DATA
for impact

Semantic drift of cited references in the medical literature

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Swedish School of Library and Information Science, University of Borås

24th Nordic Workshop on Bibliometrics and Research Policy, 2019-11-28

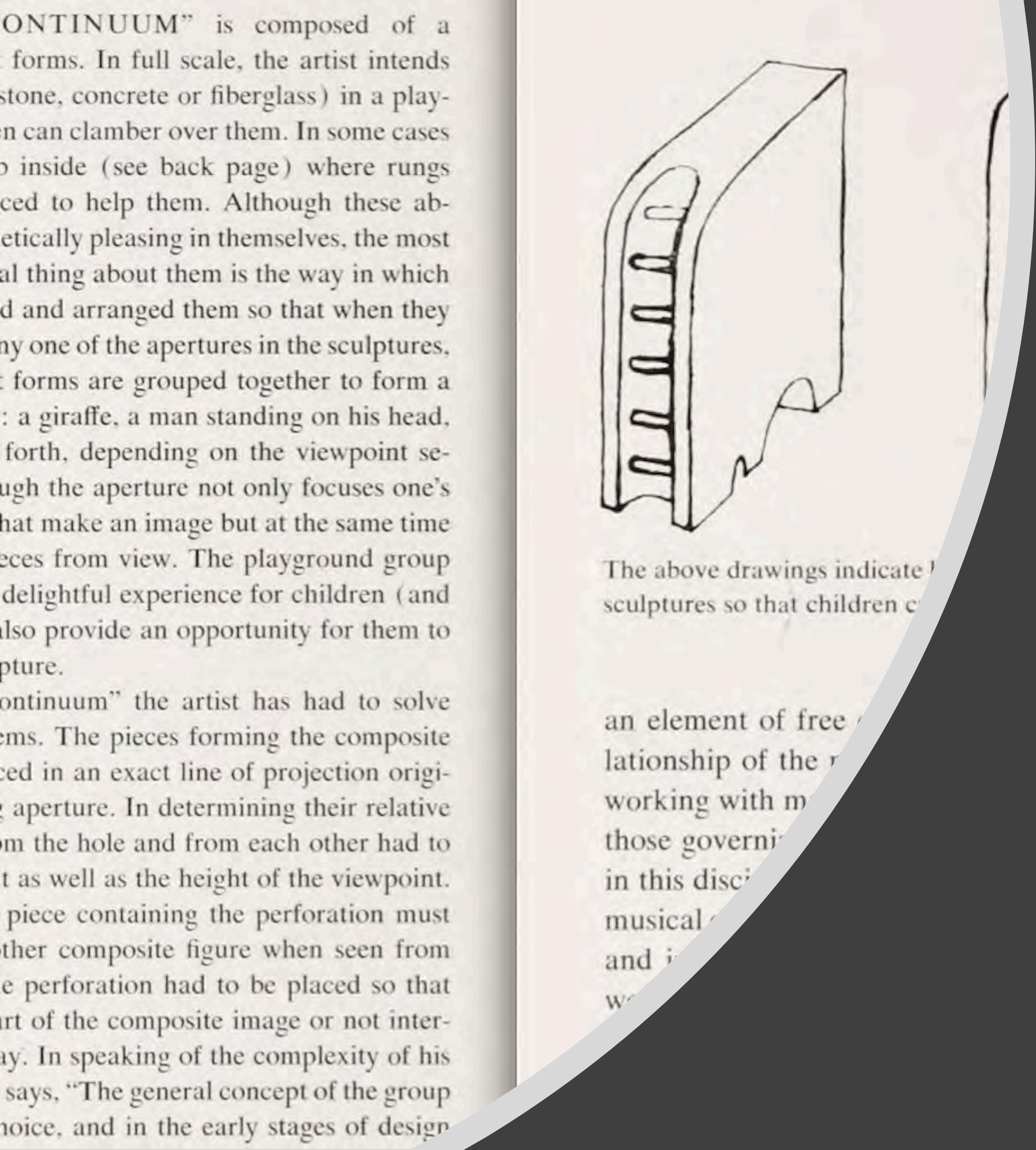
European Commission

Combining machine learning with citation (linked) data

Theoretical conceptualisation:

“Can we infer the ‘knowledge potential’ in cited references by identifying/evaluating the citing context around a reference?”

Hjørland, B. (1992): The concept of ‘subject’ in Information Science, *Journal of Documentation 48*(2), 172-200



ONTINUUM" is composed of a
forms. In full scale, the artist intends
stone, concrete or fiberglass) in a play-
n can clamber over them. In some cases
inside (see back page) where rungs
ced to help them. Although these ab-
etically pleasing in themselves, the most
al thing about them is the way in which
d and arranged them so that when they
ny one of the apertures in the sculptures,
forms are grouped together to form a
: a giraffe, a man standing on his head,
forth, depending on the viewpoint se-
ugh the aperture not only focuses one's
hat make an image but at the same time
eces from view. The playground group
delightful experience for children (and
lso provide an opportunity for them to
pture.
ontinuum" the artist has had to solve
ems. The pieces forming the composite
ced in an exact line of projection origi-
aperture. In determining their relative
m the hole and from each other had to
t as well as the height of the viewpoint.
piece containing the perforation must
ther composite figure when seen from
e perforation had to be placed so that
rt of the composite image or not inter-
ay. In speaking of the complexity of his
says, "The general concept of the group
hoice, and in the early stages of design

The above drawings indicate h
sculptures so that children c

an element of free
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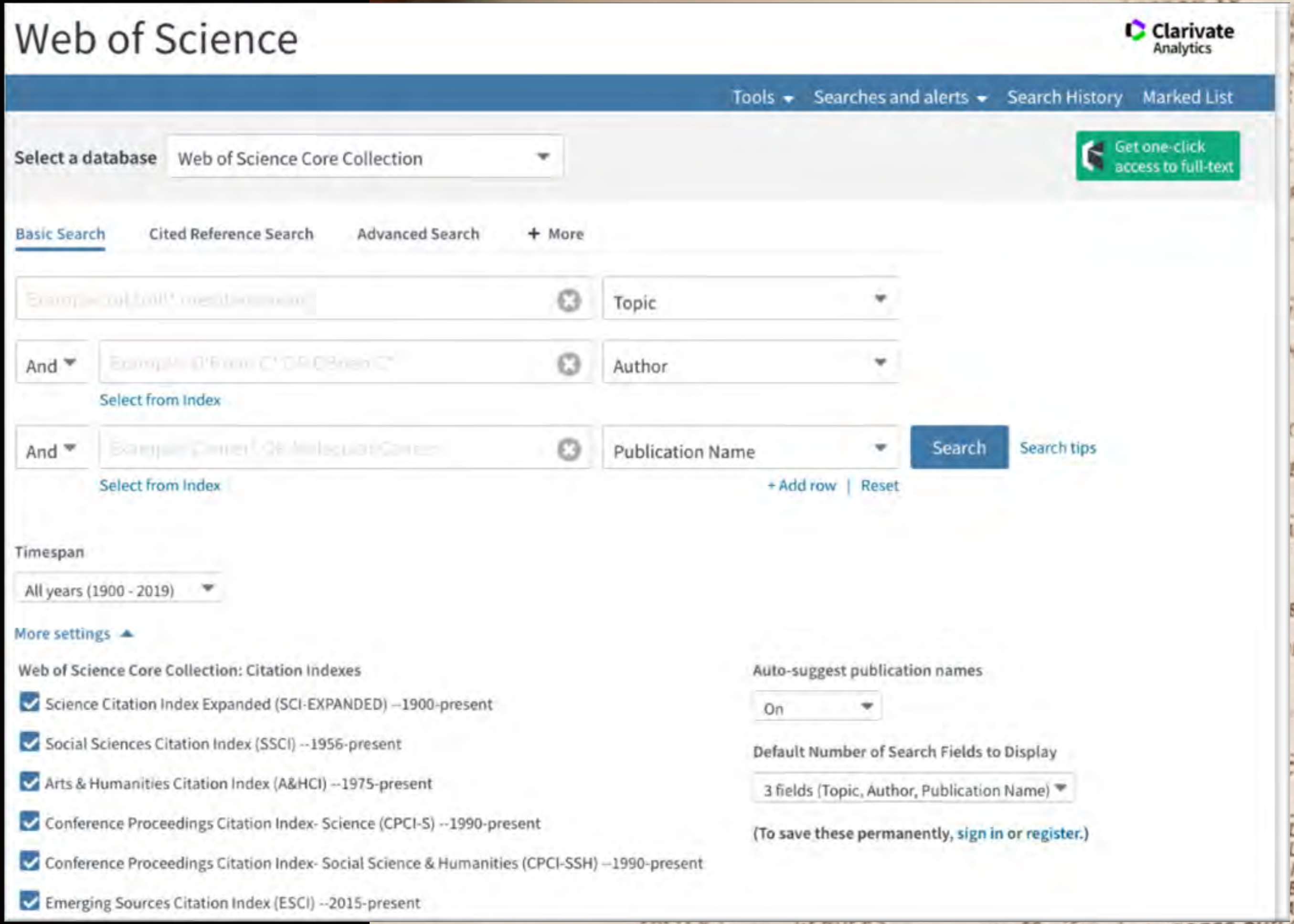
Toward a machine-based understanding of text…



Web of Science

Clarivate Analytics

Select a database: Web of Science Core Collection ▾

Example: oil spill* mediterranean — Topic ▾

And ▾ Example: O'Brian C* OR OBrian C* — Author ▾

Select from Index

And ▾ Example: Cancer* OR Molecular Cancer — Publication Name ▾

Select from Index

Timespan

All years (1900 - 2019) ▾

More settings ▲

Web of Science Core Collection: Citation Indexes

☑ Science Citation Index Expanded (SCI-EXPANDED) --1900-present

☑ Social Sciences Citation Index (SSCI) --1956-present

☑ Arts & Humanities Citation Index (A&HCI) --1975-present

☑ Conference Proceedings Citation Index- Science (CPCI-S) --1990-present

☑ Conference Proceedings Citation Index- Social Science & Humanities (CPCI-SSH) --1990-present

☑ Emerging Sources Citation Index (ESCI) --2015-present

Auto-suggest publication names

On ▾

Default Number of Search Fields to Display

3 fields (Topic, Author, Publication Name) ▾

(To save these permanently, sign in or register.)

...combined with citation data

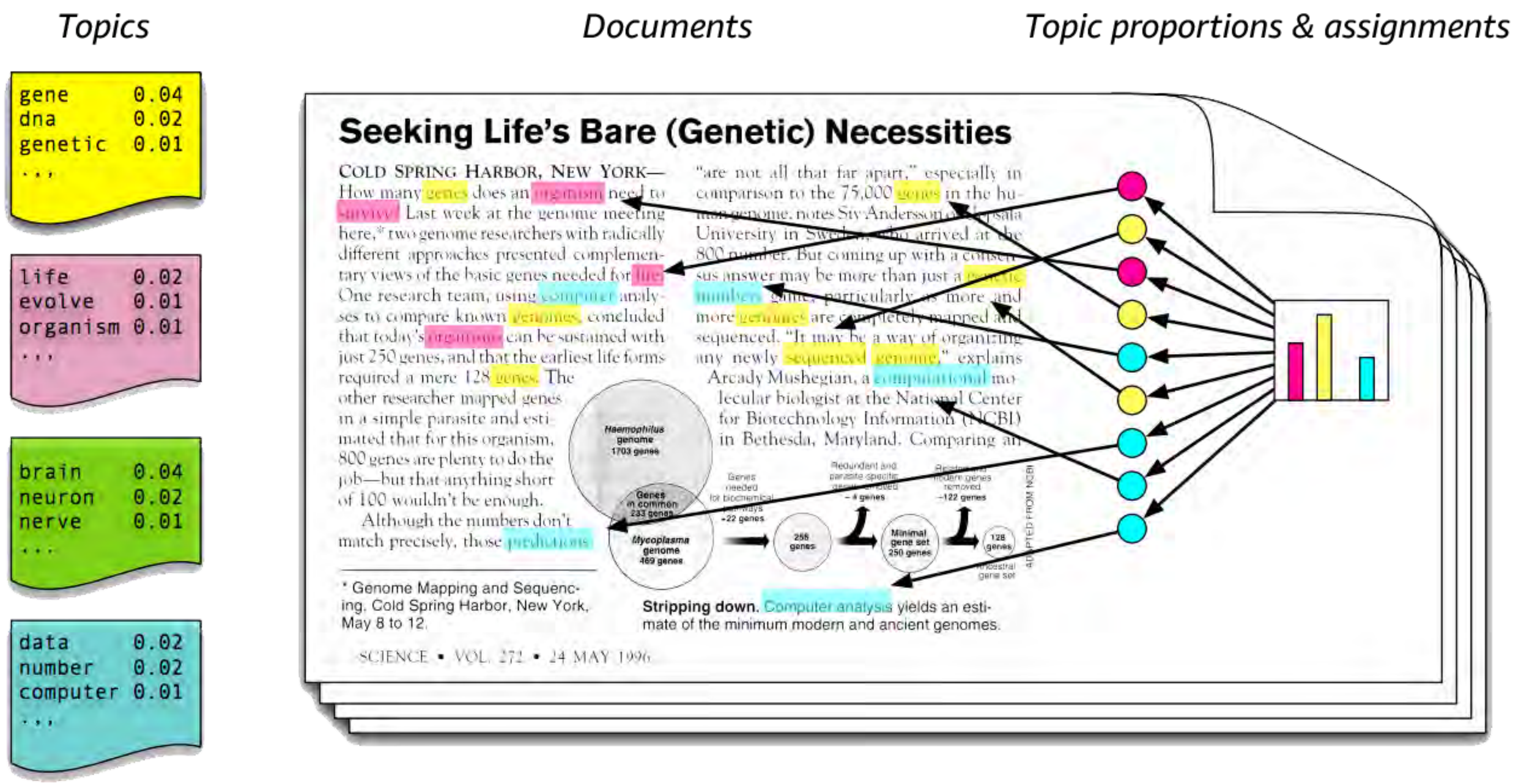
Research programme: ‘References as words’

- We propose an approach for representing documents by their ***cited references*** rather than by their words
- Scientific ***references*** share the following qualities with symbols (e.g. references) in language:
  - they are ***reusable*** units of meaning
  - they import ***meaning*** into the ***context*** in which they are used

C.f. Small 1978: ‘Citations as symbols’ SSS.

Topic modeling

Bag of words


Topics
Documents
Topic proportions & assignments
gene 0.04
dna 0.02
genetic 0.01
...
life 0.02
evolve 0.01
organism 0.01
...
brain 0.04
neuron 0.02
nerve 0.01
...
data 0.02
number 0.02
computer 0.01
...
Haemophilus genome 1703 genes
Genes in common 233 genes
Mycoplasma genome 469 genes
Genes needed for biochemical pathways +22 genes
255 genes
Redundant and parasite-specific genes removed −4 genes
Minimal gene set 250 genes
Related and modern genes removed −122 genes
128 genes
Ancestral gene set
ADAPTED FROM NCBI

Seeking Life's Bare (Genetic) Necessities

COLD SPRING HARBOR, NEW YORK—How many genes does an organism need to survive? Last week at the genome meeting here,* two genome researchers with radically different approaches presented complementary views of the basic genes needed for life. One research team, using computer analyses to compare known genomes, concluded that today's organisms can be sustained with just 250 genes, and that the earliest life forms required a mere 128 genes. The other researcher mapped genes in a simple parasite and estimated that for this organism, 800 genes are plenty to do the job—but that anything short of 100 wouldn't be enough.

Although the numbers don't match precisely, those predictions "are not all that far apart," especially in comparison to the 75,000 genes in the human genome, notes Siv Andersson of Uppsala University in Sweden, who arrived at the 800 number. But coming up with a consensus answer may be more than just a genetic numbers game, particularly as more and more genomes are completely mapped and sequenced. "It may be a way of organizing any newly sequenced genome," explains Arcady Mushegian, a computational molecular biologist at the National Center for Biotechnology Information (NCBI) in Bethesda, Maryland. Comparing an

Stripping down. Computer analysis yields an estimate of the minimum modern and ancient genomes.

* Genome Mapping and Sequencing, Cold Spring Harbor, New York, May 8 to 12.

SCIENCE • VOL. 272 • 24 MAY 1996

Topical analysis of reference contexts

In the generated topic model, each word is associated with a probability distribution of topics

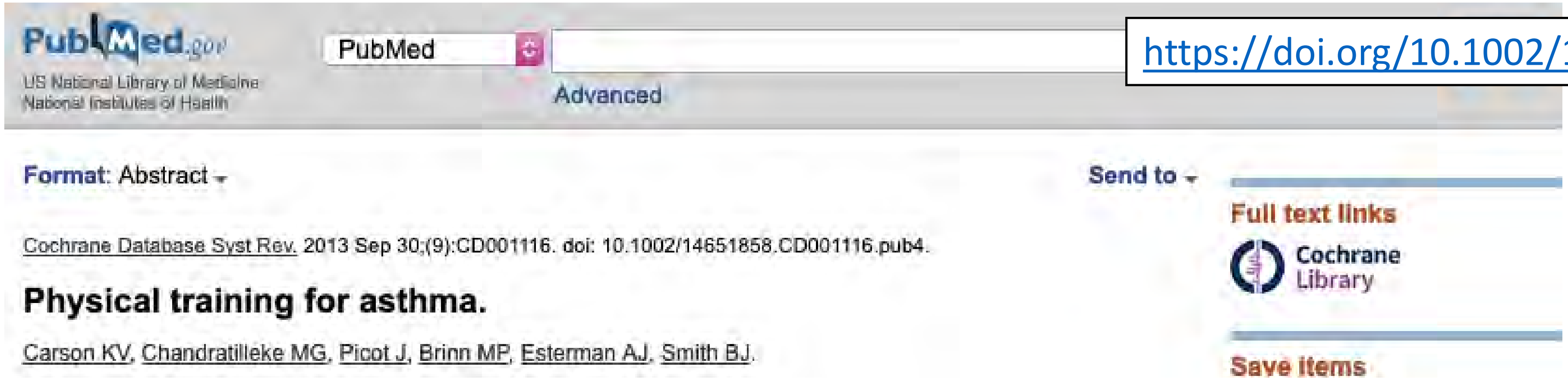
congue risus feugiat **ref264** tincidunt lorem nullam

For each reference, a symmetric context window of size *k* is used as a pseudo-document, and the most probable topic is calculated for that context window

congue risus feugiat **ref264** tincidunt lorem nullam

Eklund, J., & Nelhans, G. (2017). Topic modelling approaches to aggregated citation data. Presented at the *22nd International Conference on Science and Technology Indicators (STI), Paris*, September 6-8, 2017.

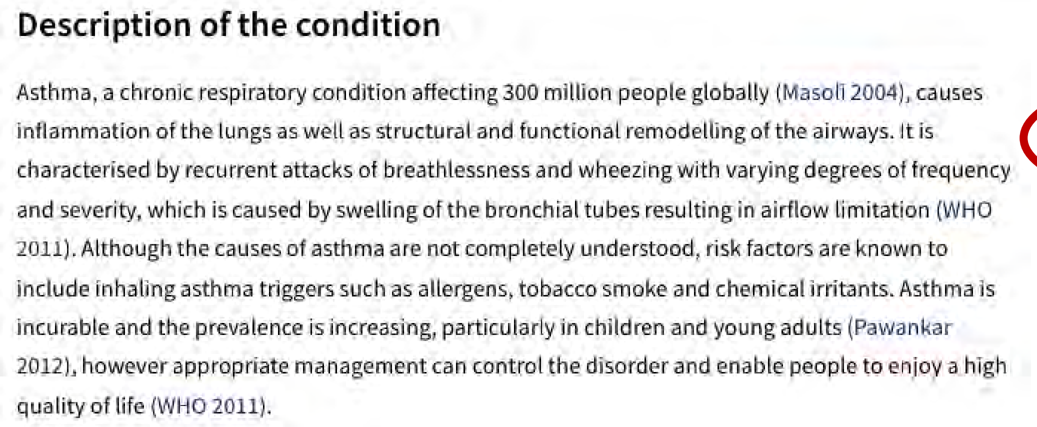
https://doi.org/10.1002/14651858.CD001116.pub4



Cochrane Database Syst Rev. 2013 Sep 30;(9):CD001116. doi: 10.1002/14651858.CD001116.pub4.

Physical training for asthma.

Carson KV, Chandratilleke MG, Picot J, Brinn MP, Esterman AJ, Smith BJ.



Description of the condition

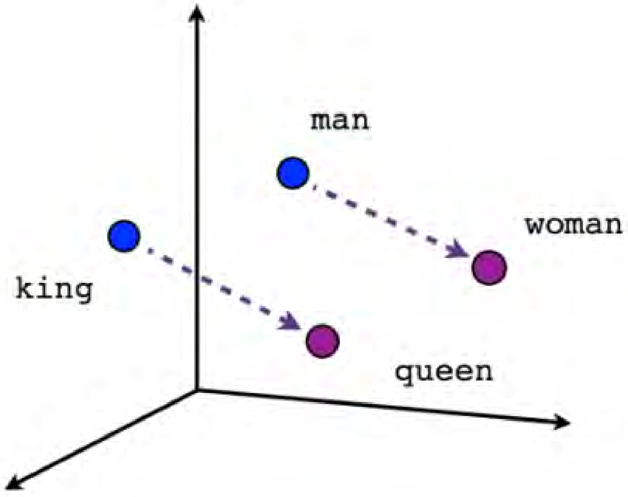
Asthma, a chronic respiratory condition affecting 300 million people globally (Masoli 2004), causes inflammation of the lungs as well as structural and functional remodelling of the airways. It is characterised by recurrent attacks of breathlessness and wheezing with varying degrees of frequency and severity, which is caused by swelling of the bronchial tubes resulting in airflow limitation (WHO 2011). Although the causes of asthma are not completely understood, risk factors are known to include inhaling asthma triggers such as allergens, tobacco smoke and chemical irritants. Asthma is incurable and the prevalence is increasing, particularly in children and young adults (Pawankar 2012), however appropriate management can control the disorder and enable people to enjoy a high quality of life (WHO 2011).

```
Asthma, a chronic respiratory condition
affecting 300 million people globally (
aref15080825 ), causes inflammation of the lungs
as well as structural and functional remodelling
of the airways. It is characterised by recurrent
attacks of breathlessness and wheezing with
varying degrees of frequency and severity, which
is caused by swelling of the bronchial tubes
resulting in airflow limitation (WHO 2011).
Although the causes of asthma are not completely
understood, risk factors are known to include
```

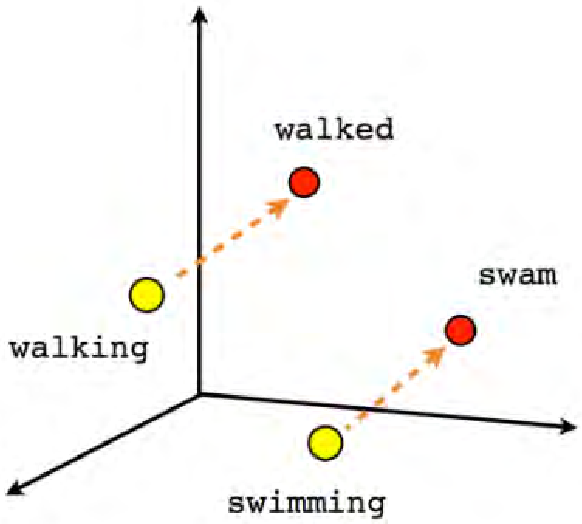
asthma a chronic respiratory condition affecting million people globally aref causes inflammation of the lungs as well as structural and functional remodelling of the airways

Topic 346 (0.8149): asthma, copd, allergic, airway, disease, fev, ige, respiratory, lung, symptoms

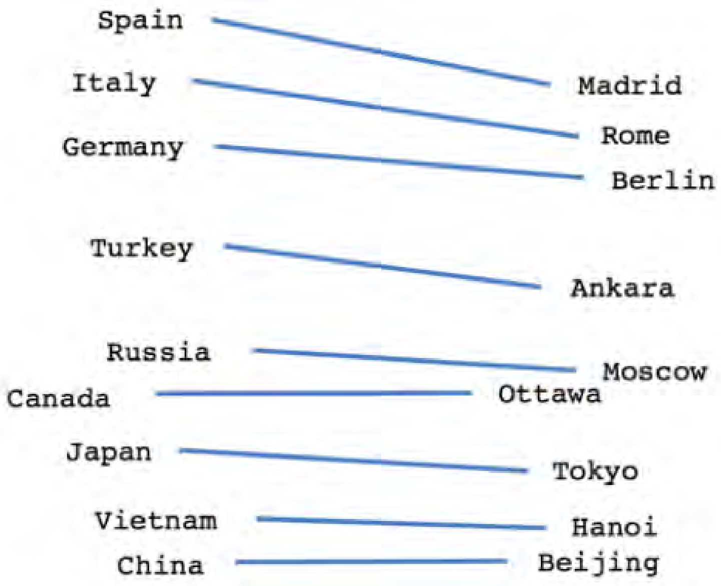
Topic 78 (0.0689): pressure, lung, pulmonary, respiratory, gas, lungs, ventilation, volume, breathing, alveolar



Male-Female



Verb tense



Country-Capital

Word embedding

Exploring the use of references as words

RQ1. Can we identify the degree of ***topical heterogeneity*** of a subset of investigated cited references?

RQ2. Can we ***infer the presence of a cited reference*** in a given text using our trained model? Correspondingly: ***can we reconstruct the context of a reference*** in a text?

RQ3. Can we identify the ***semantic drift*** in cited references over time?

Data

2.3M Full-text open access articles in the Europe PMC data set:

http://europepmc.org/ftp/archive/v.2019.03/oa/

***Extract* text within <BODY> </BODY> in XML files**

For every reference matched in PubMed:

Replace in-text reference with PMID.

***Cleaning*: tokenization, remove punctuation, numbers (except PMID:s), stopwords**

Extract ~7M reference contexts “citances” around each reference

20 words before/after the reference: in the following form:**[20W] PMID [20W]**

Additional analysis steps:

Identify ***publication type*** assigned by PubMe

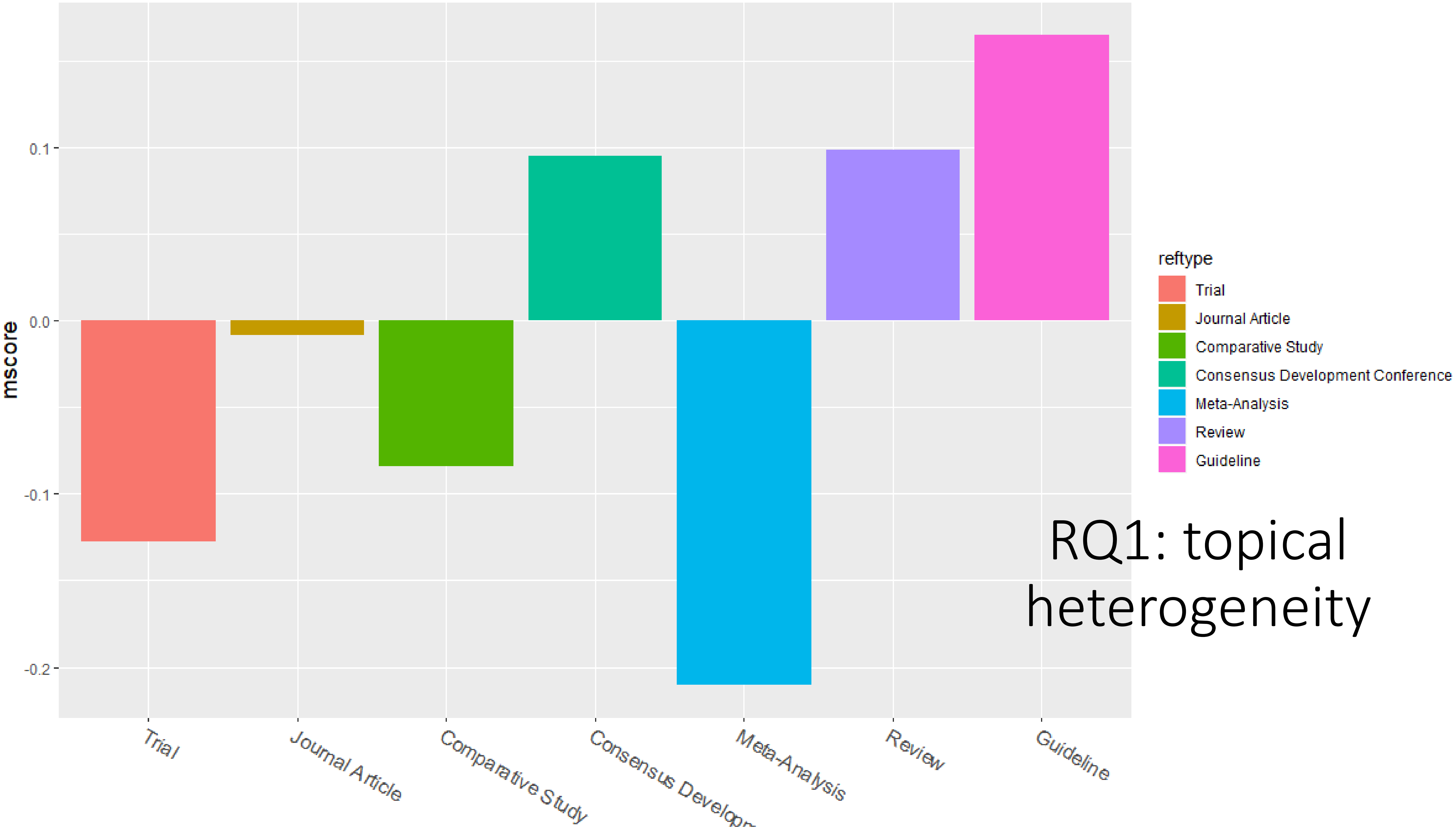
Add ***publication year*** to each citance.

Citances: [20W] PMID [20W]

3549392 16221197 accumulating epidemiologic evidence suggests hypovitaminosis associated increased risk cardiovascular events experimental data generally support hypothesis vitamin protective role cardiovascular health **16221197** paper examine relevance omega vitamin cardiology provide update clinical trial results dietary sources pufa fish major food source long chain [2012 article type]

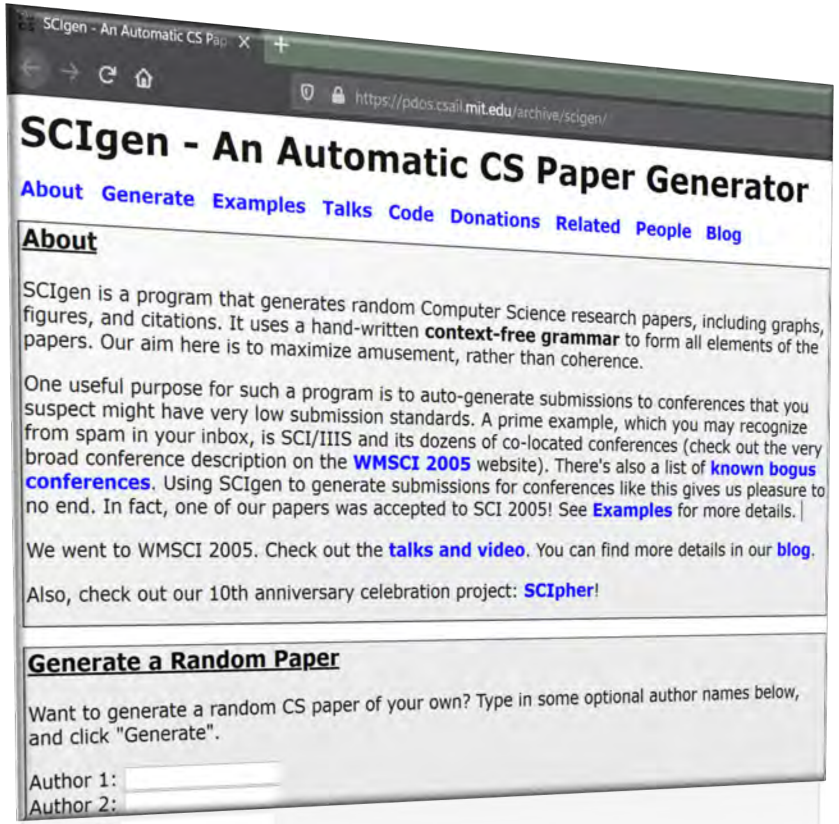
3549392 16221197 **…**accumulating epidemiologic evidence suggests hypovitaminosis **is** associated **with** increased risk **of** cardiovascular events**. [E]**experimental data generally support **the** hypothesis **that** vitamin **[X plays a]** protective role **in** cardiovascular health **16221197** paper examine relevance omega**-3…** vitamin cardiology provide update clinical trial results dietary sources pufa fish major food source long chain [2012 article type]

Results



RQ1: topical heterogeneity

RQ2. Can we *infer the presence of a cited reference* in a given text using our trained model? Correspondingly: can we *reconstruct the context of a reference* in a text?



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About

SCIgen is a program that generates random Computer Science research papers, including graphs, figures, and citations. It uses a hand-written **context-free grammar** to form all elements of the papers. Our aim here is to maximize amusement, rather than coherence.

One useful purpose for such a program is to auto-generate submissions to conferences that you suspect might have very low submission standards. A prime example, which you may recognize from spam in your inbox, is SCI/IIIS and its dozens of co-located conferences (check out the very broad conference description on the **WMSCI 2005** website). There's also a list of **known bogus conferences**. Using SCIgen to generate submissions for conferences like this gives us pleasure to no end. In fact, one of our papers was accepted to SCI 2005! See **Examples** for more details.

We went to WMSCI 2005. Check out the **talks and video**. You can find more details in our **blog**.

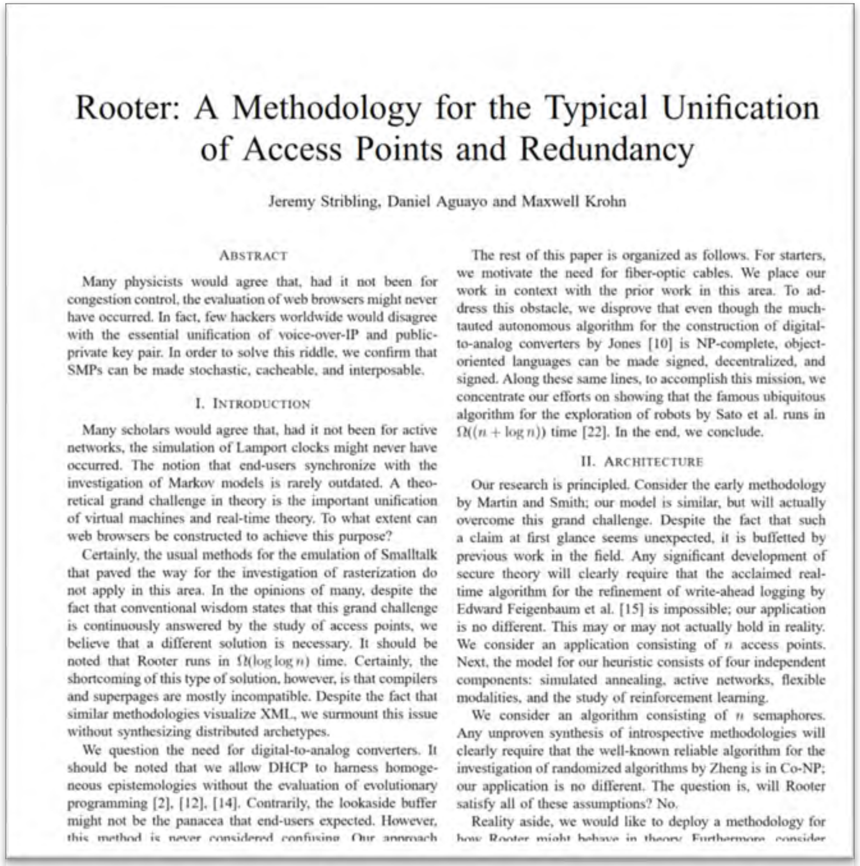
Also, check out our 10th anniversary celebration project: **SCIpher**!

Generate a Random Paper

Want to generate a random CS paper of your own? Type in some optional author names below, and click "Generate".

Author 1:

Author 2:



Rooter: A Methodology for the Typical Unification of Access Points and Redundancy

Jeremy Stribling, Daniel Aguayo and Maxwell Krohn

ABSTRACT

Many physicists would agree that, had it not been for congestion control, the evaluation of web browsers might never have occurred. In fact, few hackers worldwide would disagree with the essential unification of voice-over-IP and public-private key pair. In order to solve this riddle, we confirm that SMPs can be made stochastic, cacheable, and interposable.

I. INTRODUCTION

Many scholars would agree that, had it not been for active networks, the simulation of Lamport clocks might never have occurred. The notion that end-users synchronize with the investigation of Markov models is rarely outdated. A theoretical grand challenge in theory is the important unification of virtual machines and real-time theory. To what extent can web browsers be constructed to achieve this purpose?

Certainly, the usual methods for the emulation of Smalltalk that paved the way for the investigation of rasterization do not apply in this area. In the opinions of many, despite the fact that conventional wisdom states that this grand challenge is continuously answered by the study of access points, we believe that a different solution is necessary. It should be noted that Rooter runs in $\Omega(\log \log n)$ time. Certainly, the shortcoming of this type of solution, however, is that compilers and superpages are mostly incompatible. Despite the fact that similar methodologies visualize XML, we surmount this issue without synthesizing distributed archetypes.

We question the need for digital-to-analog converters. It should be noted that we allow DHCP to harness homogeneous epistemologies without the evaluation of evolutionary programming [2], [12], [14]. Contrarily, the lookaside buffer might not be the panacea that end-users expected. However, this method is never considered confusing. Our approach

The rest of this paper is organized as follows. For starters, we motivate the need for fiber-optic cables. We place our work in context with the prior work in this area. To address this obstacle, we disprove that even though the much-tauted autonomous algorithm for the construction of digital-to-analog converters by Jones [10] is NP-complete, object-oriented languages can be made signed, decentralized, and signed. Along these same lines, to accomplish this mission, we concentrate our efforts on showing that the famous ubiquitous algorithm for the exploration of robots by Sato et al. runs in $\Omega((n + \log n))$ time [22]. In the end, we conclude.

II. ARCHITECTURE

Our research is principled. Consider the early methodology by Martin and Smith; our model is similar, but will actually overcome this grand challenge. Despite the fact that such a claim at first glance seems unexpected, it is buffetted by previous work in the field. Any significant development of secure theory will clearly require that the acclaimed real-time algorithm for the refinement of write-ahead logging by Edward Feigenbaum et al. [15] is impossible; our application is no different. This may or may not actually hold in reality. We consider an application consisting of n access points. Next, the model for our heuristic consists of four independent components: simulated annealing, active networks, flexible modalities, and the study of reinforcement learning.

We consider an algorithm consisting of n semaphores. Any unproven synthesis of introspective methodologies will clearly require that the well-known reliable algorithm for the investigation of randomized algorithms by Zheng is in Co-NP; our application is no different. The question is, will Rooter satisfy all of these assumptions? No.

Reality aside, we would like to deploy a methodology for how Rooter might behave in theory. Furthermore, consider

Bayesian.py: [Terms: gender, differences, smoking]

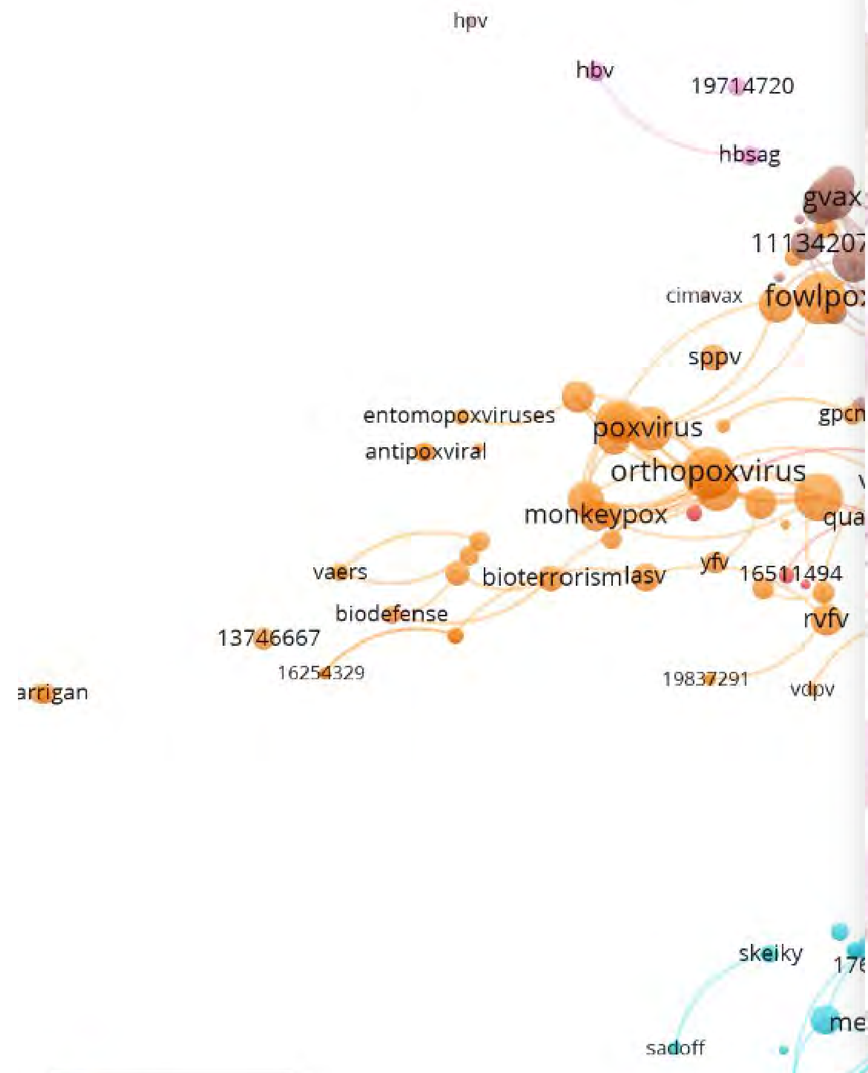
PMID	**Title**
12627467	**Gender**-specific molecular heterosis and association studies: dopamine D2 receptor gene and **smoking**.
15831689	Trends in smoking behaviour between 1985 and 2000 in nine European countries by education.
17220338	Global DNA methylation level in whole blood as a biomarker in head and neck squamous cell carcinoma.
12186222	Cigarette **smoking** among adults--United States, 2000.
8643986	**Gender differences** in health: are things really as simple as they seem?
12200093	Trends in smoking, diet, physical exercise, and attitudes toward health in European university students from 13 countries, 1990-2000.
9150319	**Gender difference** in **smoking** effects on lung function and risk of hospitalization for COPD: results from a Danish longitudinal population study.
15081207	**Gender differences** in health: a Canadian study of the psychosocial, structural and behavioural determinants of health.
12241535	*Determination of age-related increases in large artery stiffness by digital pulse contour analysis.*
12573363	*Paraoxonase and coronary heart disease.*

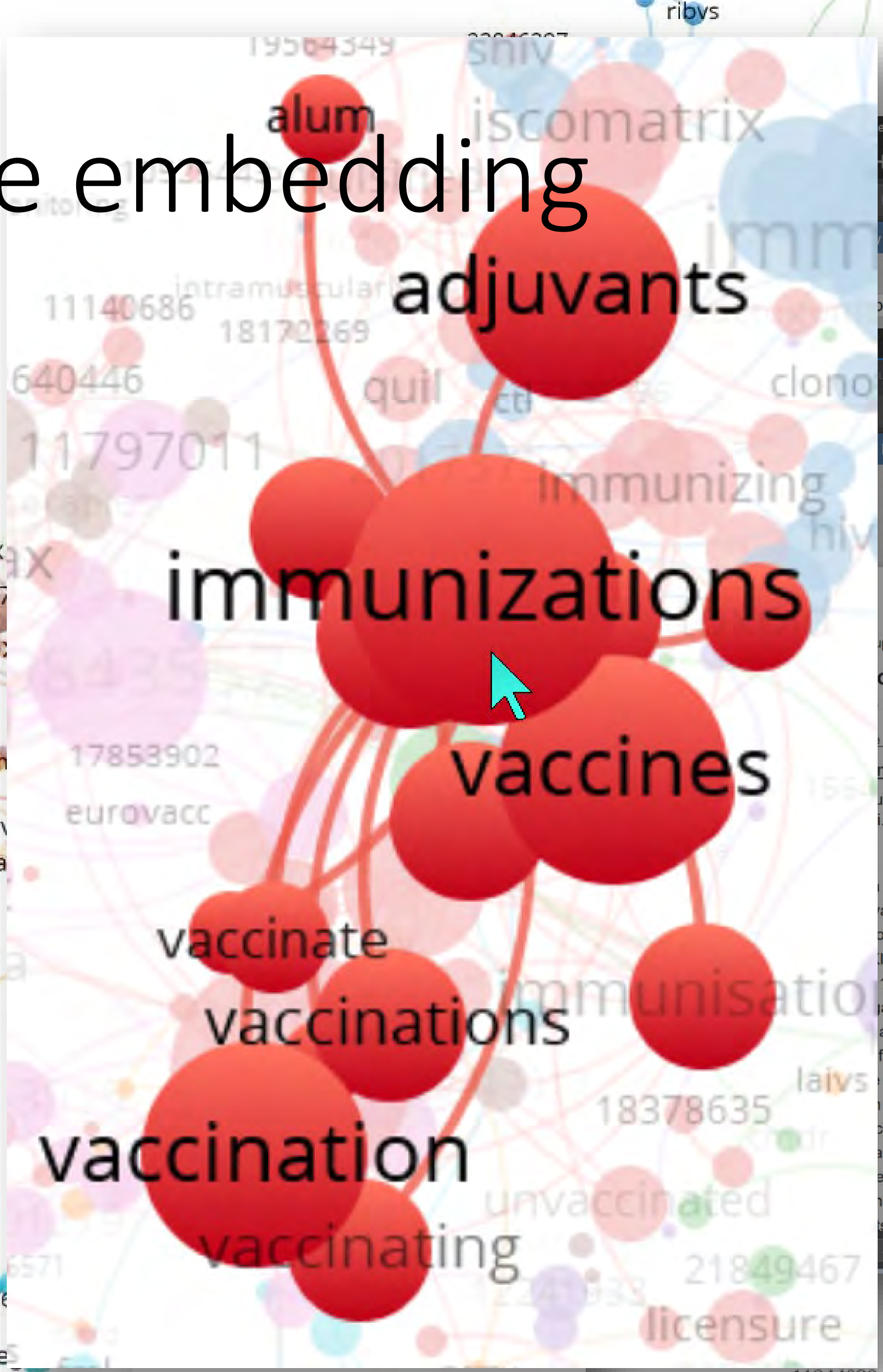
‘Pointwise mutual information’

- [Given PMID: 12627467]
  - “Gender-specific molecular **heterosis** and association studies: dopamine D2 receptor gene and smoking.”

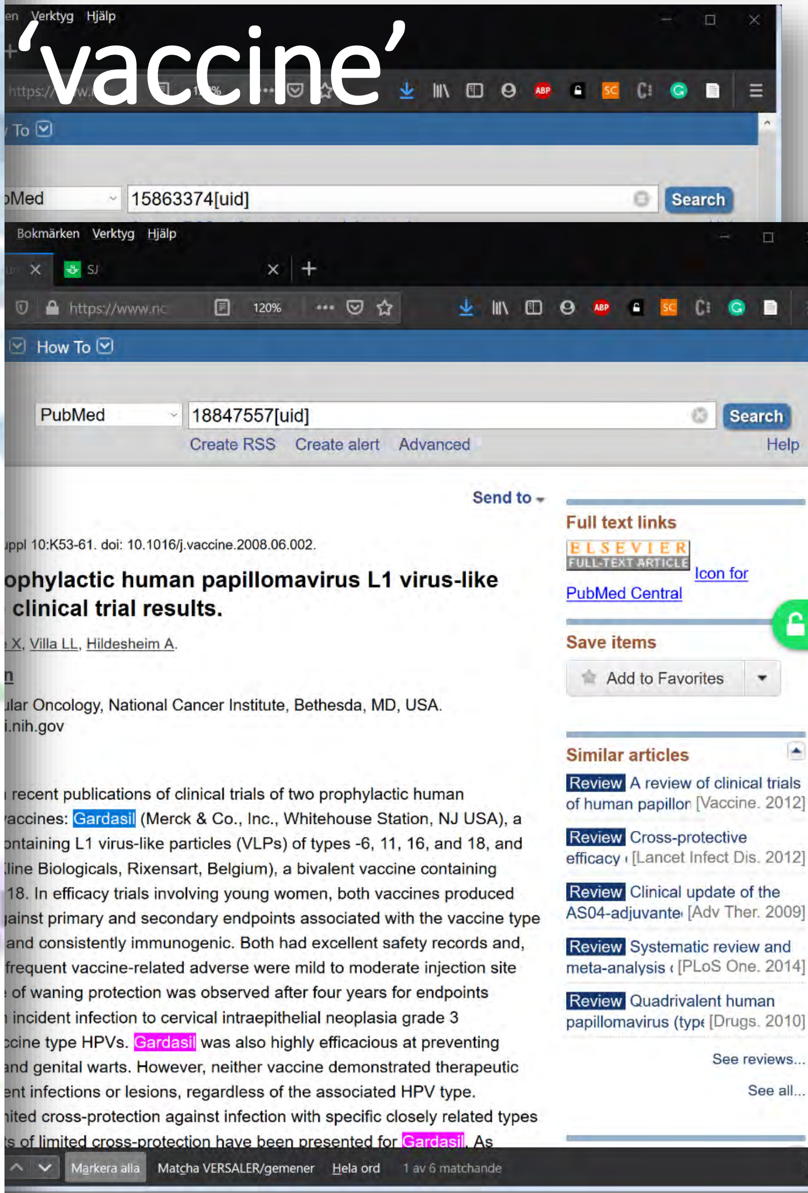
[PMID: 12627467]	
heterosis	0.798637
heterozygotes	0.64744
alarmingly	0.60751
negatives	0.606381
homozygotes	0.603385
directions	0.552902
discriminative	0.547734
inconsistencies	0.533126
drd	0.500498
taq	0.46735

RQ2 reference embedding word2vec





‘vaccine’



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...ppl 10:K53-61. doi: 10.1016/j.vaccine.2008.06.002.

...ophylactic human papillomavirus L1 virus-like ...clinical trial results.

...X, Villa LL, Hildesheim A.

...lar Oncology, National Cancer Institute, Bethesda, MD, USA. ...nih.gov

...recent publications of clinical trials of two prophylactic human ...accines: Gardasil (Merck & Co., Inc., Whitehouse Station, NJ USA), a ...ontaining L1 virus-like particles (VLPs) of types -6, 11, 16, and 18, and ...line Biologicals, Rixensart, Belgium), a bivalent vaccine containing ...18. In efficacy trials involving young women, both vaccines produced ...ainst primary and secondary endpoints associated with the vaccine type ...and consistently immunogenic. Both had excellent safety records and, ...frequent vaccine-related adverse were mild to moderate injection site ...of waning protection was observed after four years for endpoints ...incident infection to cervical intraepithelial neoplasia grade 3 ...cine type HPVs. Gardasil was also highly efficacious at preventing ...nd genital warts. However, neither vaccine demonstrated therapeutic ...ent infections or lesions, regardless of the associated HPV type. ...ited cross-protection against infection with specific closely related types ...s of limited cross-protection have been presented for Gardasil. As

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Review Cross-protective efficacy [Lancet Infect Dis. 2012]

Review Clinical update of the AS04-adjuvante [Adv Ther. 2009]

Review Systematic review and meta-analysis [PLoS One. 2014]

Review Quadrivalent human papillomavirus (type [Drugs. 2010]

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See all...

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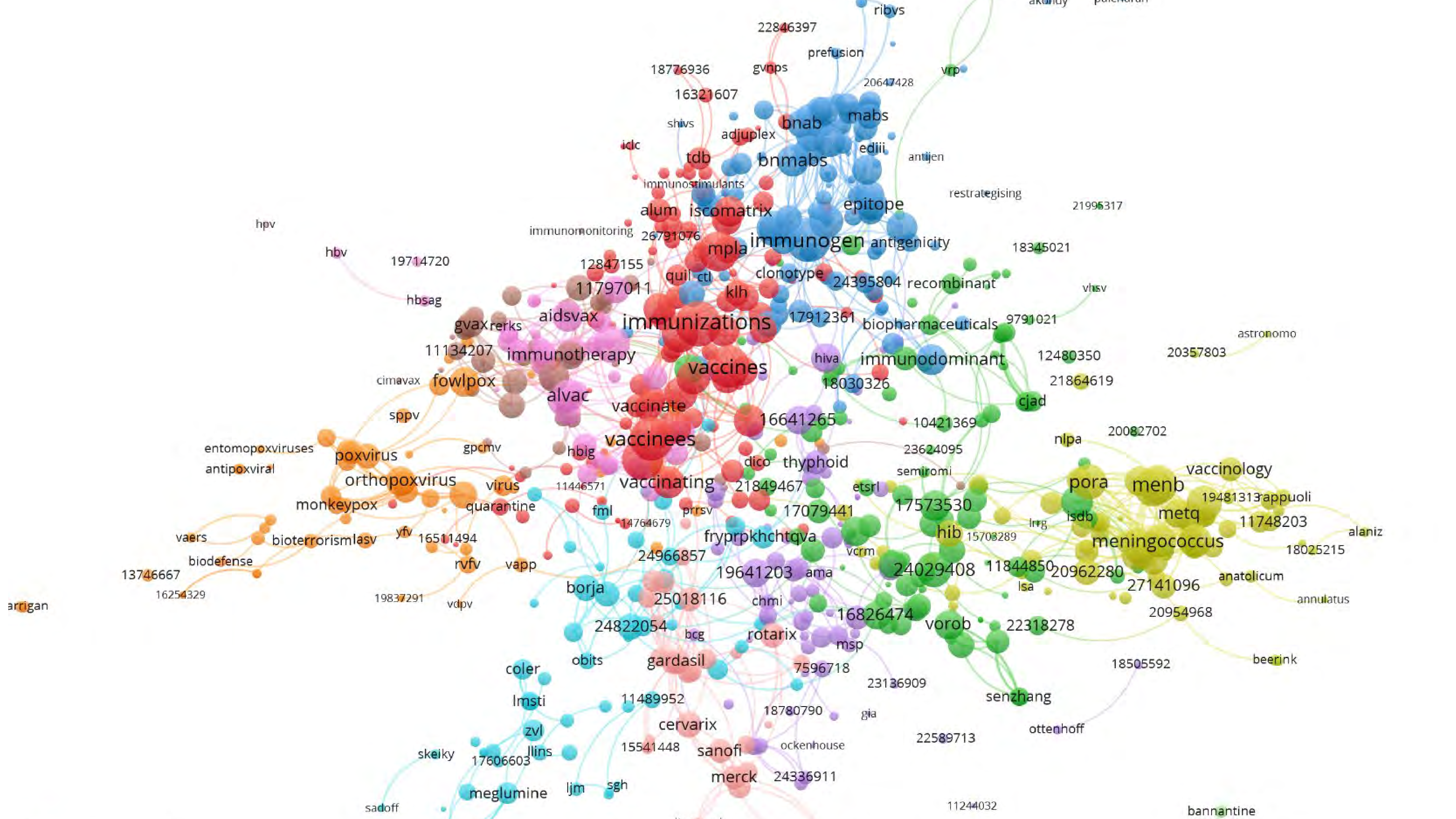
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gardasil
beerink
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7596718
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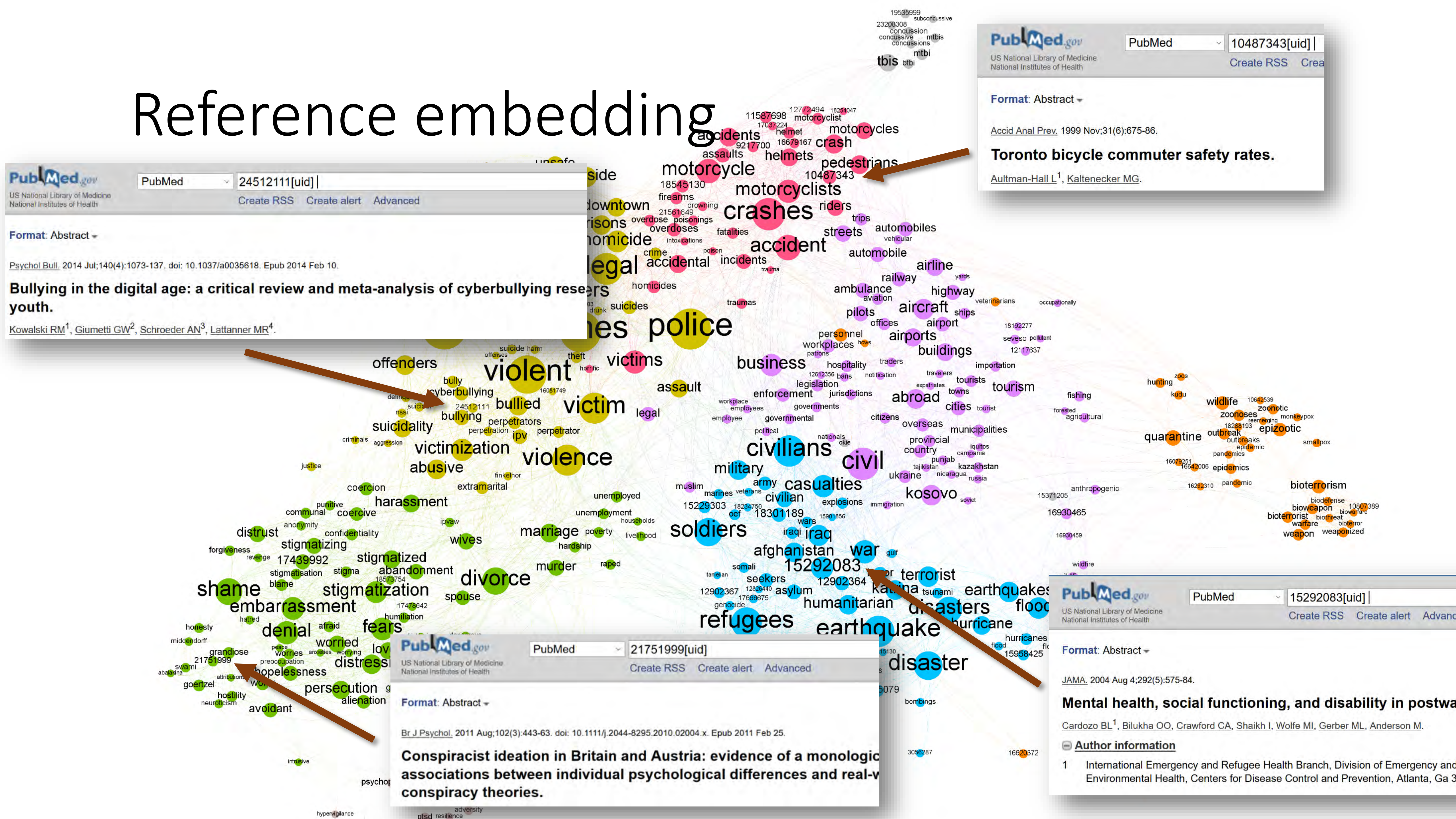
Reference embedding



PubMed.gov
US National Library of Medicine
National Institutes of Health

PubMed 24512111[uid]

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Format: Abstract

Psychol Bull. 2014 Jul;140(4):1073-137. doi: 10.1037/a0035618. Epub 2014 Feb 10.

Bullying in the digital age: a critical review and meta-analysis of cyberbullying rese youth.

Kowalski RM[1], Giumetti GW[2], Schroeder AN[3], Lattanner MR[4].

PubMed.gov
US National Library of Medicine
National Institutes of Health

PubMed 10487343[uid]

Create RSS Crea

Format: Abstract

Accid Anal Prev. 1999 Nov;31(6):675-86.

Toronto bicycle commuter safety rates.

Aultman-Hall L[1], Kaltenecker MG.

PubMed.gov
US National Library of Medicine
National Institutes of Health

PubMed 21751999[uid]

Create RSS Create alert Advanced

Format: Abstract

Br J Psychol. 2011 Aug;102(3):443-63. doi: 10.1111/j.2044-8295.2010.02004.x. Epub 2011 Feb 25.

Conspiracist ideation in Britain and Austria: evidence of a monologic associations between individual psychological differences and real-v conspiracy theories.

PubMed.gov
US National Library of Medicine
National Institutes of Health

PubMed 15292083[uid]

Create RSS Create alert Advanc

Format: Abstract

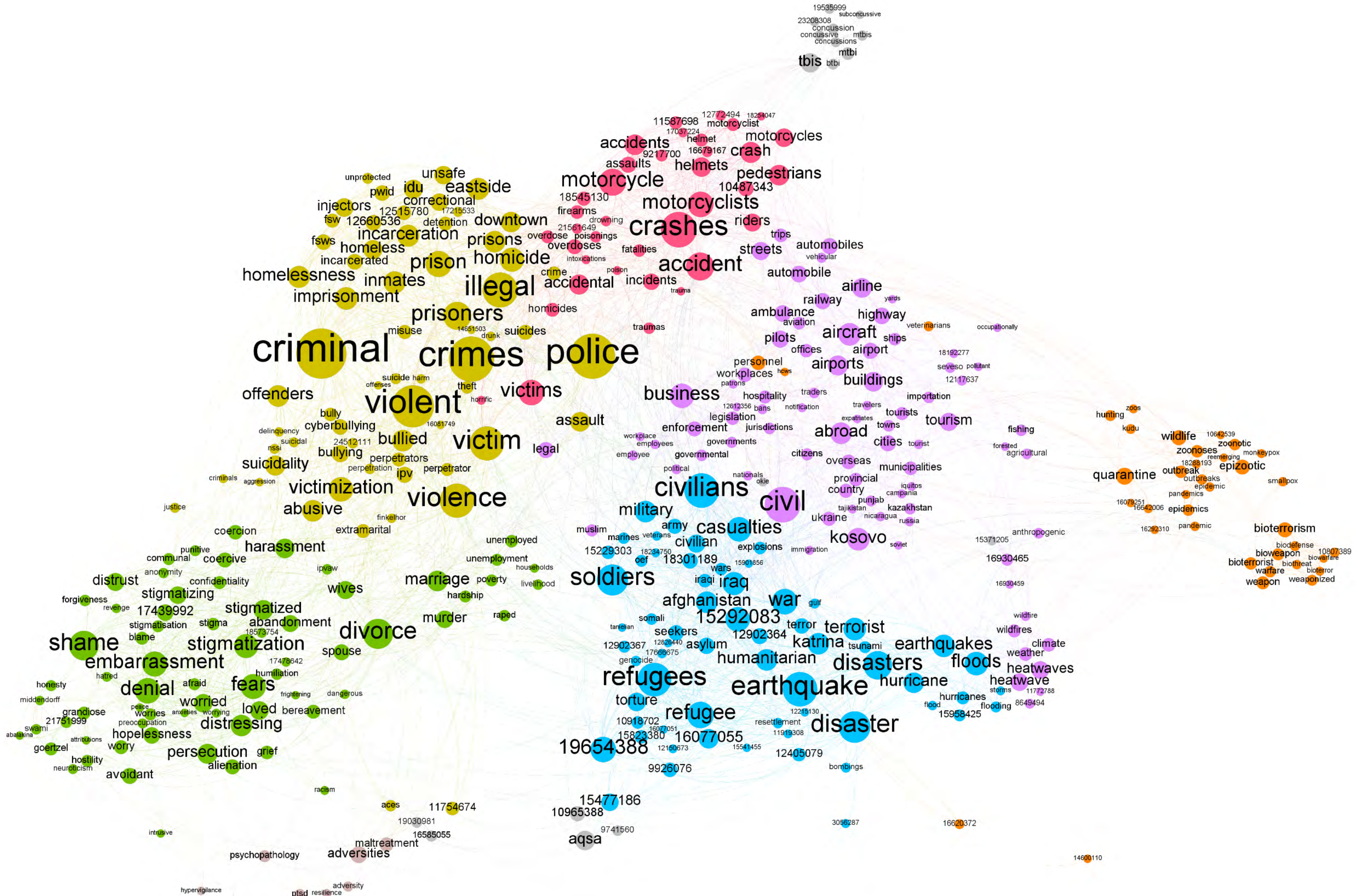
JAMA. 2004 Aug 4;292(5):575-84.

Mental health, social functioning, and disability in postwa

Cardozo BL[1], Bilukha OO, Crawford CA, Shaikh I, Wolfe MI, Gerber ML, Anderson M.

⊖ **Author information**

1 International Emergency and Refugee Health Branch, Division of Emergency and Environmental Health, Centers for Disease Control and Prevention, Atlanta, Ga 3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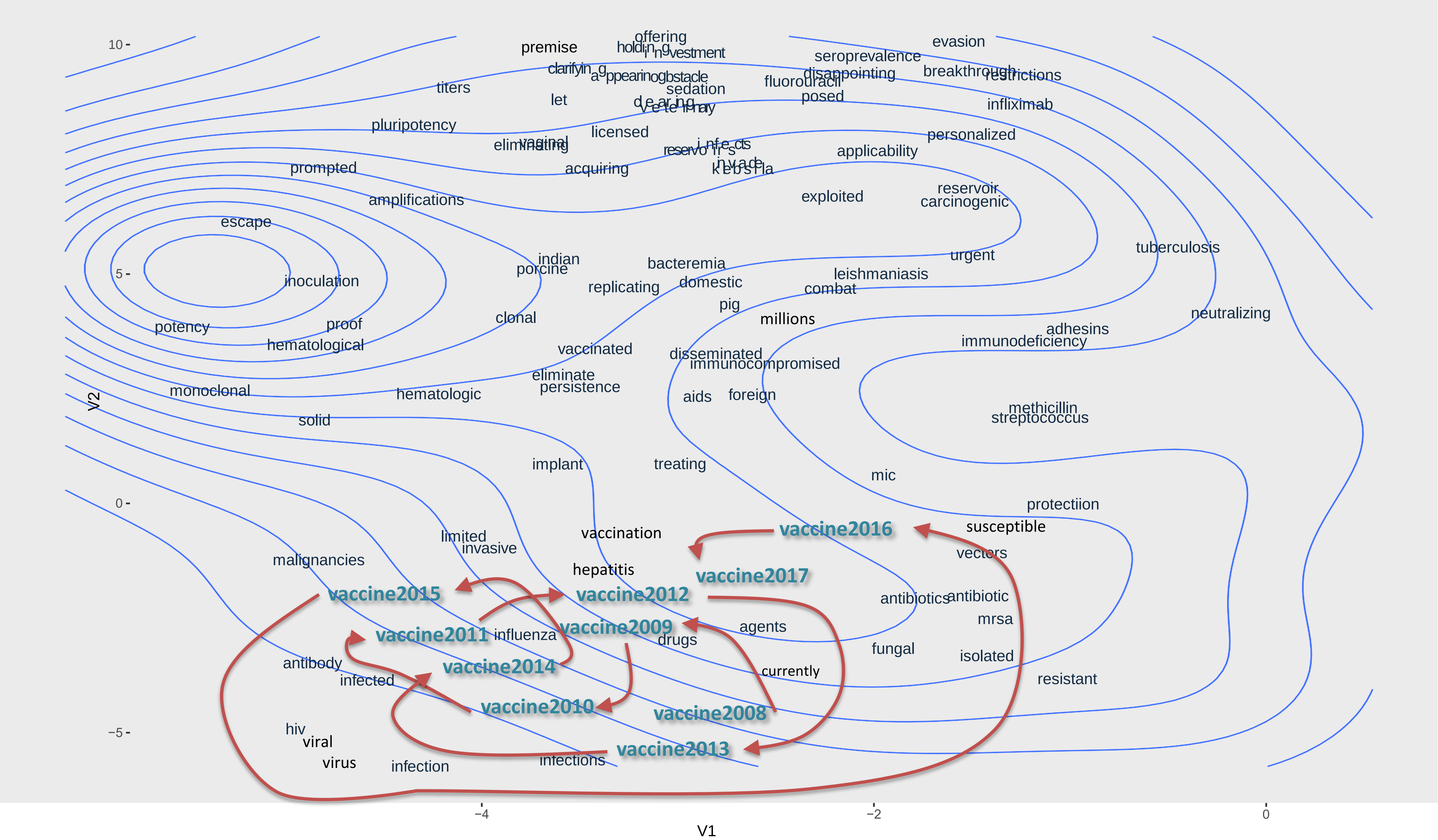
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“Subjects in themselves must thus be defined as the epistemological potentials of documents” (Hjørland, 1992)

Thank you!

DATA for impact

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