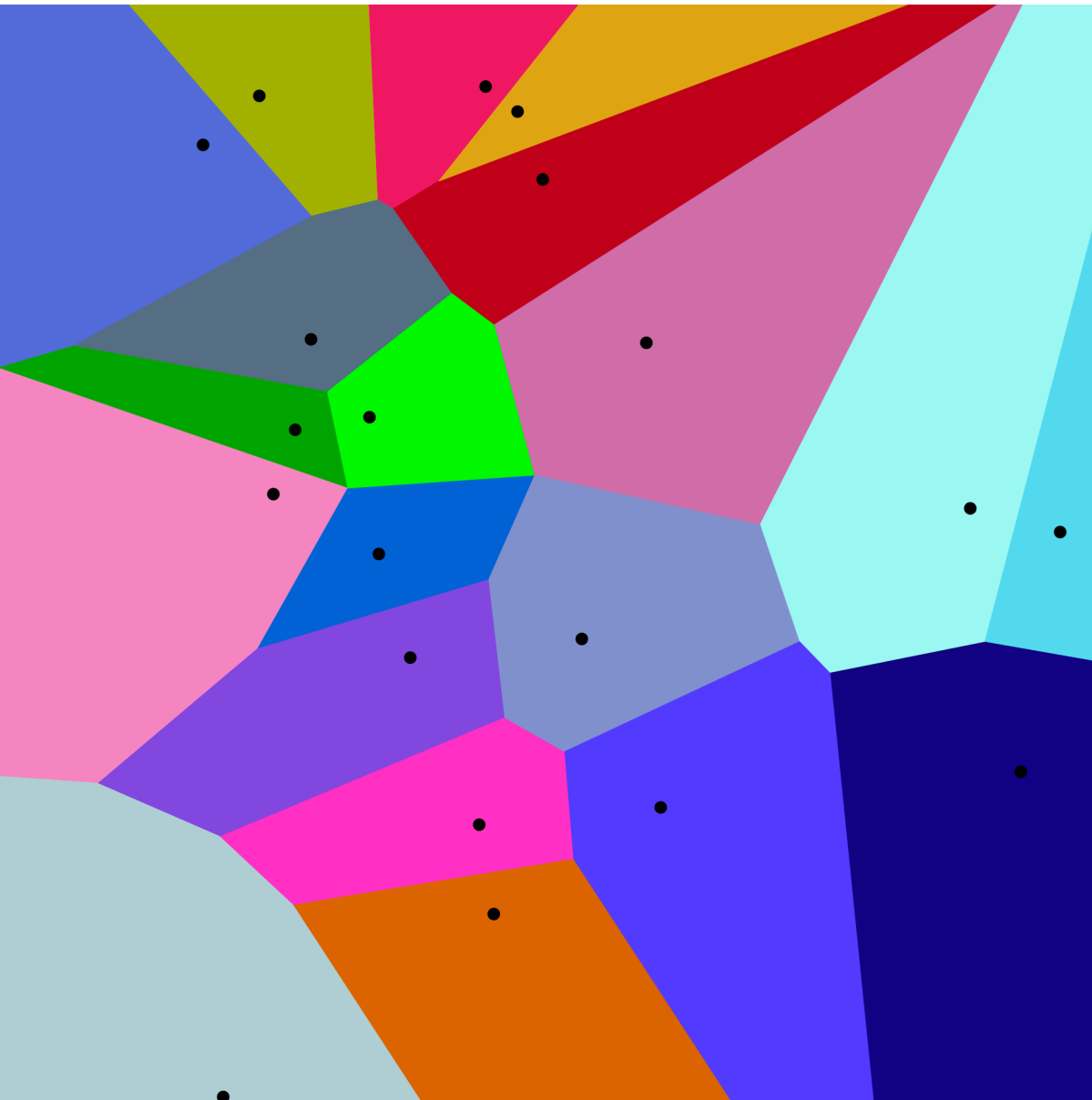
his

(/6)

Most masculine & feminine

- **Masculine:** semiautomatic_pistol, semiautomatic_handgun, colt_revolver, taurus_revolver, magnum_revolver, derringer, sig_sauer, semiauto_handgun, rugar, special_revolver
- **Feminine:** anti_seizure, dispensing, anti_nausea, antianxiety, anti_anxiety, stockpiling, prescribed_psychotropic, allergy, anti_diarrhea

Currently...



atoms give a **Voronoi tessellation** of **embedding space**

provide **coarse-grained** recoding of narratives to reveal **deep structure**

Understanding violent death

Pre-print: <https://osf.io/preprints/socarxiv/nkyaq/>



NYTimes

Two examples



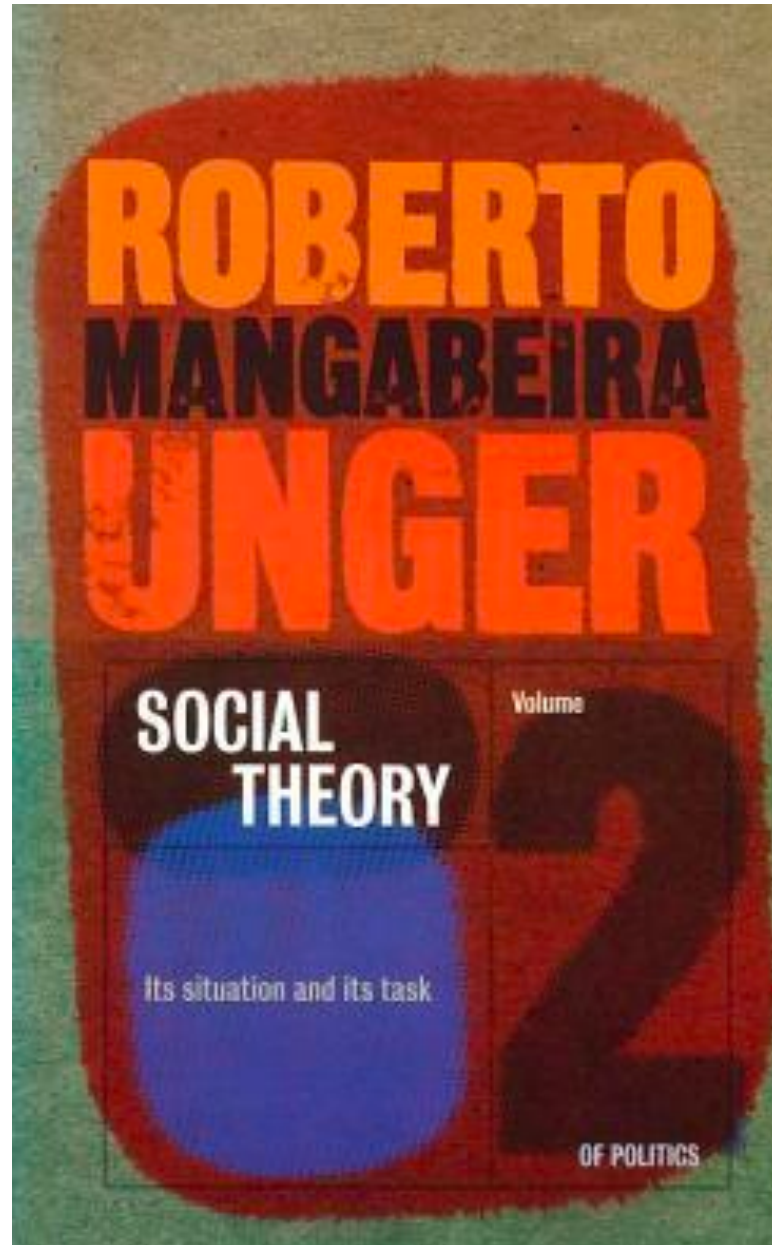
COMPUTATION FOR EMANCIPATION

Computation: “the evolution process of some environment by a sequence of ‘simple, local’ steps”

-Avi Wigderson



cf. Roberto Unger

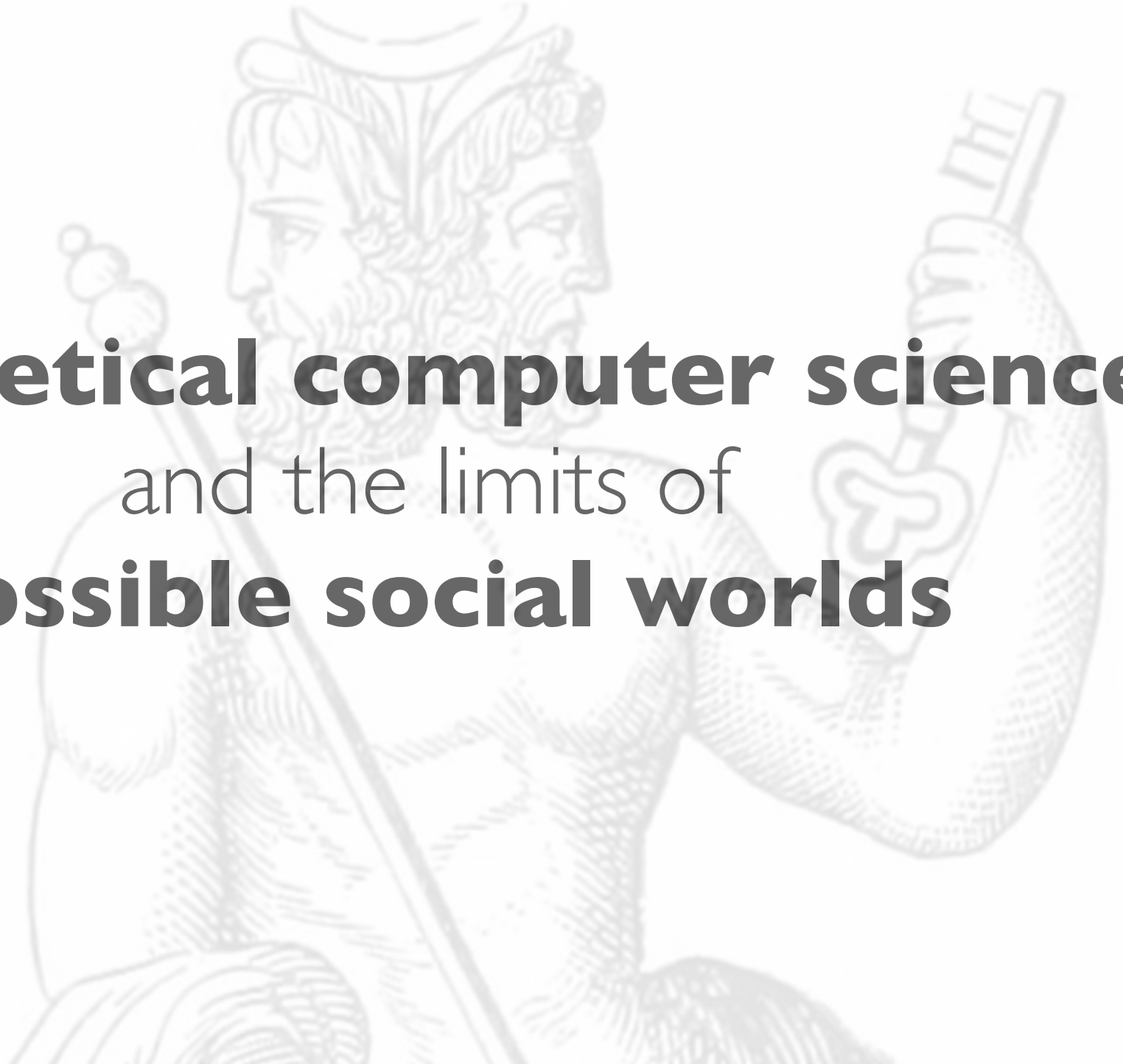


Theoretical computer science and the limits of **possible social worlds**

imagination

understanding

Theoretical computer science
and the limits of
possible social worlds





John
Templeton
Foundation



National Institutes
of Health



TEMPLETON WORLD
CHARITY FOUNDATION

Thank you

