Tag 2: Big Data, Good Data? Die kritische Nutzung von Daten

Session 5: Möglichkeiten und Probleme mit Big Data

Simon Munzert
Hertie School

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Übung

Umgang mit Evidenz als Detektivarbeit

Der Ansatz

- Auswertung von Daten ist wie Detektivarbeit
- Wir müssen die **Evidenz genau unter die Lupe nehmen**, um herauszufinden, ob der Verdächtige - der vermutete Zusammenhang, der deskriptive Befund - tatsächlich hält, was er verspricht
- Dazu müssen wir versuchen **Alternativerklärungen auszuschließen**

Die Ausstattung

- **Unsere Toolbox:** Kritisches Denken, Beobachtung (Datenerhebung), Wahrnehmung (Messung), externes Wissen, statistische Methoden
- Ohne qualitative Beurteilung sind die quantitativen Werkzeuge häufig ohne Wert

Ein paar einfache Fälle

Drückende Schuhe (?)

> Umfrageergebnisse zeigen, dass Menschen, die mit Schuhen schlafen, viel häufiger mit Kopfschmerzen aufwachen.

Gezuckerte Getränke führen zu Fettleibigkeit (?)

> Personen, die regelmäßig zuckerhaltige Getränke konsumieren, haben einen 30% höheren BMI.

Lock-downs haben COVID-19-bedingte Tode herbeigeführt (?)

> Europäische Länder, die strengere und längere Lock-downs hatten, hatten höhere COVID-19-Todesraten.

UN-Friedensmissionen schützen die Zivilbevölkerung nicht (?)

> UN-Friedensmissionen in Bürgerkriegsszenarien sind stark positiv mit höheren Todesraten unter Zivilisten korreliert

Automated Inference on Criminality using Face Images

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Abstract

We study, for the first time, automated inference on criminality based solely on still face images. Via supervised machine learning, we build four classifiers (logistic regression, KNN, SVM, CNN) using facial images of 1856 real persons controlled for race, gender, age and facial expressions, nearly half of whom were convicted criminals, for discriminating between criminals and non-criminals. All four classifiers perform consistently well and produce evidence for the validity of automated face-induced inference on criminality, despite the historical controversy surrounding the topic. Also, we find some discriminating structural features for predicting criminality, such as lip curvature, eye inner corner distance, and the so-called nose-mouth angle. Above all, the most important discovery of this research is that criminal and non-criminal face images populate two quite distinctive manifolds. The variation among criminal faces is significantly greater than that of the non-criminal faces. The two manifolds consisting of criminal and non-criminal faces appear to be concentric, with the non-criminal manifold lying in the kernel with a smaller span, exhibiting a law of normality for faces of non-criminals. In other words, the faces of general law-biding public have a greater degree of resemblance compared with the faces of criminals, or criminals have a higher degree of dissimilarity in facial appearance than normal people.

people share the belief that the face alone suffices to reveal innate traits of a person. Aristotle in his famous work Prior Analytics asserted, "It is possible to infer character from features, if it is granted that the body and the soul are changed together by the natural affections". Psychologists have known, for as long as a millennium, the human tendency of inferring innate traits and social attributes (e.g., the trustworthiness, dominance) of a person from his/her facial appearance, and a robust consensus of individuals' inferences . These are the facts found through numerous studies [2, 32, 4, 5, 9, 20, 21, 27, 25].

Independent of the validity of pedestrian belief in the (pseudo)science of physiognomy, a tantalizing question naturally arises: what facial features influence average Joe's impulsive and yet consensual judgments on social attributes of a non-acquaintance member of their own specie? Attempting to answer the question, Todorov and Oosterhof proposed a data-driven statistical modeling method to find visual determinants of social attributes by asking human subjects to score four percepts: dominance, attractiveness, trustworthiness, and extroversion, based on first impression of static face images [26]. This method can synthesize a representative (average) face image for a set of input face images scored closely on any of the four aforementioned social percepts. The ranking of these synthesized face images by subjective scores (e.g., from least to most trustworthy looking) apparently agrees with the intuition of most people.

Weitere Evidenz: Erkennen von Straftätern durch Gesichtsdaten

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(a) Three samples in criminal ID photo set S_c.

(b) Three samples in non-criminal ID photo set S_n

Figure 1. Sample ID photos in our data set.

Weitere Evidenz: Erkennen von Straftätern durch Gesichtsdaten

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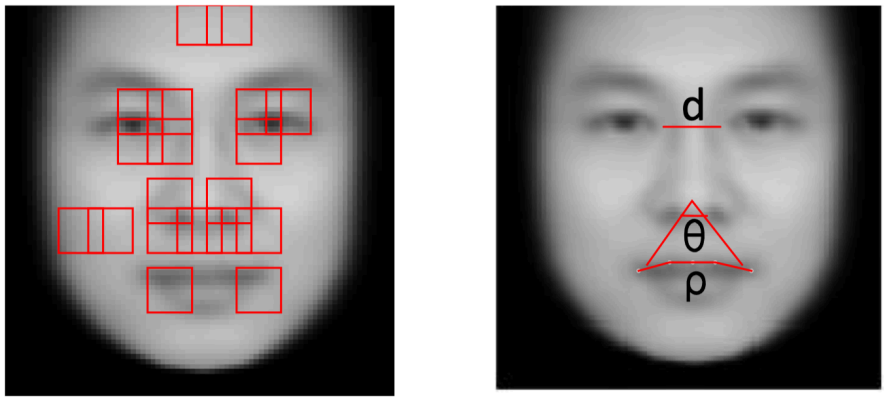


(a) (b)

Figure 4. (a) FGM results; (b) Three discriminative features ρ, d and θ.

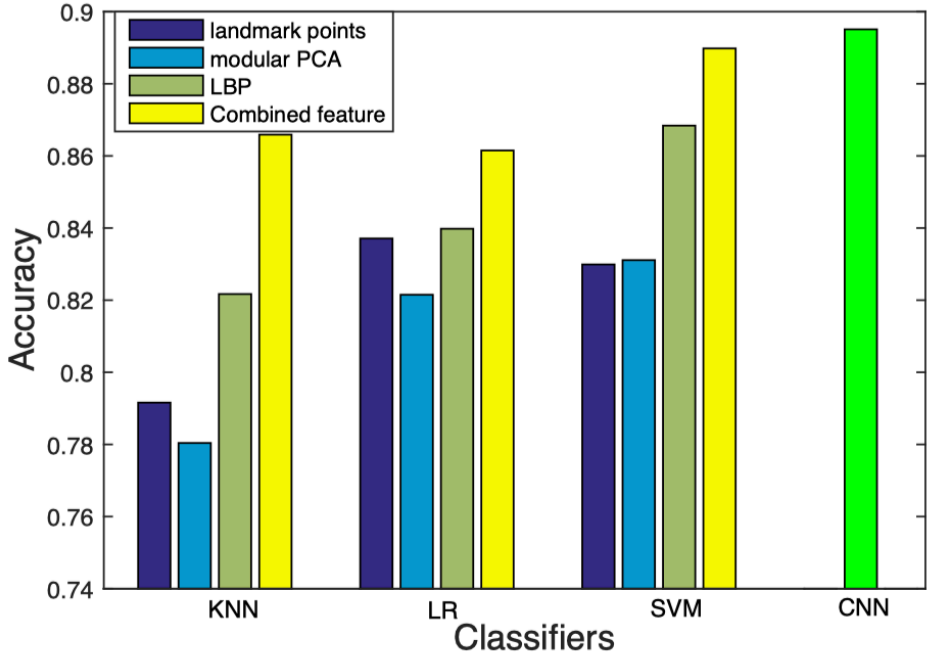


Figure 2. Accuracy of all four classifiers in all thirteen cases.

Lösung des Falles

	Evidenz und Schlüsse
Der Tatort	Gesichter sagen Straftäter vorher
Die Verdächtigen	Lifestyle, Physiognomik
Die Tatwaffe	Konfundierung in Datenerhebung (biased training set)

> "Extraordinary claims require extraordinary evidence. The authors of this paper make the extraordinary claim that facial structure reveals criminal tendencies. We have argued that, given all publicly available information, their findings can be explained by a much more reasonable hypothesis: non-criminals are more likely to be smiling in photos chosen for publicity purposes than are criminals in the ID photos (not mugshots) chosen by police departments for wanted posters and other purposes. Notice that we did all of this without digging into the details of the machine learning algorithms at all. We didn't need to. We know that a machine learning algorithm is only as good as its training data, and we can see that the training set used here is fundamentally flawed for the purpose it is used."
>
> Carl Bergstrom and Jevin West, Calling Bullshit[1]

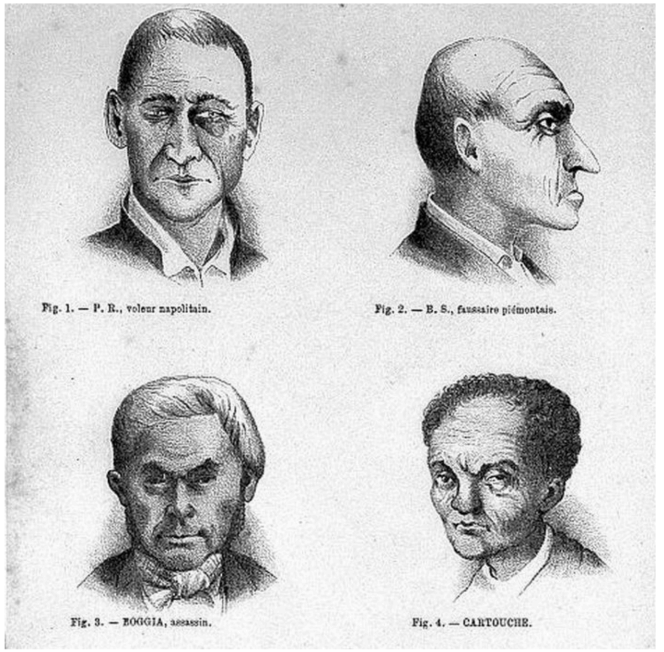
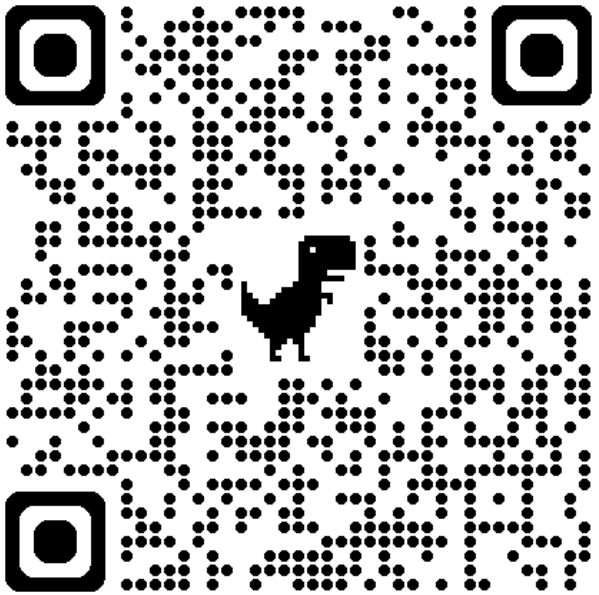


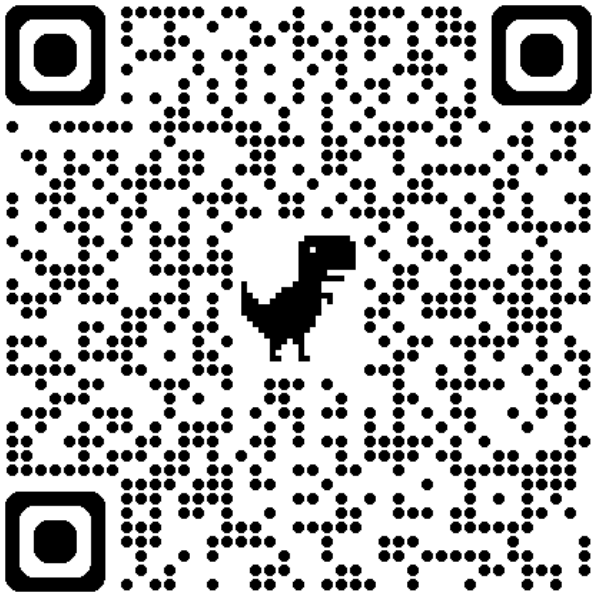
Figure 1. Criminal faces from Cesare Lombroso's 1876 book *L'Homme Criminel*

`Quelle` Bergstrom/West, Calling Bullshit

Data Detective, Fall 2: Predictive Policing



Data Detective, Fall 3: SARS-CoV-2-Abwassermonitoring



Was ist Big Data?

The five V's of big data

VOLUME

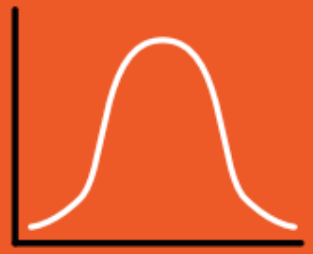
The scale of data.

VARIETY

Data comes in different forms. Structured data are easily searchable like spreadsheets. Unstructured data include disorganized information like tweets and video.

VELOCITY

The speed of data processing. These days a great deal of data are available in real time, such as social media posts.



VARIABILITY

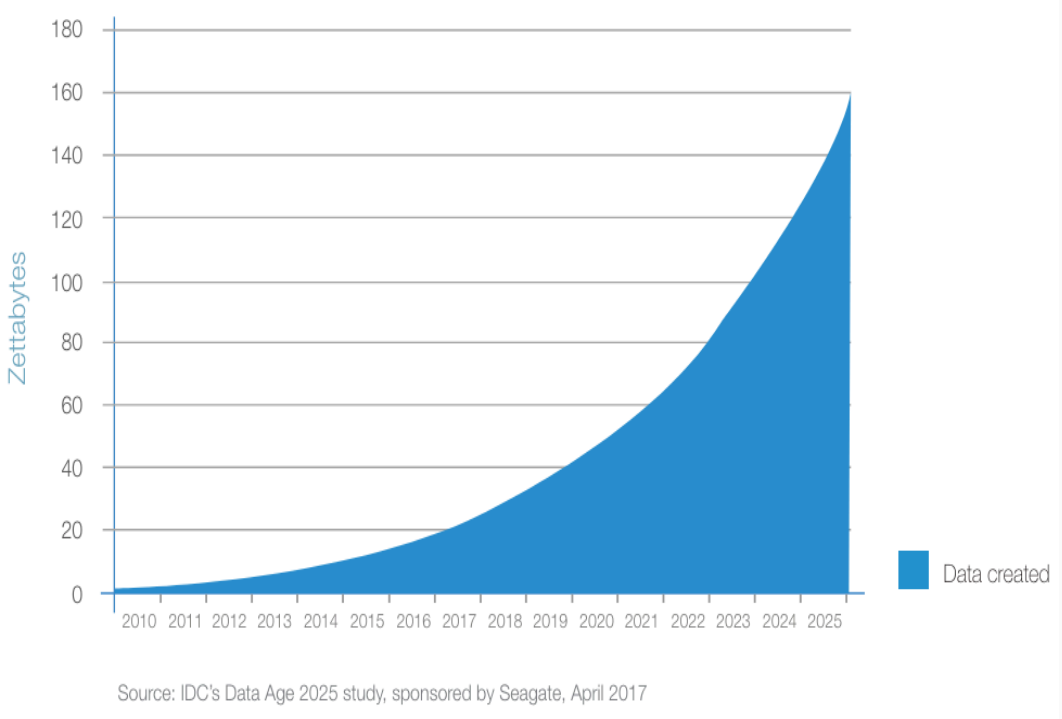
How spread out the data are.

VERACITY

The accuracy of data provides confidence during research.

Das Zeitalter von Big Data - Große Trends

1. Massive Erzeugung von **vom Menschen erzeugten Daten** insbesondere im digitalen Bereich
2. Verwendung von **neuen Datentypen**: Text, Video, digitale Spuren
3. **Rechen- und Speicherkosten** sind drastisch gesunken
4. Mainstreaming von **maschinellem Lernen** und **KI**-Technologien
5. (Begrenzte) **Demokratisierung des Zugangs** zu großen Datenbeständen
6. **Verlagerung der Forschungsavantgarde** von der akademischen Welt zur Industrie



`Quelle` Reinsel et al., 2017, "Data Age 2025"

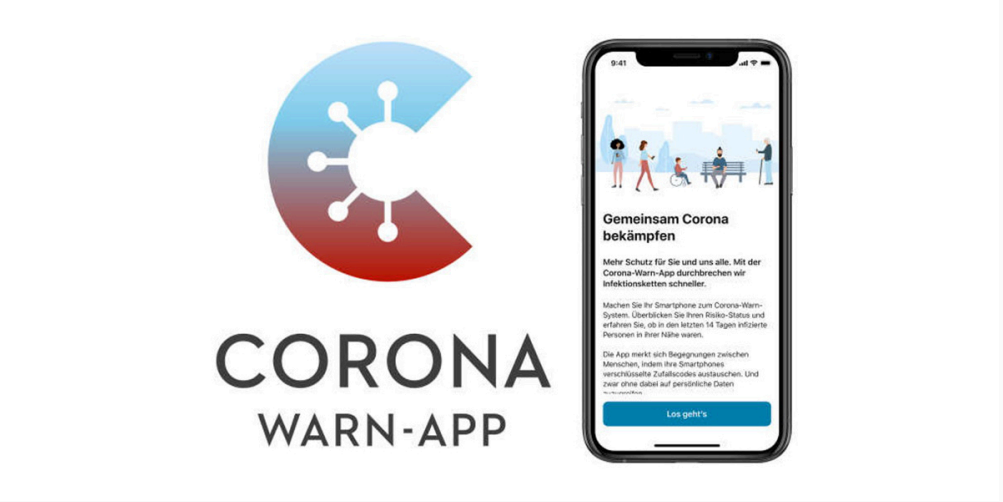
[1]Die Zahlen sind mit Vorsicht zu genießen. SIe sind fundamental schwer zu messen; deshalb weichen veröffentlichte Daten teilweise um ein Vielfaches voneinander ab.

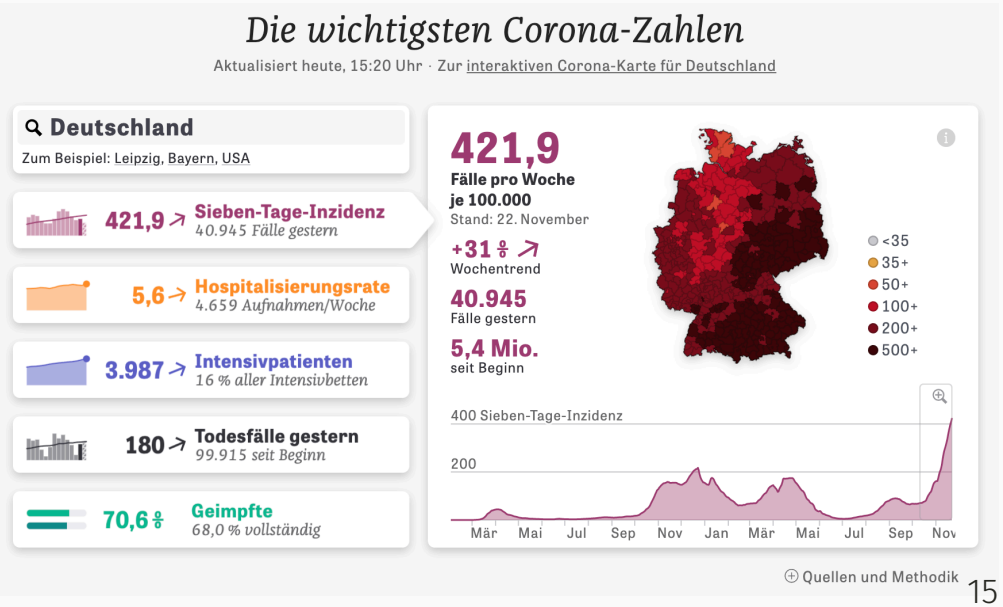
Beispiel: COVID-19-Überwachung

- Nutzung von Mobilfunk-, Social-Media- und Gesundheitsdaten durch WHO, CDC, RKI
- Modellierung und Vorhersage von Infektionsclustern
- Grundlage für politische Entscheidungen (Lockdowns, Impfpriorisierung)

Auswirkungen

- **Schnellere Reaktionen** auf Pandemien
- **Evidenzbasierte Gesundheitspolitik**
- **Datenschutz- und Ethikdebatten** über Bewegungs- und Gesundheitsdaten





Smart Cities und urbane Datenplattformen

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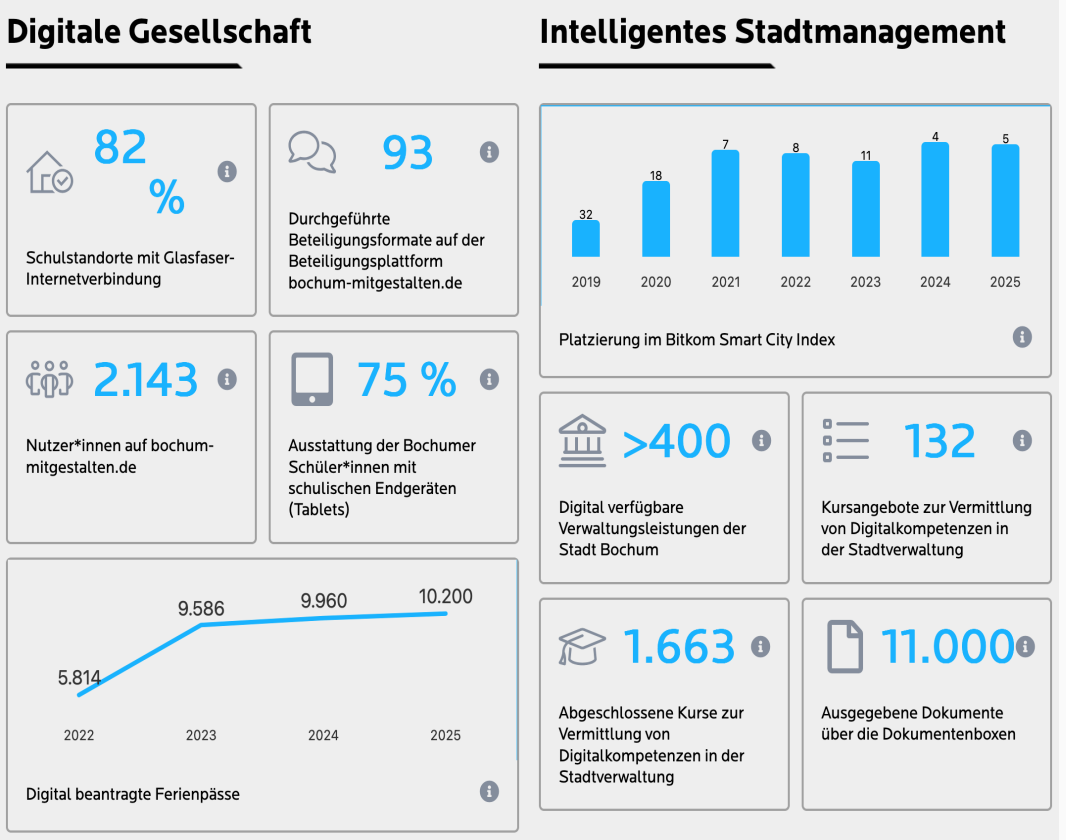
Beispiel: Singapur, Barcelona, London

- Nutzung von Verkehrs-, Sensor- und Energiedaten
- Steuerung von Verkehrsflüssen, Energieverbrauch und öffentlichem Raum

Auswirkungen

- **Effizientere Infrastruktur** und geringere Emissionen
- **Datengetriebene Stadtplanung**
- **Kontroversen** um Überwachung, Fairness und Dateneigentum



Integration von Migranten in den Arbeitsmarkt

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SOCIAL SCIENCE

Improving refugee integration through data-driven algorithmic assignment

Kirk Bansak,[1,2]* Jeremy Ferwerda,[2,3]* Jens Hainmueller,[1,2,4]*† Andrea Dillon,[2] Dominik Hangartner,[2,5,6] Duncan Lawrence,[2] Jeremy Weinstein[1,2]

Developed democracies are settling an increased number of refugees, many of whom face challenges integrating into host societies. We developed a flexible data-driven algorithm that assigns refugees across resettlement locations to improve integration outcomes. The algorithm uses a combination of supervised machine learning and optimal matching to discover and leverage synergies between refugee characteristics and resettlement sites. The algorithm was tested on historical registry data from two countries with different assignment regimes and refugee populations, the United States and Switzerland. Our approach led to gains of roughly 40 to 70%, on average, in refugees' employment outcomes relative to current assignment practices. This approach can provide governments with a practical and cost-efficient policy tool that can be immediately implemented within existing institutional structures.

`Quelle` Science, apolitical.co

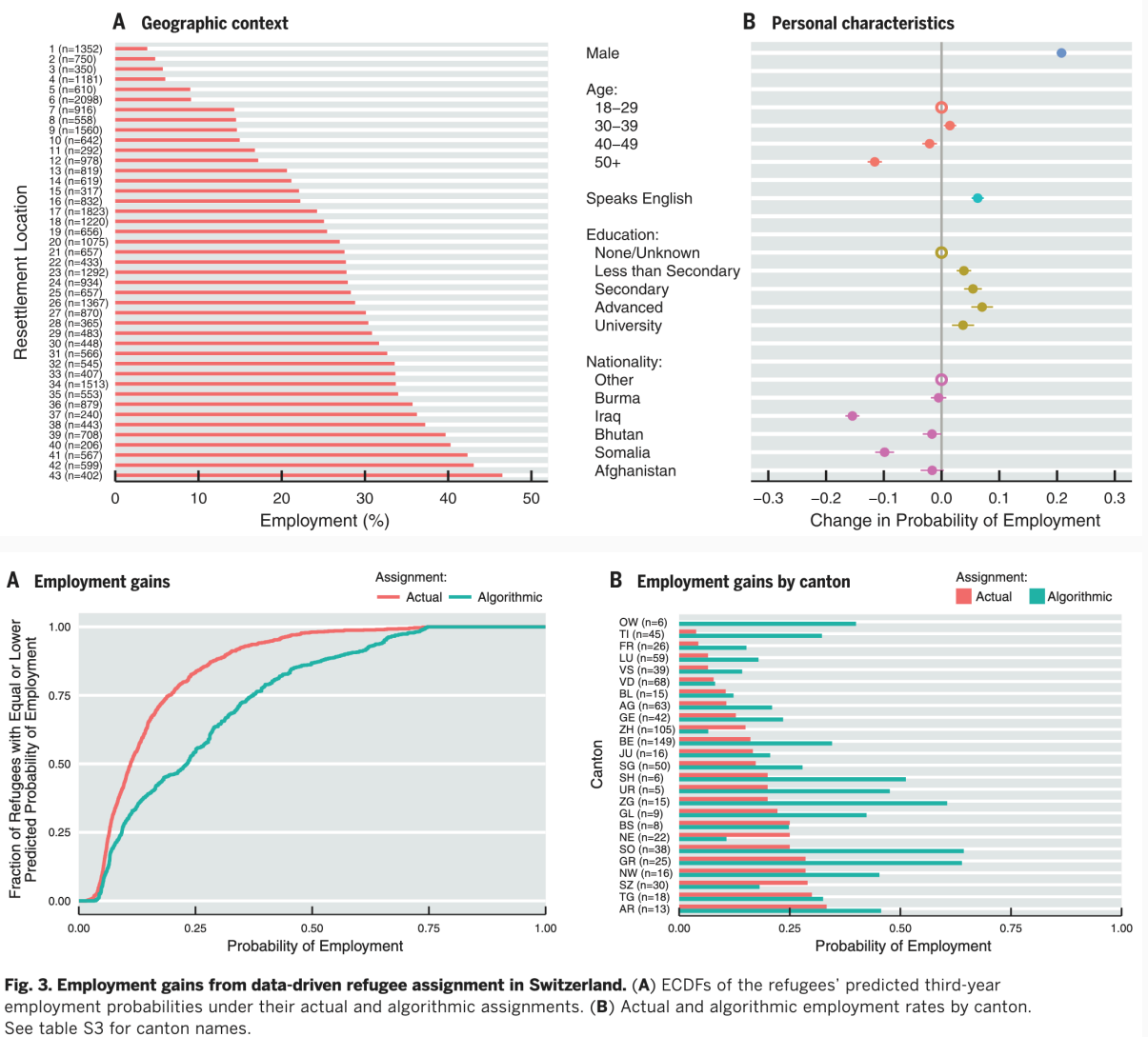

Fig. 3. Employment gains from data-driven refugee assignment in Switzerland. (**A**) ECDFs of the refugees' predicted third-year employment probabilities under their actual and algorithmic assignments. (**B**) Actual and algorithmic employment rates by canton. See table S3 for canton names.

LLMs für effizientere Verwaltung?

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LLM Based Multi-Agent Generation of Semi-structured Documents from Semantic Templates in the Public Administration Domain

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Abstract. In the last years' digitalization process, the creation and management of documents in various domains, particularly in Public Administration (PA), have become increasingly complex and diverse. This complexity arises from the need to handle a wide range of document types, often characterized by semi-structured forms. Semi-structured documents present a fixed set of data without a fixed format. As a consequence, a template-based solution cannot be used, as understanding a document requires the extraction of the data structure. The recent introduction of Large Language Models (LLMs) has enabled the creation of customized text output satisfying user requests. In this work, we propose a novel approach that combines the LLMs with prompt engineering and multi-agent systems for generating new documents compliant with a desired structure.The main contribution of this work concerns replacing the commonly used manual prompting with a task description generated by semantic retrieval from an LLM. The potential of this approach is demonstrated through a series of experiments and case studies, showcasing its effectiveness in real-world PA scenarios.

Keywords: Human-Centered AI · Public Administration · Task optimization

Leveraging Large Language Models for Topic Classification in the Domain of Public Affairs

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Abstract. The analysis of public affairs documents is crucial for citizens as it promotes transparency, accountability, and informed decision-making. It allows citizens to understand government policies, participate in public discourse, and hold representatives accountable. This is crucial, and sometimes a matter of life or death, for companies whose operation depend on certain regulations. Large Language Models (LLMs) have the potential to greatly enhance the analysis of public affairs documents by effectively processing and understanding the complex language used in such documents. In this work, we analyze the performance of LLMs in classifying public affairs documents. As a natural multi-label task, the classification of these documents presents important challenges. In this work, we use a regex-powered tool to collect a database of public affairs documents with more than 33K samples and 22.5M tokens. Our experiments assess the performance of 4 different Spanish LLMs to classify up to 30 different topics in the data in different configurations. The results shows that LLMs can be of great use to process domain-specific documents, such as those in the domain of public affairs.

Keywords: Domain Adaptation · Public Affairs · Topic Classification · Natural Language Processing · Document Understanding · LLM

RESEARCH ARTICLE

PAR Public Administration Review — ASPA

"Chat-Up": The role of competition in street-level bureaucrats' willingness to break technological rules and use generative pre-trained transformers (GPTs)

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Abstract
Organizations worldwide are concerned about workers using generative pretrained transformers (GPTs), which can generate human-like text in seconds at work. These organizations are setting rules on how and when to use GPTs. This article focuses on street-level bureaucrats' (SLBs) intentions to use GPTs even if their public organization does not allow its use (tech rule-breaking). Based on a mixed-methods exploratory design, using focus groups ($N = 14$) and a survey experiment ($N = 279$), we demonstrate that SLBs intend to break the rules and use GPTs when their competitors from the private sector have access to artificial intelligence (AI) tools. We discuss these findings in the context of hybrid forms of public management and the Promethean moment of GPTs.

Evidence for practice
- Regulating the use of AI by street-level bureaucrats' (SLBs) in public organizations is a growing challenge.
- SLBs have mixed feelings toward using GPTs in their work. On the one hand, they feel that GPTs can make their work more efficient, while on the other hand, they do not have the resources to learn how to use this tool well.
- However, SLBs are willing to use GPTs even if the organization does not allow their use under some circumstances. Public institutions should recognize this tendency.
- Competition with street-level professional colleagues from the private sector on resources and reputation mobilizes tech rule-breaking intentions among SLBs. When SLBs know that street-level colleagues from the private sector have access to AI tools, they are more willing to use GPTs even if the organization does not allow their use.

Analysis of Research on Artificial Intelligence in Public Administration: Literature Review and Textual Analysis

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ABSTRACT

Purpose: This study aims to investigate how analysing academic research through digital tools can improve our understanding of the applications, functions, and challenges related to the use of advanced artificial technologies (AI) in public administration.

Methodology: The applied methodology relies on the use of digital tools, specifically Voyant-Tools and Chat Generative Pre-Trained Transformer (GPT-4), for text analysis in conjunction with a selection of scientific literature on artificial intelligence and public administration.

Findings: The results of our study show that researchers equally report advantages and disadvantages of using AI in public administration. Moreover, the research highlights the benefits of using artificial intelligence while emphasising the importance of the ethical and appropriate regulation thereof.

Practical implications: Our innovative approach of developing and using a combined methodology involving specialised digital tools to analyse scientific literature introduces a new dimension to the examination of scientific texts and has the potential to shape public policy in the field of public administration.

Originality: The existing body of research on public administration and artificial intelligence is limited. Our study expands the scientific field by delving into the use of artificial intelligence in public administration.

Automating Government Response to Citizens' Questions: A Large Language Model-Based Question-Answering Guidance Generation System

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***Abstract*-In the era of digital governance, governments are expected to respond to citizens' inquiries timely and effectively. Nevertheless, government agencies find it increasingly difficult to cope with an unprecedented volume of citizens' inquiries on diverse issues. Governments are calling for a more effective and intelligent question-answering (QA) system to generate responses to citizens' inquiries. However, the existing QA systems in governments are primarily operated by human agents, with limited assistance from AI algorithms. The application of advanced large language models (LLMs) in digital governments holds promise to addressing citizens' requests in an automatic and effective manner. LLMs can enhance the efficiency and intelligence of government-citizen interactions, offering nuanced and human-like answers to diverse citizen inquiries. Nevertheless, existing LLMs-based all-purpose GPT application has limited understanding of professional expressions in the government domain and are unable to effectively respond like public officials. This study tries to build a QA guidance system specialized in government affairs based on LLMs and historical citizen question vector databases. After inputting a new question, the system can generate practically effective exemplary responses for government staff to reference when answering citizens' new questions. This system shows better performance than baseline models and improves the efficiency and accuracy of digital governments when answering citizens' questions.**

significant value for both citizens and the government.

Traditional digital government QA systems primarily operate in three approaches [4]. Information retrieval-based systems answer questions by searching for short text snippets in document collections [5]. Knowledge-matching systems respond to user queries by mapping natural language questions to queries on structured databases [5]. The third approach involves applying machine learning and deep learning methods to train models in learning the mapping relationships between questions and answers [6]. While these three approaches can achieve relatively good results in QA systems, they exhibit certain flaws when applied to e-government queries. The first is their relatively low comprehension of some professional and fixed expressions in the public service domain. The second is that their responses often deviate from the user's original intent. These shortcomings become more apparent in the era of digital government. Citizens' online inquiry data is vast and diverse, particularly in China, where regional policy differences are significant [7]. This necessitates strong capabilities in historical data retrieval and efficient, high- quality handling of numerous inquiries by the government. Current digital government QA systems struggle to grasp the contextual

The End of the Policy Analyst? Testing the Capability of Artificial Intelligence to Generate Plausible, Persuasive, and Useful Policy Analysis

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Policy advising in government centers on the analysis of public problems and the developing of recommendations for dealing with them. In carrying out this work, policy analysts consult a variety of sources and work to synthesize that body of evidence into useful decision support documents commonly called briefing notes. Advances in natural language processing (NLP) have led to the continuing development of tools that can undertake a similar task. Given a brief prompt, a large language model (LLM) can synthesize information in content databases. This article documents the findings from an experiment that tested whether contemporary NLP technology is capable of producing public policy relevant briefing notes that expert evaluators judge to be useful. The research involved two stages. First, briefing notes were created using three models: NLP generated; human generated; and NLP generated/human edited. Next, two panels of retired senior public servants (with only one panel informed of the use of NLP in the experiment) were asked to judge the briefing notes using a heuristic evaluation rubric. The findings indicate that contemporary NLP tools were not able to, on their own, generate useful policy briefings. However, the feedback from the expert evaluators indicates that automatically generated briefing notes might serve as a useful supplement to the work of human policy analysts. And the speed with which the capabilities of NLP tools are developing, supplemented with access to a larger corpus of previously prepared policy briefings and other policy-relevant material, suggests that the quality of automatically generated briefings may improve significantly in the coming years. The article concludes with reflections on what such improvements might mean for the future practice of policy analysis.

INACIA: Integrating Large Language Models in Brazilian Audit Courts: Opportunities and Challenges

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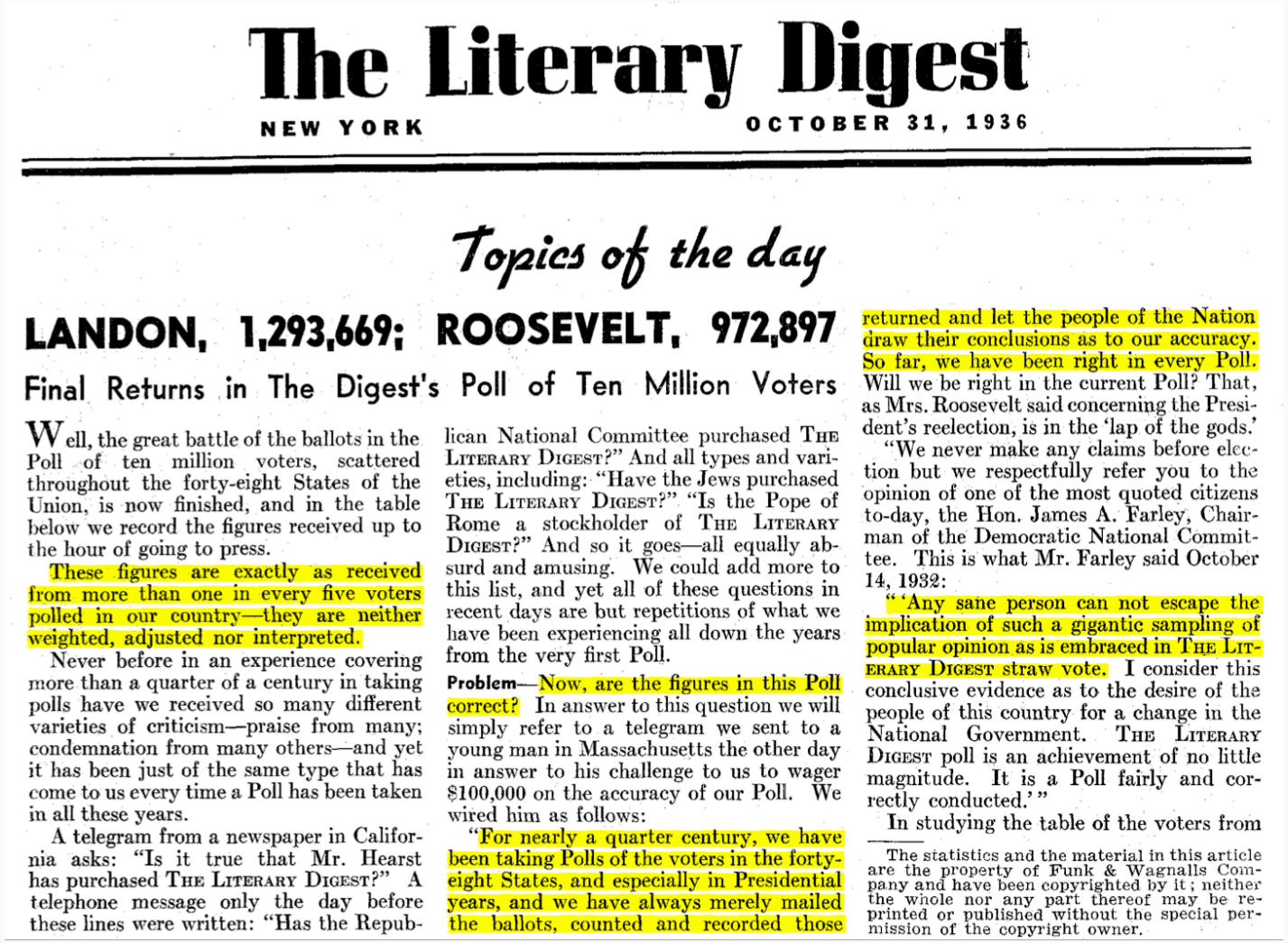
This paper introduces INACIA (**I**nstrução **A**ssistida com **I**nteligência **A**rtificial), a groundbreaking system designed to integrate Large Language Models (LLMs) into the operational framework of Brazilian Federal Court of Accounts (TCU). The system automates various stages of case analysis, including basic information extraction, admissibility examination, *Periculum in mora* and *Fumus boni iuris* analyses, and recommendations generation. Through a series of experiments, we demonstrate INACIA's potential in extracting relevant information from case documents, evaluating its legal plausibility, and formulating propositions for judicial decision-making. Utilizing a validation dataset alongside LLMs, our evaluation methodology presents a novel approach to assessing system performance, correlating highly with human judgment. These results underscore INACIA's potential in complex legal task handling while also acknowledging the current limitations. This study discusses possible improvements and the broader implications of applying AI in legal contexts, suggesting that INACIA represents a significant step towards integrating AI in legal systems globally, albeit with cautious optimism grounded in the empirical findings.

Das Big-Data-Paradoxon

Ein frühes Big-Data-Disaster



The Literary Digest

NEW YORK OCTOBER 31, 1936

Topics of the day

LANDON, 1,293,669; ROOSEVELT, 972,897

Final Returns in The Digest's Poll of Ten Million Voters

Well, the great battle of the ballots in the Poll of ten million voters, scattered throughout the forty-eight States of the Union, is now finished, and in the table below we record the figures received up to the hour of going to press.

These figures are exactly as received from more than one in every five voters polled in our country—they are neither weighted, adjusted nor interpreted.

Never before in an experience covering more than a quarter of a century in taking polls have we received so many different varieties of criticism—praise from many; condemnation from many others—and yet it has been just of the same type that has come to us every time a Poll has been taken in all these years.

A telegram from a newspaper in California asks: "Is it true that Mr. Hearst has purchased THE LITERARY DIGEST?" A telephone message only the day before these lines were written: "Has the Republican National Committee purchased THE LITERARY DIGEST?" And all types and varieties, including: "Have the Jews purchased THE LITERARY DIGEST?" "Is the Pope of Rome a stockholder of THE LITERARY DIGEST?" And so it goes—all equally absurd and amusing. We could add more to this list, and yet all of these questions in recent days are but repetitions of what we have been experiencing all down the years from the very first Poll.

Problem—Now, are the figures in this Poll correct? In answer to this question we will simply refer to a telegram we sent to a young man in Massachusetts the other day in answer to his challenge to us to wager $100,000 on the accuracy of our Poll. We wired him as follows:

"For nearly a quarter century, we have been taking Polls of the voters in the forty-eight States, and especially in Presidential years, and we have always merely mailed the ballots, counted and recorded those returned and let the people of the Nation draw their conclusions as to our accuracy. So far, we have been right in every Poll. Will we be right in the current Poll? That, as Mrs. Roosevelt said concerning the President's reelection, is in the 'lap of the gods.'

"We never make any claims before election but we respectfully refer you to the opinion of one of the most quoted citizens to-day, the Hon. James A. Farley, Chairman of the Democratic National Committee. This is what Mr. Farley said October 14, 1932:

"'Any sane person can not escape the implication of such a gigantic sampling of popular opinion as is embraced in THE LITERARY DIGEST straw vote. I consider this conclusive evidence as to the desire of the people of this country for a change in the National Government. THE LITERARY DIGEST poll is an achievement of no little magnitude. It is a Poll fairly and correctly conducted.'"

In studying the table of the voters from

Wahlumfrage 1936 der Zeitschrift Literary Digest

Hintergrund

- Die Wochenzeitschrift *Literary Digest* hatte die Ergebnisse aller Präsidentschaftswahlen zwischen 1920 und 1932 anhand von Umfragen korrekt vorhergesagt.
- Die Umfrage von 1936 unter 10 Millionen Wählerinnen und Wählern ergab einen deutlichen Sieg des republikanischen Kandidaten Alfred Landon

Nachwehen

- Landon verlor erdrutschartig gegen Franklin D. Roosevelt, der 46 von 48 Bundesstaaten für sich entschied und 60,8% der Wählerstimmen erhielt.
- Das Ergebnis wurde von George Gallup mit einem Sample von 50.000 Personen richtig vorhergesagt.
- Die Zeitschrift ging 1938 in Konkurs.

Wahlumfrage 1936 der Zeitschrift Literary Digest

The Literary Digest
NEW YORK NOVEMBER 14, 1936

Topics of the day

WHAT WENT WRONG WITH THE POLLS?

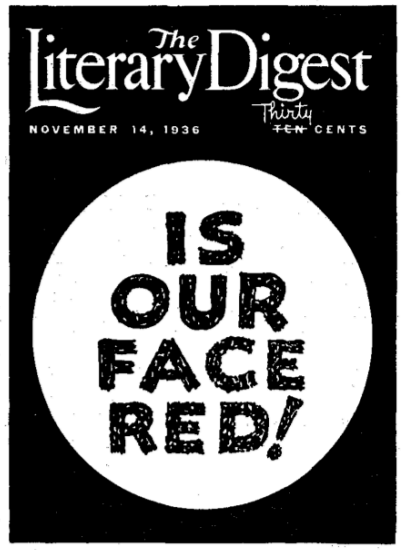
None of Straw Votes Got Exactly the Right Answer—Why?

In 1920, 1924, 1928 and 1932, THE LITERARY DIGEST Polls were right. Not only right in the sense that they showed the winner; they forecast the *actual popular vote* with such a small percentage of error (less than 1 per cent. in 1932) that newspapers and individuals everywhere heaped such phrases as "uncannily accurate" and "amazingly right" upon us.

Four years ago, when the Poll was running his way, our very good friend Jim Farley was saying that "no sane person could escape the implication" of a sampling "so fairly and correctly conducted."

Well, this year we used precisely the same method that had scored four bull's-eyes in four previous tries. And we were far from correct. Why? We ask that question in all sincerity, because *we want to know*.

"Reasons"—Oh, we've been flooded with "reasons." Hosts of people who feel they have learned more about polling in a few months than we have learned in more than a score of years have told us just where we were off. Hundreds of astute "second-guessers" have assured us by tele-



The following telegram was received by The Literary Digest: "With full and sympathetic appreciation of the rather tough spot you now

out of the 30,811 who voted returned ballots to us showing a division of 53.32 per cent. to 44.67 per cent. in favor of Mr. Landon. What was the actual result? It was 56.93 per cent. for Mr. Roosevelt, 41.17 per cent. for the Kansan.

In Chicago, the 100,929 voters who returned ballots to us showed a division of 48.63 per cent. to 47.56 per cent. in favor of Mr. Landon. The 1,672,175 who voted in the actual election gave the President 65.24 per cent., to 32.26 per cent. for the Republican candidate.

What happened? Why did only one in five voters in Chicago to whom THE DIGEST sent ballots take the trouble to reply? And why was there a preponderance of Republicans in the one-fifth that did reply? Your guess is as good as ours. We'll go into it a little more later. The important thing in all the above is that all this conjecture about our "not reaching certain strata" simply will not hold water.

Hoover Voters—Now for another "explanation" dinned into our ears: "You got too many Hoover voters in your sample."

Well, the fact is that we've *always* got too big a sampling of Republican voters. That was true in 1920, in 1924, in 1928, and even in 1932, when we *over*estimated the Roosevelt popular vote by three-quarters of 1 per cent.

Wahlumfrage 1936 der Zeitschrift Literary Digest

Anatomie eines Debakels

1. **Stichprobenrahmen**: (1) eigene Leser, (2) registrierte Autobesitzer, (3) registrierte Telefonnutzer
2. **Datenerhebung**: Jeder bekam einen Musterstimmzettel zugeschickt und wurde gebeten, den markierten Stimmzettel zurückzugeben
3. **Rücklaufquote**: 2,4 Mio. von 10 Mio.

Stichprobenverzerrung als Folge von **coverage error** und **non-reponse**: Überrepräsentation von wohlhabenderen Personen mit einer Präferenz für Landon

`Quelle` Peverill Squire, 1988, Public Opinion Quarterly

Table 1. 1936 Presidential Vote by Car and Telephone Ownership (in Percent)

Presidential Vote	Car & Phone	Car, No Phone	Phone, No Car	Neither
Roosevelt	55	68	69	79
Landon	45	30	30	19
Other	1	2	0	2
Total *N*	946	447	236	657

SOURCE: American Institute of Public Opinion, 28 May 1937.

Table 2. Presidential Vote by Receiving *Literary Digest* Straw Vote Ballot or Not (in Percent)

Presidential Vote	Received Poll	Not Receive Poll	Do Not Know
Roosevelt	55	71	73
Landon	44	27	25
Other	1	1	3
Total *N*	780	1339	149

SOURCE: American Institute of Public Opinion, 28 May 1937.

Table 3. Presidential Vote by Returning or Not Returning Straw Vote Ballot (in Percent)

Presidential Vote	Did Return	Did Not Return	Do Not Know
Roosevelt	48	69	56
Landon	51	30	40
Other	1	1	4
Total *N*	493	288	48

SOURCE: American Institute of Public Opinion, 28 May 1937.

Umfrage-basierte Evidenz ist mit Vorsicht zu genießen

Ein modernes Big-Data-Umfrage-Desaster

Hertie School

Unrepresentative big surveys significantly overestimated US vaccine uptake

https://doi.org/10.1038/s41586-021-04198-4

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Check for updates

Valerie C. Bradley[1,6], Shiro Kuriwaki[2,6], Michael Isakov[3], Dino Sejdinovic[1], Xiao-Li Meng[4] & Seth Flaxman[5]✉

Surveys are a crucial tool for understanding public opinion and behaviour, and their accuracy depends on maintaining statistical representativeness of their target populations by minimizing biases from all sources. Increasing data size shrinks confidence intervals but magnifies the effect of survey bias: an instance of the Big Data Paradox[1]. Here we demonstrate this paradox in estimates of first-dose COVID-19 vaccine uptake in US adults from 9 January to 19 May 2021 from two large surveys: Delphi–Facebook[2,3] (about 250,000 responses per week) and Census Household Pulse[4] (about 75,000 every two weeks). In May 2021, Delphi–Facebook overestimated uptake by 17 percentage points (14–20 percentage points with 5% benchmark imprecision) and Census Household Pulse by 14 (11–17 percentage points with 5% benchmark imprecision), compared to a retroactively updated benchmark the Centers for Disease Control and Prevention published on 26 May 2021. Moreover, their large sample sizes led to miniscule margins of error on the incorrect estimates. By contrast, an Axios–Ipsos online panel[5] with about 1,000 responses per week following survey research best practices[6] provided reliable estimates and uncertainty quantification. We decompose observed error using a recent analytic framework[1] to explain the inaccuracy in the three surveys. We then analyse the implications for vaccine hesitancy and willingness. We show how a survey of 250,000 respondents can produce an estimate of the population mean that is no more accurate than an estimate from a simple random sample of size 10. Our central message is that data quality matters more than data quantity, and that compensating the former with the latter is a mathematically provable losing proposition.

Table 1 | Comparison of survey designs

	Axios-Ipsos	Census Household Pulse	Delphi-Facebook
Recruitment mode	Address-based mail sample to Ipsos KnowledgePanel	SMS and email	Facebook Newsfeed
Interview mode	Online	Online	Online
Average size	1,000/wave	75,000/wave	250,000/week
Sampling frame	Ipsos KnowledgePanel; internet/tablets provided to ~5% of panelists who lack home internet	Census Bureau's Master Address File (individuals for whom email / phone contact information is available)	Facebook active users
Vaccine uptake question	"Do you personally know anyone who has already received the COVID-19 vaccine?"	"Have you received a COVID-19 vaccine?"	"Have you had a COVID-19 vaccination?"
Vaccine uptake definition	"Yes, I have received the vaccine"	"Yes"	"Yes"
Other vaccine uptake response options	"Yes, a member of my immediate family", "Yes, someone else", "No"	"No"	"No", "I don't know"
Weighting variables	Gender by age, race, education, Census region, metropolitan status, household income, partisanship.	Education by age by sex by state, race/ethnicity by age by sex by state, household size	Stage 1: age, gender "other attributes which we have found in the past to correlate with survey outcomes" to FAUB; Stage 2: state by age by gender

Comparison of key design choices across the Axios–Ipsos, Census Household Pulse and Delphi–Facebook studies. All surveys target the US adult population. See Extended Data Table 1 for additional comparisons and Methods for additional implementation details.

Ein modernes Big-Data-Umfrage-Desaster

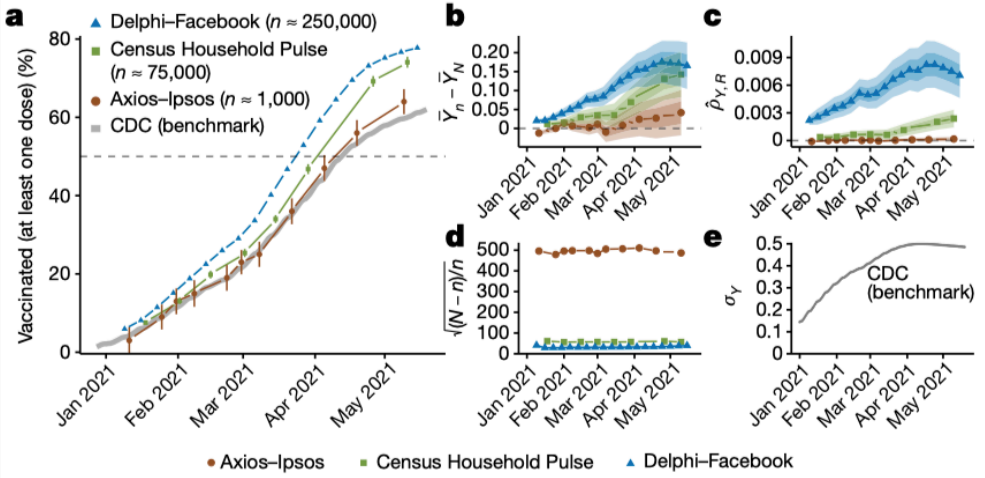


Fig 1 | Errors in estimates of vaccine uptake. **a**, Estimates of vaccine uptake for US adults in 2021 compared to CDC benchmark data, plotted by the end date of each survey wave. Points indicate each study's weighted estimate of first-dose vaccine uptake, and intervals are 95% confidence intervals using reported standard errors and design effects. Delphi–Facebook has $n = 4{,}525{,}633$ across 19 waves, Census Household Pulse has $n = 606{,}615$ across 8 waves and Axios–Ipsos has $n = 11{,}421$ across 11 waves. Delphi–Facebook's confidence intervals are too small to be visible. **b**, Total error $\bar{Y}_n - \bar{Y}_N$. **c**, Data defect correlation $\hat{\rho}_{Y,R}$. **d**, Data scarcity $\sqrt{(N-n)/n}$. **e**, Inherent problem difficulty σ_Y. Shaded bands represent scenarios of ±5% (darker) and ±10% (lighter) imprecision in the CDC benchmark relative to reported values (points). **b**–**e** comprise the decomposition in equation (1).

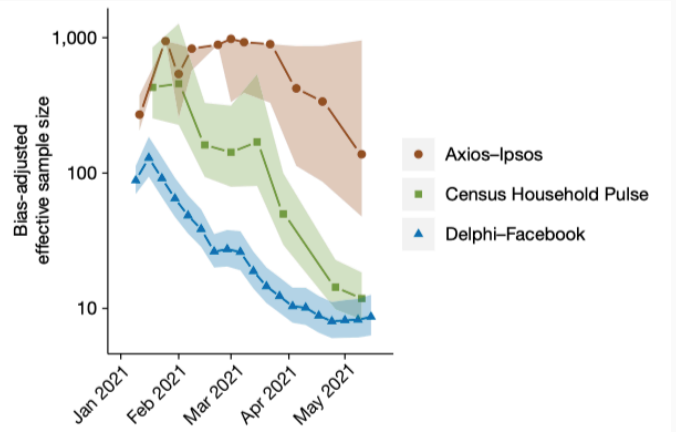


Fig 2 | Bias-adjusted effective sample size. An estimate's bias-adjusted effective sample size (different from the classic Kish effective sample size) is the size of a simple random sample that would have the same MSE as the observed estimate. Effective sample sizes are shown here on the $\log_{10}$ scale. The original sample size was $n = 4{,}525{,}633$ across 19 waves for Delphi–Facebook, $n = 606{,}615$ across 8 waves for Census Household Pulse and $n = 11{,}421$ across 11 waves for Axios–Ipsos. Shaded bands represent scenarios of ±5% benchmark imprecision in the CDC benchmark.

Das Big-Data-Paradoxon

> „Wenn verzerrte Stichproben groß sind, sind sie doppelt irreführend: Sie erzeugen Konfidenzintervalle mit falschen Mitteln und erheblich unterschätzter Unsicherheit. Dies ist das **Big-Data-Paradoxon**: Je umfangreicher die Daten sind, desto sicherer täuschen wir uns selbst, wenn wir die Verzerrungen bei der Datenerhebung nicht berücksichtigen."

Bradley et al. (2021), *Nature*

> „Die 'Größe' solcher Big Data (für Rückschlüsse auf die Population) sollte an der relativen Größe f = n/N der Stichprobe zur Population gemessen werden, nicht an der absoluten Größe n der Stichprobe.

Xiao-Li Meng (2018), *The Annals of Applied Statistics*

Besserung durch Korrektur für endliche Grundgesamtheiten?

- Die Intuition sagt uns, dass die Wahrscheinlichkeit eines Fehlers geringer sein sollte, wenn der Stichprobenumfang im Verhältnis zum Umfang der Grundgesamtheit groß ist.
- Das stimmt auch, aber der Zugewinn ist relativ langsam.
- Der endliche Populationskorrekturfaktor für den Standardfehler einer interessierenden Größe ist zum Beispiel gegeben durch $\sqrt{\frac{N-n}{N-1}}$.

Beispiel

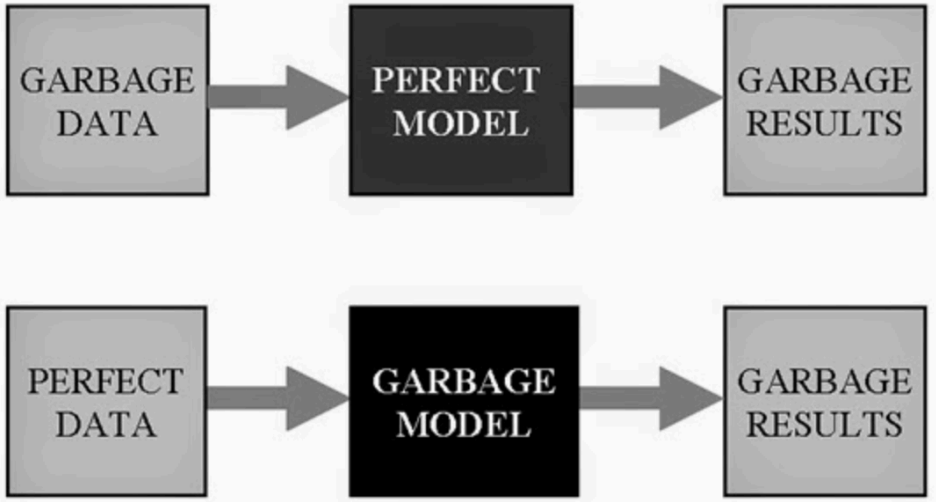
- Wir führen eine Umfrage bei 100k Personen in einer Bevölkerung von 3,7 Mio. durch.
- Für $N = 3.7m$ und $n = 100k$ ist dies $\sqrt{0.973}$.

Garbage in, Garbage out

Garbage in, Garbage out

Das GIGO Prinzip

- Die Qualität der Informationen, die ein Modell produziert (z.B. Vorhersagen), kann nicht besser sein als die Qualität der Informationen, die in das Modell eingespeist werden.
- Dieser Grundsatz ist wird umso relevanter in Big-Data-Kontexten, wenn Daten unzureichend validiert oder Datenqualität schlicht nicht gegeben ist.
- Das Problem verschärft sich potentiell in ML-Anwendungen, wenn Modelle komplex und intransparent sind.



Google Flu Trends

Hertie School

nature Vol 457|19 February 2009|doi:10.1038/nature07634

LETTERS

Detecting influenza epidemics using search engine query data

Jeremy Ginsberg[1], Matthew H. Mohebbi[1], Rajan S. Patel[1], Lynnette Brammer[2], Mark S. Smolinski[1] & Larry Brilliant[1]

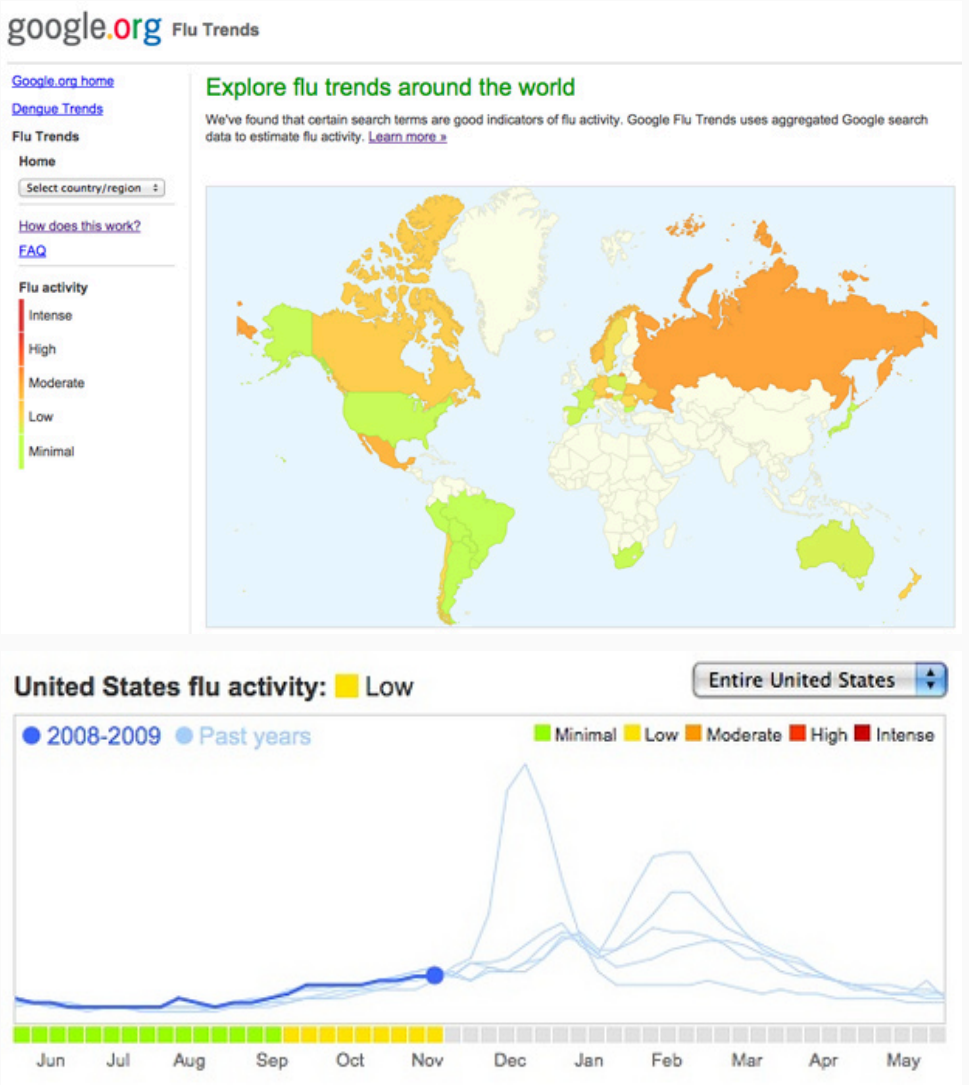
Seasonal influenza epidemics are a major public health concern, causing tens of millions of respiratory illnesses and 250,000 to 500,000 deaths worldwide each year[1]. In addition to seasonal influenza, a new strain of influenza virus against which no previous immunity exists and that demonstrates human-to-human transmission could result in a pandemic with millions of fatalities[2]. Early detection of disease activity, when followed by a rapid response, can reduce the impact of both seasonal and pandemic influenza[3,4]. One way to improve early detection is to monitor health-seeking behaviour in the form of queries to online search engines, which are submitted by millions of users around the world each day. Here we present a method of analysing large numbers of Google search queries to track influenza-like illness in a population. Because the relative frequency of certain queries is highly correlated with the percentage of physician visits in which a patient presents with influenza-like symptoms, we can accurately estimate the current level of weekly influenza activity in each region of the United States, with a reporting lag of about one day. This approach may make it possible to use search queries to detect influenza epidemics in areas with a large population of web search users.

By aggregating historical logs of online web search queries submitted between 2003 and 2008, we computed a time series of weekly counts for 50 million of the most common search queries in the United States. Separate aggregate weekly counts were kept for every query in each state. No information about the identity of any user was retained. Each time series was normalized by dividing the count for each query in a particular week by the total number of online search queries submitted in that location during the week, resulting in a query fraction (Supplementary Fig. 1).

We sought to develop a simple model that estimates the probability that a random physician visit in a particular region is related to an ILI; this is equivalent to the percentage of ILI-related physician visits. A single explanatory variable was used: the probability that a random search query submitted from the same region is ILI-related, as determined by an automated method described below. We fit a linear model using the log-odds of an ILI physician visit and the log-odds of an ILI-related search query: $\text{logit}(I(t)) = \alpha\text{logit}(Q(t)) + \varepsilon$, where $I(t)$ is the percentage of ILI physician visits, $Q(t)$ is the ILI-related query fraction at time t, α is the multiplicative coefficient, and ε is the error term. $\text{logit}(p)$ is simply $\ln(p/(1-p))$.

Publicly available historical data from the CDC's US Influenza

`Quelle` Ginsberg et al., 2009, Nature



POLICYFORUM

BIG DATA

The Parable of Google Flu: Traps in Big Data Analysis

Large errors in flu prediction were largely avoidable, which offers lessons for the use of big data.

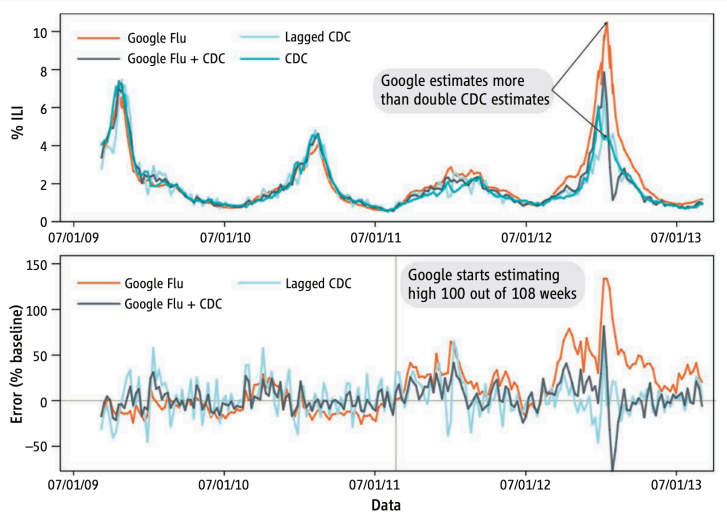
David Lazer,[1,2*] Ryan Kennedy,[1,3,4] Gary King,[3] Alessandro Vespignani[5,6,3]

In February 2013, Google Flu Trends (GFT) made headlines but not for a reason that Google executives or the creators of the flu tracking system would have hoped. *Nature* reported that GFT was predicting more than double the proportion of doctor visits for influenza-like illness (ILI) than the Centers for Disease Control and Prevention (CDC), which bases its estimates on surveillance reports from laboratories across the United States (*1*, *2*). This happened despite the fact that GFT was built to predict CDC reports. Given that GFT is often held up as an exemplary use of big data (*3*, *4*), what lessons can we draw from this error?

The problems we identify are not limited to GFT. Research on whether search or social media can

run ever since, with a few changes announced in October 2013 (*10*, *15*).

Although not widely reported until 2013, the new GFT has been persistently overestimating flu prevalence for a much longer time. GFT also missed by a very large margin in the 2011–2012 flu season and has missed high for 100 out of 108 weeks starting with August 2011 (see the graph). These errors are not randomly distributed. For example, last week's errors predict this week's errors (temporal autocorrelation), and the direction and magnitude of error varies with the time of year (seasonality). These patterns mean that GFT overlooks considerable information that could be extracted by traditional statistical methods.



GFT overestimation. GFT overestimated the prevalence of flu in the 2012–2013 season and overshot the actual level in 2011–2012 by more than 50%. From 21 August 2011 to 1 September 2013, GFT reported overly high flu prevalence 100 out of 108 weeks. (**Top**) Estimates of doctor visits for ILI. "Lagged CDC" incorporates 52-week seasonality variables with lagged CDC data. "Google Flu + CDC" combines GFT, lagged CDC estimates, lagged error of GFT estimates, and 52-week seasonality variables. (**Bottom**) Error [as a percentage [[Non-CDC estmate)−(CDC estimate)]/(CDC) estimate)]. Both alternative models have much less error than GFT alone. Mean absolute error (MAE) during the out-of-sample period is 0.486 for GFT, 0.311 for lagged CDC, and 0.232 for combined GFT and CDC. All of these differences are statistically significant at $P < 0.05$. See SM.

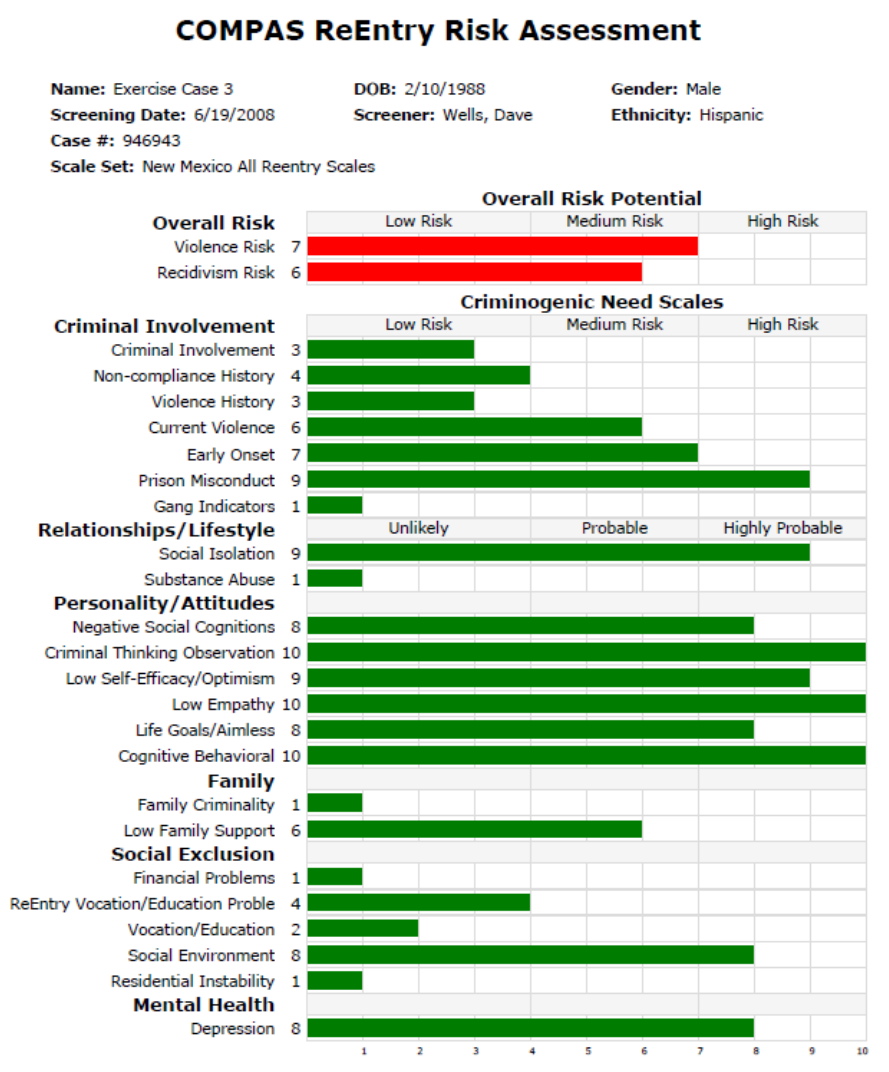
`Quelle` Lazer et al., 2014, Science

Vorhersage der Rückfälligkeit von Straftätern

Hertie School

Hintergrund

- Correctional Offender Management Profiling for Alternative Sanctions (COMPAS) ist ein von Northpointe (jetzt Equivant) entwickeltes Entscheidungshilfeinstrument, das von US-Gerichten zur **Bewertung der Rückfallwahrscheinlichkeit** eingesetzt wird.
- Erstellt mehrere Skalen (Risiko der vorzeitigen Entlassung, allgemeine Rückfälligkeit, gewalttätige Rückfälligkeit) auf der Grundlage von Faktoren wie Alter, Vorstrafen und Drogenmissbrauch
- Der Algorithmus ist urheberrechtlich geschützt und seine inneren Abläufe sind nicht öffentlich.



`Quelle` Leitfaden für Praktiker zum COMPAS Core

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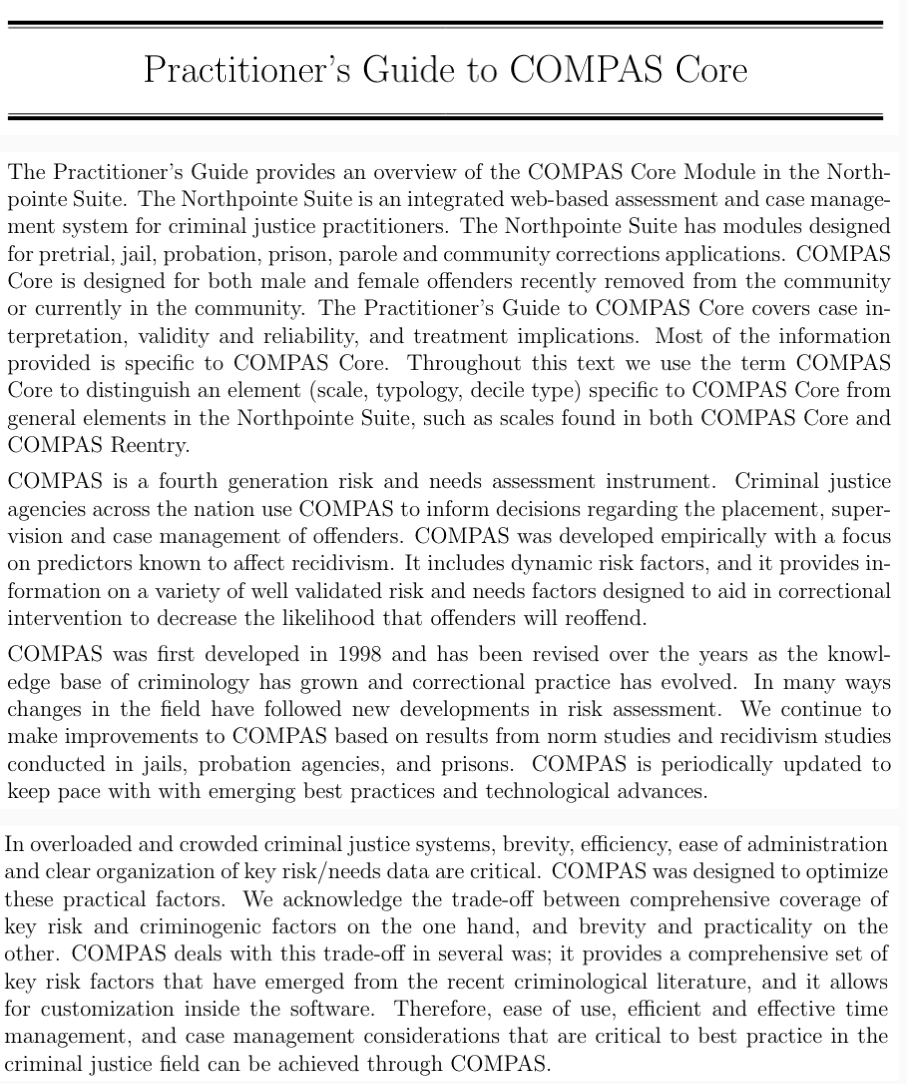

Practitioner's Guide to COMPAS Core

The Practitioner's Guide provides an overview of the COMPAS Core Module in the Northpointe Suite. The Northpointe Suite is an integrated web-based assessment and case management system for criminal justice practitioners. The Northpointe Suite has modules designed for pretrial, jail, probation, prison, parole and community corrections applications. COMPAS Core is designed for both male and female offenders recently removed from the community or currently in the community. The Practitioner's Guide to COMPAS Core covers case interpretation, validity and reliability, and treatment implications. Most of the information provided is specific to COMPAS Core. Throughout this text we use the term COMPAS Core to distinguish an element (scale, typology, decile type) specific to COMPAS Core from general elements in the Northpointe Suite, such as scales found in both COMPAS Core and COMPAS Reentry.

COMPAS is a fourth generation risk and needs assessment instrument. Criminal justice agencies across the nation use COMPAS to inform decisions regarding the placement, supervision and case management of offenders. COMPAS was developed empirically with a focus on predictors known to affect recidivism. It includes dynamic risk factors, and it provides information on a variety of well validated risk and needs factors designed to aid in correctional intervention to decrease the likelihood that offenders will reoffend.

COMPAS was first developed in 1998 and has been revised over the years as the knowledge base of criminology has grown and correctional practice has evolved. In many ways changes in the field have followed new developments in risk assessment. We continue to make improvements to COMPAS based on results from norm studies and recidivism studies conducted in jails, probation agencies, and prisons. COMPAS is periodically updated to keep pace with with emerging best practices and technological advances.

In overloaded and crowded criminal justice systems, brevity, efficiency, ease of administration and clear organization of key risk/needs data are critical. COMPAS was designed to optimize these practical factors. We acknowledge the trade-off between comprehensive coverage of key risk and criminogenic factors on the one hand, and brevity and practicality on the other. COMPAS deals with this trade-off in several was; it provides a comprehensive set of key risk factors that have emerged from the recent criminological literature, and it allows for customization inside the software. Therefore, ease of use, efficient and effective time management, and case management considerations that are critical to best practice in the criminal justice field can be achieved through COMPAS.

`Quelle` Leitfaden für Praktiker zum COMPAS Core

Die ProPublica und andere Untersuchungen

- Im Jahr 2016 veröffentlichte ProPublica eine Untersuchung, die zeigte, dass COMPAS **voreingenommen gegenüber Afroamerikanern** war
- **Bias:** Der Algorithmus sagte bei Afroamerikanern mit höherer Wahrscheinlichkeit falsch voraus, dass Angeklagte wieder straffällig werden würden.
- **Mangelnde Präzision:** Nur 20 % der Personen, denen Gewaltverbrechen vorhergesagt wurden, wurden tatsächlich straffällig (in einer späteren Studie wurde der Wert auf 65 % geschätzt - schlechter als eine Gruppe von Nicht-Experten)

`Quelle` ProPublica 2016

Machine Bias*

Julia Angwin, Jeff Larson, Surya Mattu, and Lauren Kirchner

There's software used across the country to predict future criminals. And it's biased against blacks.

ON A SPRING AFTERNOON IN 2014, Brisha Borden was running late to pick up her god-sister from school when she spotted an unlocked kid's blue Huffy bicycle and a silver Razor scooter. Borden and a friend grabbed the bike and scooter and tried to ride them down the street in the Fort Lauderdale suburb of Coral Springs.

Just as the 18-year-old girls were realizing they were too big for the tiny conveyances—which belonged to a 6-year-old boy—a woman came running after them saying, "That's my kid's stuff." Borden and her friend immediately dropped the bike and scooter and walked away.

But it was too late—a neighbor who witnessed the heist had already called the police. Borden and her friend were arrested and charged with burglary and petty theft for the items, which were valued at a total of $80.

Compare their crime with a similar one: The previous summer, 41-year-old Vernon Prater was picked up for shoplifting $86.35 worth of tools from a nearby Home Depot store (Figure 6.1.1).

Prater was the more seasoned criminal. He had already been convicted of armed robbery and attempted armed robbery, for which he served five years in prison, in addition to another armed robbery charge. Borden had a record, too, but it was for misdemeanors committed when she was a juvenile.

Yet something odd happened when Borden and Prater were booked into jail: A computer program spat out a score predicting the likelihood of each committing a future crime. Borden—who is black—was rated a high risk. Prater—who is white—was rated a low risk.

Two years later, we know the computer algorithm got it exactly backward. Borden has not been charged with any new crimes. Prater is serving an eight-year prison term for subsequently breaking into a warehouse and stealing thousands of dollars' worth of electronics.

Scores like this—known as risk assessments—are increasingly common in courtrooms across the nation. They are used to inform decisions about who can be set free at every stage of the criminal justice system, from assigning bond amounts—as is the case in Fort Lauderdale—to

* Julia Angwin, Jeff Larson, Surya Mattu, Lauren Kirchner, "Machine Bias," *ProPublica* (May 23, 2016). Reprinted with permission.

254 DOI: 10.1201/9781003278290-37

Vorhersage der Rückfälligkeit von Straftätern

Die ProPublica und andere Untersuchungen

- Im Jahr 2016 veröffentlichte ProPublica eine Untersuchung, die zeigte, dass COMPAS **voreingenommen gegenüber Afroamerikanern** war
- **Bias:** Der Algorithmus sagte bei Afroamerikanern mit höherer Wahrscheinlichkeit falsch voraus, dass Angeklagte wieder straffällig werden würden.
- **Mangelnde Präzision:** Nur 20 % der Personen, denen Gewaltverbrechen vorhergesagt wurden, wurden tatsächlich straffällig (in einer späteren Studie wurde der Wert auf 65 % geschätzt - schlechter als eine Gruppe von Nicht-Experten)

`Quelle` Dressel and Fair, 2018, Science Advances

SCIENCE ADVANCES | RESEARCH ARTICLE

RESEARCH METHODS

The accuracy, fairness, and limits of predicting recidivism

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Algorithms for predicting recidivism are commonly used to assess a criminal defendant's likelihood of committing a crime. These predictions are used in pretrial, parole, and sentencing decisions. Proponents of these systems argue that big data and advanced machine learning make these analyses more accurate and less biased than humans. We show, however, that the widely used commercial risk assessment software COMPAS is no more accurate or fair than predictions made by people with little or no criminal justice expertise. In addition, despite COMPAS's collection of 137 features, the same accuracy can be achieved with a simple linear predictor with only two features.

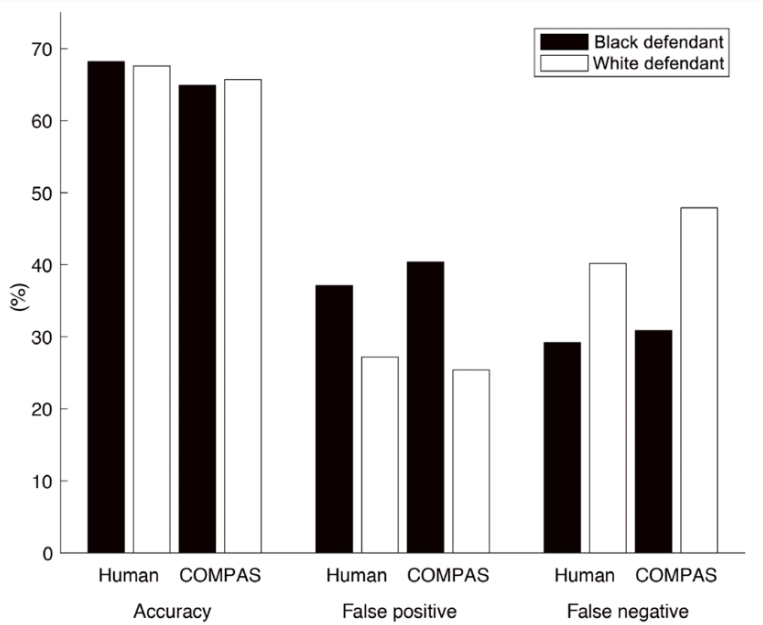
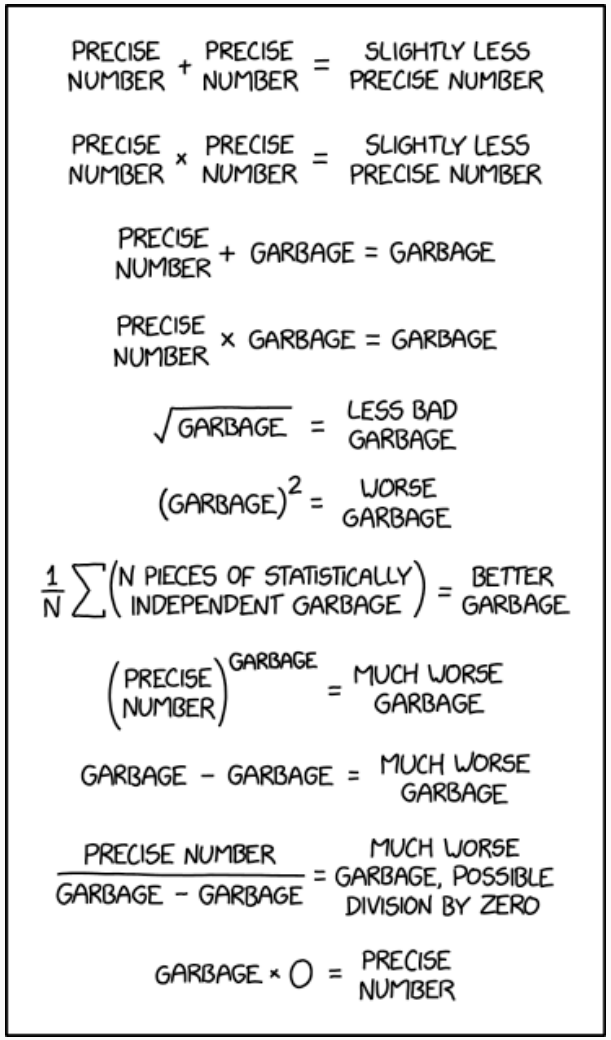


Fig. 1. Human (no-race condition) versus COMPAS algorithmic predictions (see also Table 1).

Garbage in, Garbage out: Lessons learned

1. **Messung-** und **Selektions-Fragen** sind bei der Big-Data-Analyse nach wie vor entscheidend.
2. Trauen Sie **Messungen** nicht, die nicht **richtig validiert** wurden.
3. Achten Sie darauf, was in ein Modell einfließt (der **Input**: Fälle, Variablen/Merkmale).
4. Achten Sie auf eine angemessene **Out-of-Sample-Validierung** von Modellen.
5. Vorsicht bei **unkritischer Nutzung von Online-/Sozialen Medien** als Datenquelle.



`Quelle` XKCD, 2295, (hier erklärt)