

INTRODUCTION

ALEXANDER SEREBRENİK

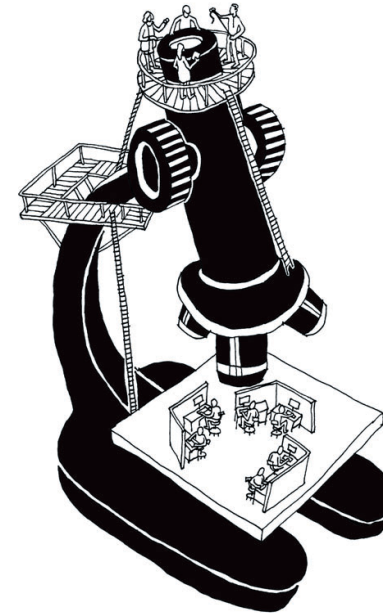


Illustration by Tom Dunne.
American Scientist 99(6):466, 2011

ADMINISTRATION

5 ECTS = 140 h

28h lectures/workshops
1.5h exam
110h homework

Tuesday 13:30-15:15
Thursday 8:45-10:30
Auditorium 13
Check mytimetable.tue.nl

No classes on
December 26, 28
January 2, 4



prof. dr. Alexander Serebrenik
(he/him)
a.serebrenik@tue.nl



ir. Nathan Cassee
(he/him)
n.w.cassee@tue.nl

We will try to stay on campus if it is possible, but we will move on-line if needed

AFTER TAKING THIS CLASS, YOU SHOULD BE ABLE TO

- independently **design** and **execute** a sound empirical study in Software Engineering given a state-of-the-art dataset.
- **evaluate** empirical studies in Software Engineering using tools accepted in the field, and identify **threats to validity**.
- describe the results of empirical studies to **practitioners** not familiar with academic research.
- **comprehend** the research methods used for empirical studies in Software Engineering

These are the new learning goals but they do not agree with OSIRIS, not sure what to do here



We have two kinds of meetings: lectures and workshops. Most of the class meeting will be lectures, but we also have three workshops where you will work

ASSESSMENT

- **Assignments:**

- Design a study (4 students) **70%**
- Describe a study (individual) **30%**
- **5 or more to pass the course**

- **Exam**

- January 23, 9:00-12:00
- **5 or more to pass the course**

- **Final**

- Assignments * 0.7 + Exam * 0.3,
if Assignments ≥ 5 and Exam ≥ 5
- $\min(5, \text{Assignments} * 0.7 + \text{Exam} * 0.3)$, otherwise


When	What	Topic
Nov 14 13:30	Lecture	Introduction to Empiricism and Rationalism
Nov 16 08:45	Lecture	Research Questions and Research Strategies
Nov 21 13:30	Guest-Lecture	Adyen
Nov 21 14:30	Lecture	Design Science
Nov 23 08:45	Lecture	Sampling
Nov 24 23:59	Deadline	1st deadline for Design a study
Nov 28 13:30	Lecture	Interviews & Surveys
Nov 30 08:45	Workshop	How to read an empirical paper
Dec 5 13:30	Lecture	Mining Software Repositories I
Dec 7 08:45	Workshop	Mining Software Repositories
Dec 8 23:59	Deadline	2ND deadline for Design a study
Dec 12 13:30	Lecture	Quantitative Analysis
Dec 14 08:45	Lecture	Qualitative Analysis
Dec 15 23:59	Deadline	1st deadline for Describe a study
Dec 19 13:30	Coffee-hour	Feedback and assignment Q&A session
Dec 21 08:45	Lecture	Advanced Repository Mining
Dec 22 23:59	Deadline	3RD deadline for Design a study
Jan 9 13:30	Coffee-hour	Feedback and assignment Q&A session
Jan 11 08:45	Lecture	Threats to Validity
Jan 12 23:59	Deadline	2ND deadline for Describe a Study
Jan 16 13:30	Workshop	Recap & Threats & Trustworthiness
Jan 18 08:45	No lecture	
Jan 23 09:00	Exam	Final examination
Feb 2 23:59	Deadline	Final deadline for Design a study
Apr 9 18:00	Exam	Resit

For this assignment there will be a total of four deadlines, the four deadlines will build up, and for each subsequent deadline we expect a more complete version of your report. The first three deadlines are not mandatory. For these deadlines we will only give feedback on your work to help you improve your report. The fourth deadline is mandatory and will be graded.

ASSESSMENT

Check the syllabus!

- **Assignments:**
 - Design a Study (4 students) **70%**
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- **Exam**



Groups (20)	
▶ Design a study 1	0 / 4 students
▶ Design a study 2	0 / 4 students
▶ Design a study 3	0 / 4 students
▶ Design a study 4	0 / 4 students

Please register!

TEAMWORK MIGHT BE CHALLENGING

- **Communicate**

- Talk to each other and listen to each other
- Be mindful of different working styles
- Make clear and explicit agreements upfront
- Let us know *before the submission* if the things do not work out

- **Take responsibility**

- Describe who has done what
- Whether everyone has contributed equally

2IMP40 AND OTHER COURSES

- **Prerequisites:** no formal prerequisites. We do expect knowledge of **basic statistics**, readiness to **read scientific papers**, familiarity with **modern software development**, interest in software engineering **research**
 - GitHub, code review, p-value, DevOps, Wilcoxon test, ...
- **Software engineering:**
 - 2IMP25 Software evolution (Q3). 2IMP40 focuses on methods that can be applied to study different software engineering phenomena incl. software evolution. 2IMP25 focuses on the insights and techniques designed to study software evolution.
 - 2IMP00 Seminar Software Engineering & Technology (Q2/Q4)
- **Master project - if you like the topics discussed in the course reach out to Nathan and me!**

The composite image consists of four main elements:

- Book Cover:** "Perspectives on Data Science for Software Engineering" edited by Tim Menzies, Laurie Williams, and Thomas Zimmermann. The cover features a dog in a red cape and the MK logo.
- Process Flow Diagram:** A horizontal flowchart showing the selection process: 57 CERTIFIED PROJECT MANAGERS → CHECK QUALIFICATIONS → 15 EXPERTS → 6 MOST IMPORTANT RISKS IN OFFSHORING → 25 RISKS → IMPORTANCE RANKING → RANKED LIST → COMPARE PERSONAL RANKING AND AVERAGE RANKING OF THE PANEL → ADJUSTED RANKING.
- QR Code:** A square QR code located to the right of the process flow diagram.
- YouTube Channel Page:** A screenshot of the "ADS 4SE" YouTube channel page, showing a grid of 13 lecture videos. The channel has 52 subscribers. The videos include titles like "Lecture 1 - Introduction, Empiricism and Rationalism..." and "Lecture 13 - Code Reviews in Industry".

The text "And new videos!" is overlaid in large, bold, black font at the bottom right of the YouTube page screenshot.

The videos of the 2020/2021 edition are on YouTube https://www.youtube.com/channel/UCUeRK8nJKyj_i_Yz81eHa8g/ playlists This being said (a) several lectures have been adjusted in 2021/2022 or will be adjusted in 2022/2023, and these lectures are not/will not be recorded, and (b) in addition to lectures we will organise several workshops - while we are not going to check for presence, the participation in the workshops will help you to work on the assignments. There will be no new recordings in 2022/2023.

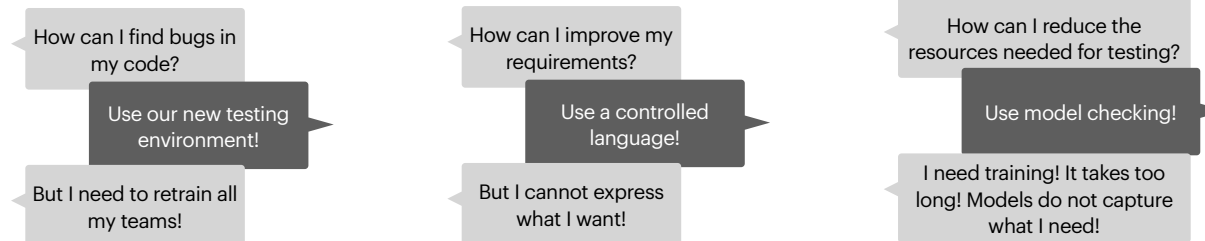
PLEASE TELL US WHAT YOU THINK



Both Nathan and I will do our best to make this course interesting for you. Please do not wait till the end of the course to provide us feedback.

SETTING UP THE STAGE

EVIDENCE NEEDED: REALITY CHECK

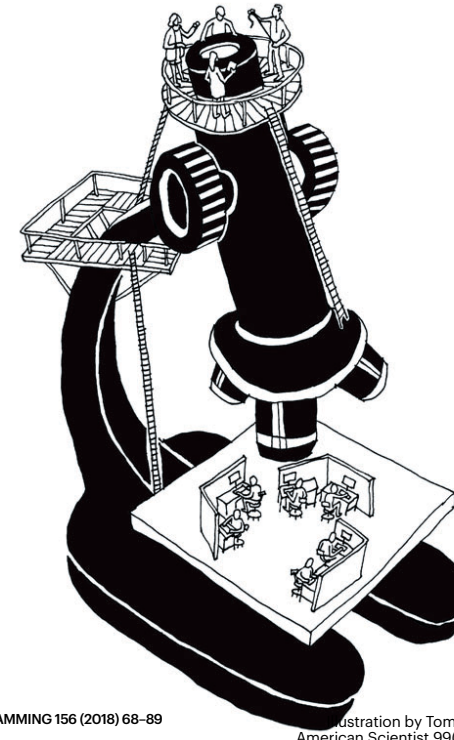


REASONING/INTUITION A PRIORI \neq OBSERVATION

Lots of good intentions
Typical consultancy scenario

EMPIRICISM

- εμπειρία (Greek) - experience
 - observation is the only source of knowledge
 - reasoning or intuition can be source of belief or conjecture
- in software engineering
 - researchers describe how software is being developed
 - to suggest best practices
 - how to develop better software (product)
 - how to develop software better (process)



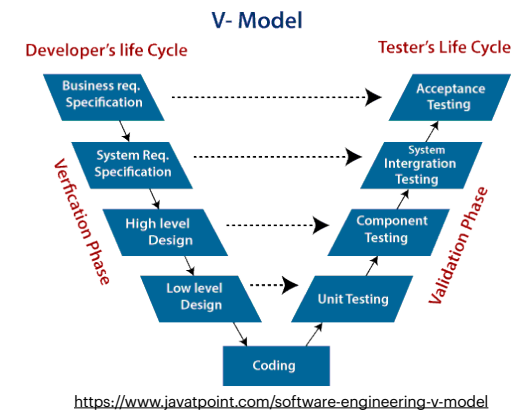
PAUL RALPH. THE TWO PARADIGMS OF SOFTWARE DEVELOPMENT RESEARCH. SCIENCE OF COMPUTER PROGRAMMING 156 (2018) 68–89

Illustration by Tom Dunne.
American Scientist 99(6):466, 2011

Empirical research is the structured way of obtaining evidence
should vs is

RATIONALISM

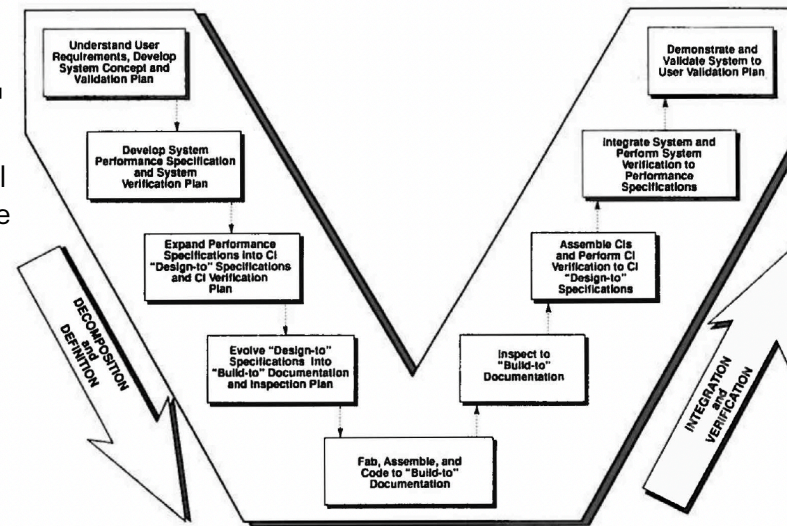
- ratio (Latin) - reason
 - knowledge can be obtained by intuition and reasoning
 - for some rationalists knowledge can also be obtained by observation
 - but this knowledge is inferior to the one obtained by intuition and reasoning
- in software engineering
 - design methods and guidelines how to develop software
 - prescriptive



One of the influential views in software engineering is rationalism.

THE V-MODEL

"A new way of portraying the technical aspect of the project cycle clarifies the role and responsibility of systems engineering to a project. <...> In our approach, the technical aspect of the project cycle is envisioned as a "vee," starting with user needs on the upper left and ending with a user-validated system on the upper right."



EMPIRICISM OR RATIONALISM?

This is an example of a rational approach to software development. The article does not refer to any kind of observations and is based on the authors' idea how the things should be done.

VIEWS ON SOFTWARE DEVELOPMENT

	Rationalism	Empiricism
Methods	Developers use methods.	Developers rarely use methods as intended if at all.
Requirements	Developers elicit requirements from the user.	Developers make sense of a problematic context.
Success	Success means delivering the required scope within the established budget and schedule.	Success is "a multidimensional variable comprising project efficiency, artefact quality, market performance and stakeholder impacts over time".
Design	Design is a phase or part of development, temporally or conceptually situated between analysis and coding.	Design encompasses the entire development process from initiation to maintenance.
Problems	Development solves given problems.	There is no "the problem", only a context that some actors view as problematic.
Attitude	How software <i>should be</i> developed (prescriptive)	How software <i>is being</i> developed (descriptive)

break

what questions are meaningful/meaningless for empirical/rational

QUESTIONS

- What is the **lower bound** of the combinatorial complexity of the fastest possible **comparison-based sorting** algorithm?

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QUESTIONS

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- Do managers' claims about how often they use UML correlate with the actual use of UML?
 - The question requires observing claims of managers and use of UML by developers - **empiricism**
- What is an effective way for teams to represent design knowledge to improve coordination?
 - This is not even about knowledge but about **design** (neither rationalism nor empiricism)
 - Next week: Lecture on Design Science

SIDE REMARK: TOOL BUILDERS

- Tend to **combine** two phases: design phase (based on rational or empirical arguments) and evaluation phase (empirical)

edited tags link edited Jun 29 at 7:40

javascript promise pg-promise

source link

Conditional task with pg-promise

I am trying to simply read a value from a table and based on the return value call for additional queries and return the combined results.

let's take a simple example: table Users has `id`, `name` and `emailid` and let's say if `emailid` is not null we want to call the email table and return a results like `{ id:[id], name:[name], email:[email]}`.

promise pg-promise



How effective is EnTagRec++?

Problem: tags on Stark Overflow are not up to date

Solution: a tool called EnTagRec++ (design)

Evaluation: effectiveness

INDUSTRY NEEDS EMPIRICAL METHODS...

The image shows a screenshot of social media replies. On the left, three replies from Tudor Girba, Jessica Joy Kerr, and another Jessica Joy Kerr are visible. On the right, two replies from Greg Wilson and Christine Gerpheide are shown in a dark-themed overlay. The replies discuss the need for empirical methods in software development, mentioning code review, observability, and performance bottlenecks.

Tudor Girba @girba · 21h
Replying to @aserebrenik
Because software is highly contextual. We can predict classes of problems, but we cannot predict the specific ones.

Jessica Joy Kerr @jessitron · 19h
Replying to @aserebrenik
We constantly have to figure out what is happening, and what will happen if we make a change.
How do we know it works? Is it working in production? Better or worse?
This is what the #observability movement is about

Jessica Joy Kerr @jessitron · 19h
Replying to @jessitron and @aserebrenik
... and that's just the parts about code. (New software engineers value those)

Greg Wilson @gwwilson@mastodon.social
@aserebrenik 1. To motivate adoption of better practices: in my experience, the evidence for the benefits of code review helped convince people to adopt it in the late 1990s/early 2000s.
2. To dispel myths: I frequently quote Prechelt's work on programmer productivity as a counter to claims about "10X" developers.
3. As part of creating a data-driven mindset for e.g. analyzing performance bottlenecks in distributed systems. (This isn't really SE, but the methods are allied.)

Christine Gerpheide 工理寿 she/her @phoxicle · 8h
Replying to @aserebrenik
- Build tools to recognize when quality may be low or complex edge cases are likely. Eg code review tools.
- Data to justify refactoring
- Understand developer community behavior, identify problem areas (tech or organizational)
- Why not to measure engineer performance by LOC

Essentially, this is a matter of reflection: self-reflection, management etc. Understanding what works and what does not. I have asked on social media why would the industry need empirical methods.



Mauricio Aniche
Carianne Pretorius
Adyen

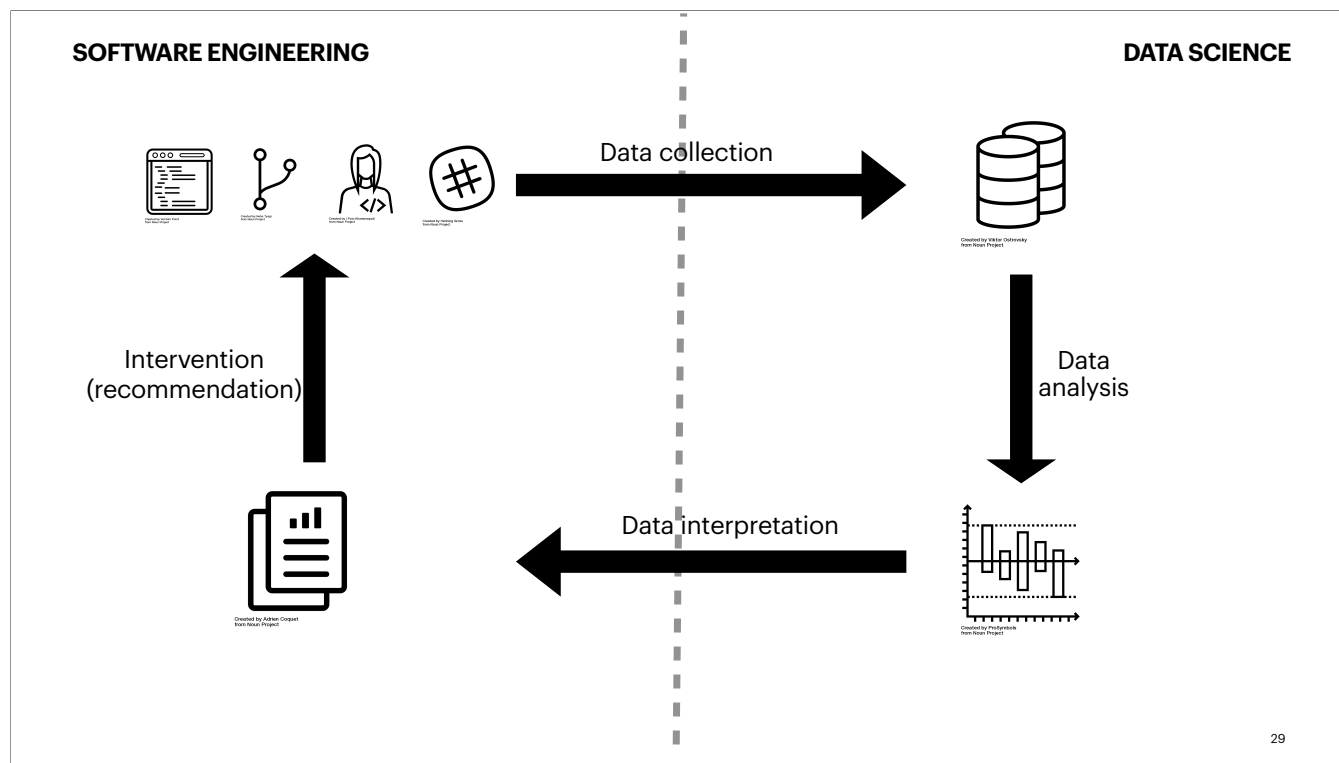
Next Tuesday we will have guests from the industry



In this course we adopt empiricism. The proof of the pudding is in the eating



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Empirical SE is an interplay between SE and Data Science

SOFTWARE ENGINEERING

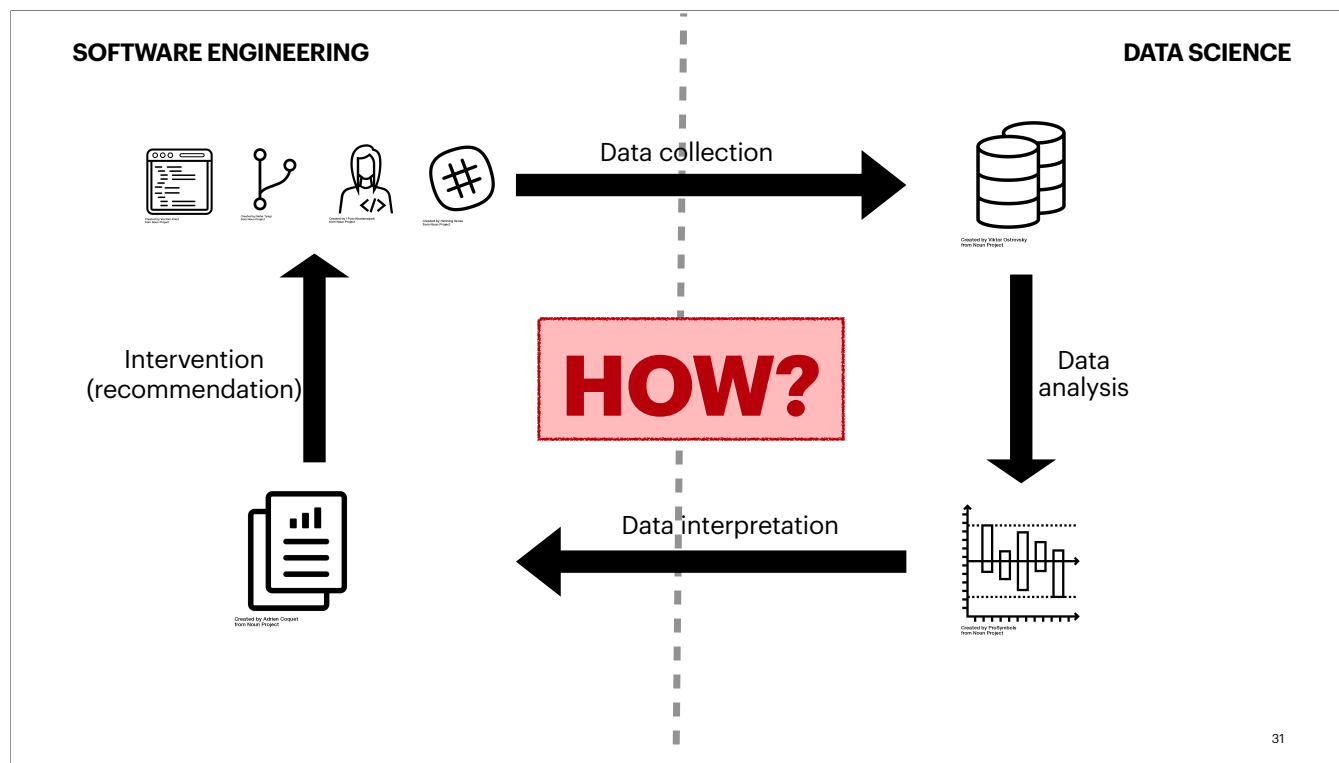
Obtain empirical evidence about what works in Software Engineering and what does not.

- How effective is modularisation?
- Does Test-Driven Development really work?
- Where do most software flaws come from?
- Are some programming languages make better programs than others?
- Why are my code reviews not finding defects?
- ...

DATA SCIENCE

Design tools and techniques for data that is

- Large
 - GitHub: 200M repositories, 83M users
 - Stack Overflow: 23M questions
- Diverse
 - Structured meta-data
 - Source code
 - Natural language texts (e.g., transcripts)
 - Schemes and diagrams
 - Videos (e.g., YouTube instructions)
- Publicly available
 - 128M public repositories on GitHub
- Rapidly evolving
 - Stack Overflow: 6-7K questions/day



So how do we collect, analyse and interpret data and how do we design interventions? We will mostly focus on design, analysis and interpretation



**BEFORE WE START:
FIVE RECENT EMPIRICAL STUDIES**

3.9 out of 5

105 Ratings



Click to Rate:



[App Support](#)

Sort by Most Helpful

Pas mal

★★★★☆

Je viens juste de l'installer (Imac 2011). J'ai créé facilement une lettre type. Pas de problème. Habitué à travailler sur des programmes de traitement de texte comme WORD ou plus professionnellement sur Xpress, j'ai su rapidement trouver mes marques. L'installation a été faite assez intuitivement après quelques minutes.

Impossible d'ouvrir certains documents

★☆☆☆☆

Je ne sais pas qu'est ce qu'il se passe, mais certaines pages n'ouvrent plus les documents sur lesquels j'ai travaillé. Le programme réagit, le programme est ouvert, mais les documents ne s'ouvrent plus. C'est embêtant. J'en ai besoin de manière régulière. Est ce que c'est parce que mon mac os ne supporte plus ce format ?

Grosses améliorations à faire

★★★☆☆

Je travaille essentiellement avec des tableaux de texte et quelle galère ! Une fois le texte ne passe pas sur la page suivante, une fois les rangs se désolidarisent, lorsqu'on change la taille d'un rang celui d'à côté diminue, on ne peut même pas choisir combien de

Crash

★★★☆☆

Since the last update, I cannot create any new file!! Please, could you solve that problem fast? Thank you very much in advance.

Plus possible de télécharger

★★★★☆

Impossible d'avoir un lien de téléchargement pour Pages! Il faut nécessairement passer par Internet et l'utiliser Online?

Retour à la version 4.3 !

2y ago

Benoit

Après la sortie de cette version de Pages, j'en ai utilisé la précédente (la 4.3 de Pages 09), et j'ai été agréablement surpris par le ravivement de façade. Cependant, sous certains aspects, la version 7 souffre encore de quelques défauts :

Voici quelques matières

[more](#)

2y ago

xavez_

I have used the reformatted Microsoft Word processing software. Absolutely love it! I use it for my business. From running my business, to typing up my business plan, it is the proverbial glass of water in the desert. Thank you, Apple!

[more](#)

Study 1

3.9 out of 5 105 Ratings

Click to Rate:
[★](#) [★](#) [★](#) [★](#) [★](#) [Write a Review](#)
 [App Support](#)

[Sort by Most Helpful](#)

Pas mal 1y ago
Reikingham

★★★★☆

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Appropriate to make good looking documents with 2y ago
becaphil

★★★★★

The first version of Pages were excellent. At version 5, it lost many useful features, but since that time it improved substantially. Assuming that it keeps improving, it is for sure worth buying. One could argue that it regained its two key advantages over competitors: 1) a lot easier than « pro » apps for what most people need and better aimed at producing nice documents. [more](#)

Déçu de la 7, j'utilise toujours la version 4.3 ! 2y ago
Benoit

★★★☆☆

Dingue... 4 ans après la sortie de cette version de Pages, j'en suis resté à la version précédente (la 4.3 de Pages 09), principalement à cause du ravalement de façade. Plus puissante sur certains aspects, la version 7 souffre encore de certains manquants criants :
- la gestion des styles
- la gestion des tables des matières [more](#)

Impossible d'ouvrir certains documents 2y ago
Multiprises

★★★☆☆

Je ne sais pas qu'est ce qu'il se passe, mais dernièrement, pages n'ouvre plus les documents sur lesquels je clique. Ca réagit, le programme est ouvert, mais les documents ne s'ouvrent plus. C'est embêtant. J'en ai besoin de manière urgente et aucune solution ! Est ce que c'est parce que mon mac os ne peut pas aller à jour ? [more](#)

Please fix Pages!! 2y ago
Koda_1993

★★★☆☆

Randomly Pages is unable to create a new file or open a pages file. Sometimes after restarting the computer it works again, but not every time. Recently I've been unable to open any Pages files. The scenario was simple: In the morning I open a standard file to write into it and close it to go eating something. [more](#)

Thank you for this, Apple 2y ago
xavez_

★★★★★

If you can let go of your malformed Microsoft Word processing habits, this is a magnificent programme. Absolutely love it! I use Pages for so many things. From running my business, to typing day to day letters. This truly is the proverbial glass of water after crossing the Microsoft desert. Thank you, Apple! [more](#)

Grosses améliorations à faire 5 Sep
Loulouch13

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Crash 2y ago
Geoffrey Degives

★★★☆☆

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Plus possible de télécharger 1y ago
MichelZin

★★★☆☆

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34

Who recognises this? (Belgian) apple app store. Reviews of one of the apps (actually it is Pages)

3.9 out of 5 105 Ratings

Click to Rate: App Support

Why users give low ratings to an app?

Sort by Most Helpful

Pas mal ★★★★★ 2y ago becapuil

Je viens juste de l'installer (Imac 2011). J'ai créé facilement une lettre type. Pas de bug. Habitué à travailler sur des programmes de mise en page comme WORD ou plus professionnellement avec quark Xpress, J'ai su rapidement trouver mes marques. La mise en page se fait assez intuitivement après quelques minutes de prise [more](#)

Déçu de la 7, j'utilise toujours la version 4.3 ! ★★★★★ 2y ago Benoit

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Crash ★★★★★ 2y ago Geoffrey Degives

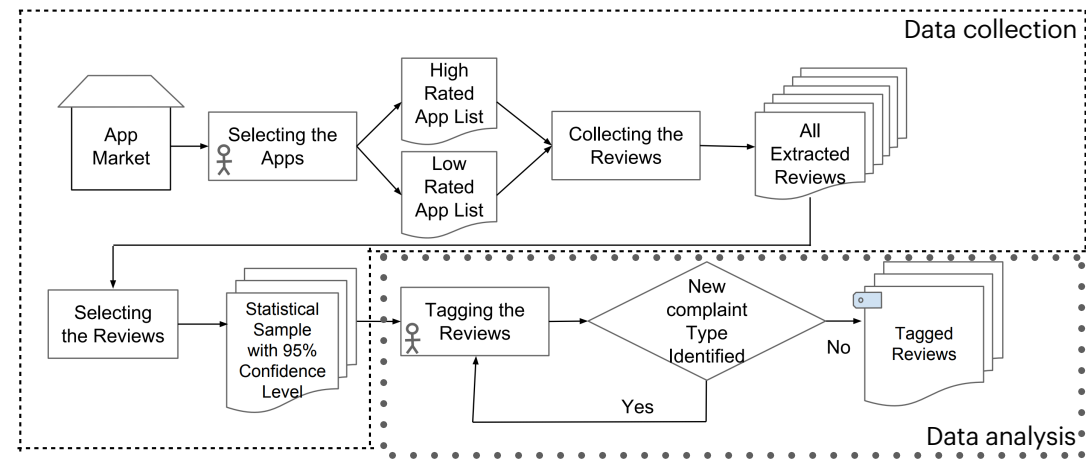
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Plus possible de télécharger ★★★★★ 1y ago MichelZin

Impossible d'avoir un lien de téléchargement pour Pages! Il faut nécessairement passer par Internet et l'utiliser Online? 35

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METHODOLOGY



HAMMAD KHALID, EMAD SHIHAB, MEIYAPPAN NAGAPPAN, AHMED E. HASSAN: WHAT DO MOBILE APP USERS COMPLAIN ABOUT? IEEE SOFTWARE 32(3): 70-77 (2015)

36

We pick the 20 most popular iOS apps. High (>3.5 stars), low (3.5 stars or less). Collect all reviews. Select review with 1 or 2 stars, in total > 250K. Sample for manual analysis 6390 reviews (stratified, i.e., every app receives the correct sample of its reviews). Human figure represents manual steps.

3.9 out of 5 105 Ratings

Click to Rate: App Support

Why users give low ratings to an app?

Sort by Most Helpful

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functional error

Please fix Pages!! ★☆☆☆☆ 2y ago

Randomly Pages crashes when opening a file. Sometimes after restoring the computer it works again, but not every time. Recently I've been unable to open any Pages files. The scenario was simple: In the morning I open a standard file to write into it and close it to go eating something. [more](#)

functional error

Thank you for this, Apple ★★★★★ 2y ago

If you can let go of your malformed Microsoft Word processing habits, this is a magnificent programme. Absolutely love it! I use Pages for so many things. From running my business, to typing day to day letters. This truly is the proverbial glass of water after crossing the Microsoft desert. Thank you, Apple! [more](#)

Grosses améliorations à faire ★☆☆☆☆ 5 Sep

Je travaille essentiellement sur des documents de type galère ! Une fois le texte ne passe pas sur la page suivante, une fois les rangs se désolidarisent, lorsqu'on change la taille d'un rang celui d'avant diminue, on ne peut même pas choisir combien de rangs on veut. [more](#)

functional error

Crash ★☆☆☆☆ 2y ago

Since the last update, Pages crashes when I try to open a document. I can't advance. [more](#)

app crashing

Plus possible de télécharger ★☆☆☆☆ 1y ago

Impossible d'ouvrir les documents en ligne, il faut nécessairement passer par Internet et l'utiliser Online? [more](#)

feature removal

most common type of complaints

RESULTS: COMPLAINT TYPES

Complaint Type	Most frequent		Most impactful	
	Rank	Median (%)	Rank	1:2 star
Functional Error	1	26.68	7	2.1
Feature Request	2	15.13	12	1.28
App Crashing	3	10.51	4	2.85
Network Problem	4	7.39	6	2.25
Interface Design	5	3.44	10	1.5
Feature Removal	6	2.73	3	4.23
Hidden Cost	7	1.54	2	5.63
Compatibility	8	1.39	5	2.44
Privacy and Ethical	9	1.19	1	8.56
Unresponsive App	10	0.73	11	1.4
Uninteresting Content	11	0.29	9	1.5
Resource Heavy	12	0.28	8	2
Not specific	-	13.28	-	3.8

- **Most common:** functional error, feature request, app crashing, network problem
- **Most impactful:** privacy and ethics, feature removal, hidden cost, app crashing

explain ethics

unethical actions of the app developer (e.g., unethical business practices or selling the user's personal data)

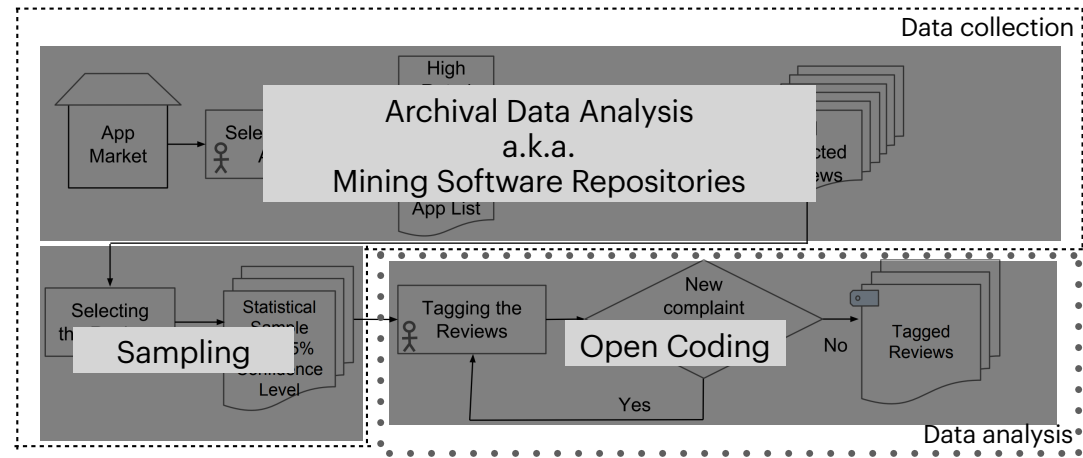
example of privacy & ethical problem: an app that uses FB friends' list

WHAT CAN DEVELOPERS DO?

- **Most common:** functional error, feature request, app crashing, network problem
 - functional error, app crashing, network problem can be directly addressed by developers
 - feature request - strategy of app evolution, developers might influence it
- **Most impactful:** privacy and ethics, feature removal, hidden cost, app crashing
 - only app crashing can be directly addressed by developers
 - feature removal - strategy of app evolution, developers might influence it
 - privacy and ethics, hidden cost - value of the app itself, outside of developers' control
- **Focus on the most impactful complaints**

hidden cost - costs incurred by the functionality of a free app, for example purchase of game coins with real money

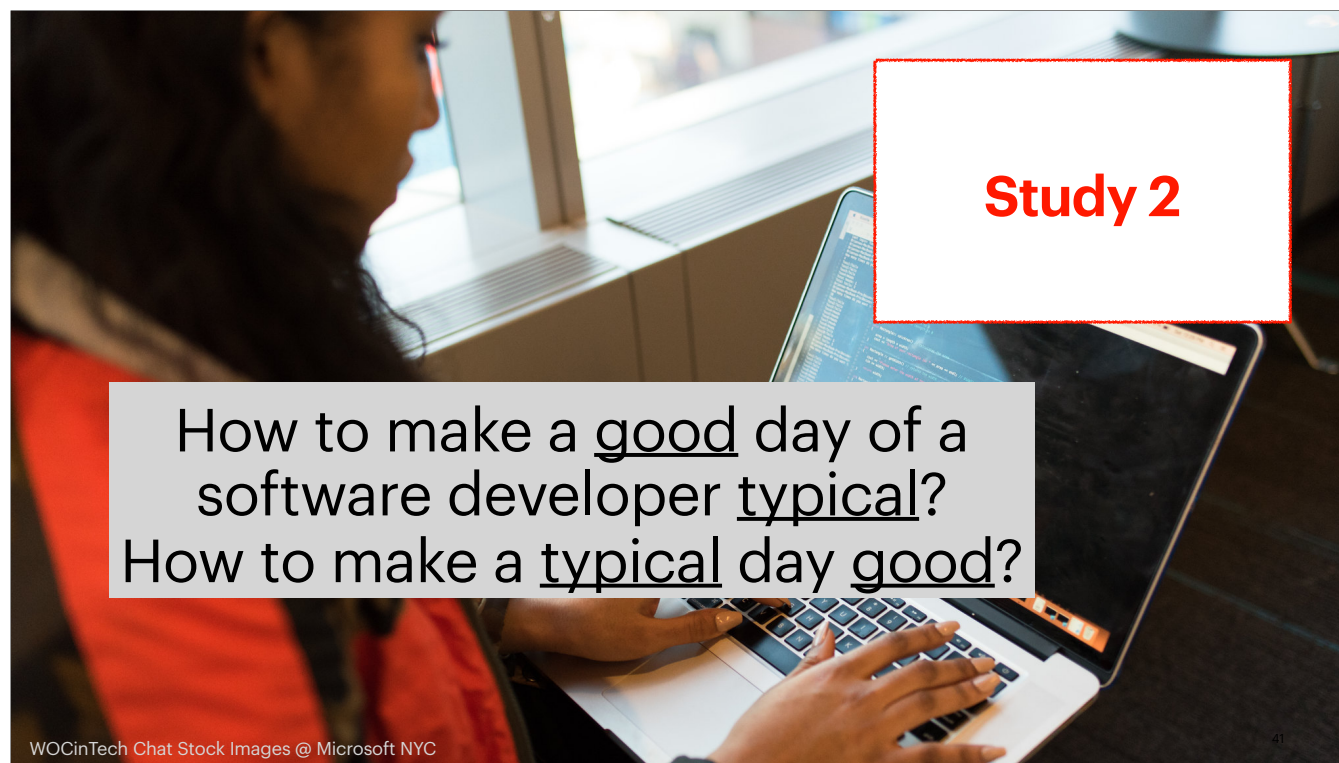
WHICH DATA SCIENCE TECHNIQUES WERE USED?



HAMMAD KHALID, EMAD SHIHAB, MEIYAPPAN NAGAPPAN, AHMED E. HASSAN: WHAT DO MOBILE APP USERS COMPLAIN ABOUT? IEEE SOFTWARE 32(3): 70-77 (2015)

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Sampling as a way of addressing too many reviews
Open coding is a form of qualitative analysis

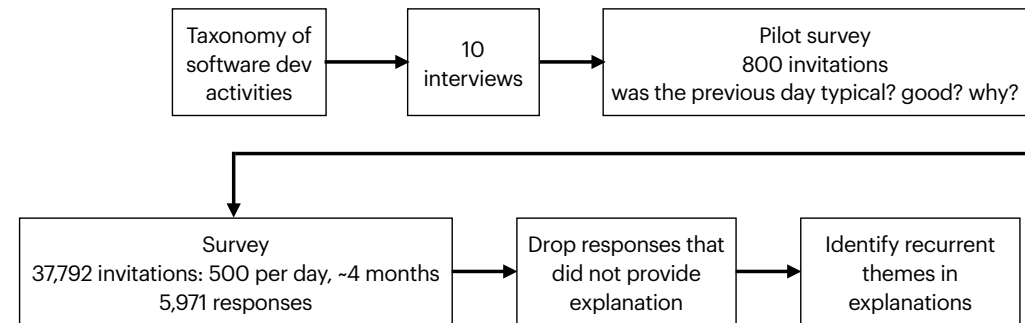


Study 2

How to make a good day of a software developer typical?
How to make a typical day good?

Software development is a human activity and it is important for developers to be happy. Otherwise, both the software development process and software products lose quality (Graziotin et al.) This is a study of Microsoft. Microsoft would like to make developers happy, by making their typical days good and good days - typical.

RESEARCH METHOD

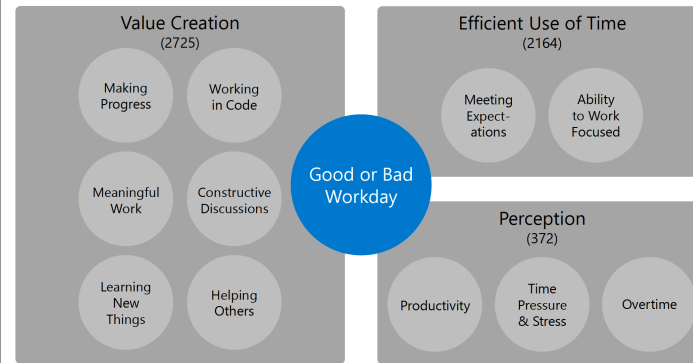


ANDRÉ N. MEYER, EARL T. BARR, CHRISTIAN BIRD, THOMAS ZIMMERMANN: TODAY WAS A GOOD DAY: THE DAILY LIFE OF SOFTWARE DEVELOPERS. IEEE TRANSACTIONS ON SOFTWARE ENGINEERING, 2020

we conducted interviews with developers until the data saturation point was reached [45]. That is, once new interviews yield no additional information, further interviews will yield only marginal (if any) value. 7 saturations, went up to 10.

pilot the survey and identify any potential problems, we then sent the survey to 800 developers over the course of one week with an additional question asking if any aspect of the survey was difficult or confusing and soliciting general feedback.

RESULTS: GOOD DAY



ANDRÉ N. MEYER, EARL T. BARR, CHRISTIAN BIRD, THOMAS ZIMMERMANN: TODAY WAS A GOOD DAY: THE DAILY LIFE OF SOFTWARE DEVELOPERS. IEEE TRANSACTIONS ON SOFTWARE ENGINEERING, 2020

Fig. 1. Conceptual framework for good workdays. The 3 high-level factors are visualized as square layers; outer layers influence the inner layers.

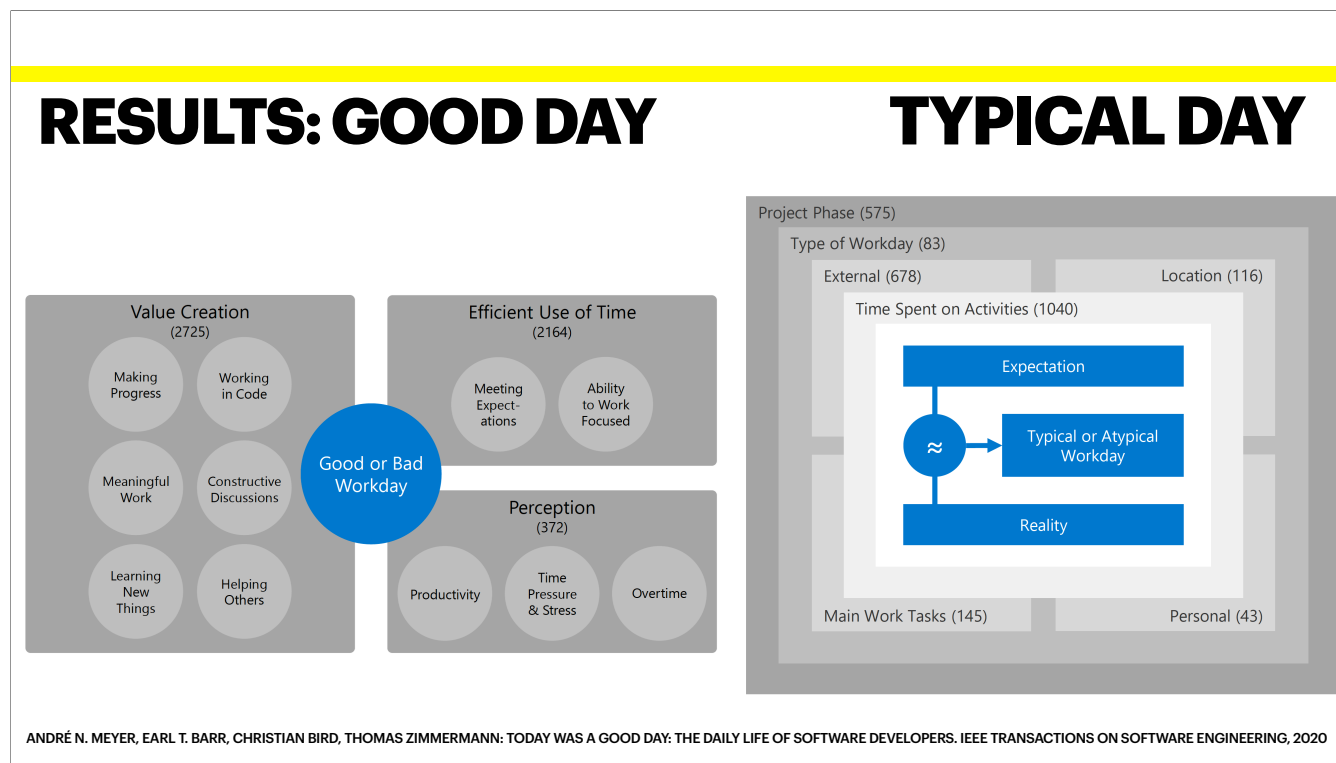


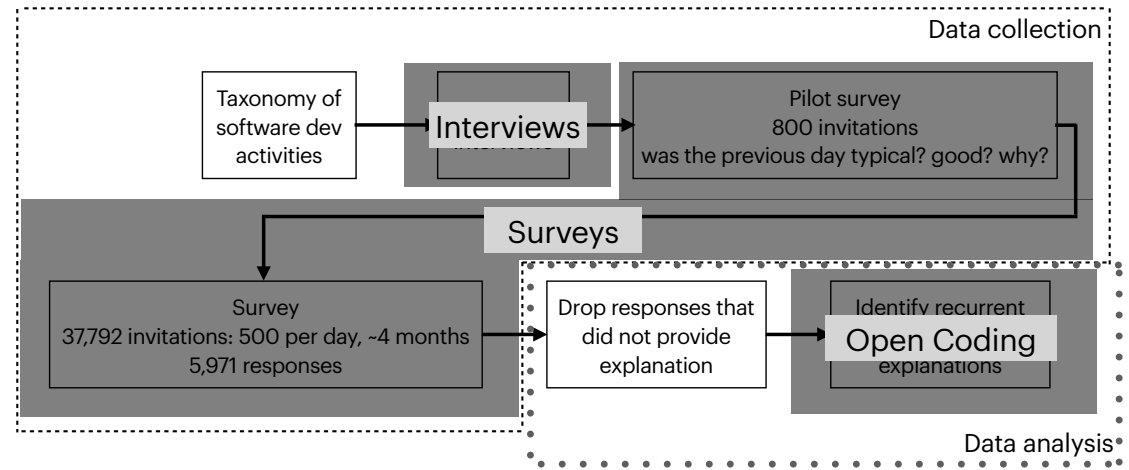
Fig. 2. Conceptual framework characterizing typical workdays. The main factors are visualized as layers; the outer layers influence all inner layers.

WHAT CAN MANAGERS DO?

- **Make good days typical** (more routine)
 - minimise administrative tasks and infrastructure issues
 - reduce interruptions and meetings
- **Make atypical days good**
 - work from home when one needs a lot of focus and attention
 - no-meeting days
 - do a bit of coding during the planning phase
 - use slow time (e.g., project wrap-up) for side projects
- **Meetings are not necessarily evil**
 - during non-development phases they are good and (usually) productive

ANDRÉ N. MEYER, EARL T. BARR, CHRISTIAN BIRD, THOMAS ZIMMERMANN: TODAY WAS A GOOD DAY: THE DAILY LIFE OF SOFTWARE DEVELOPERS. IEEE TRANSACTIONS ON SOFTWARE ENGINEERING, 2020

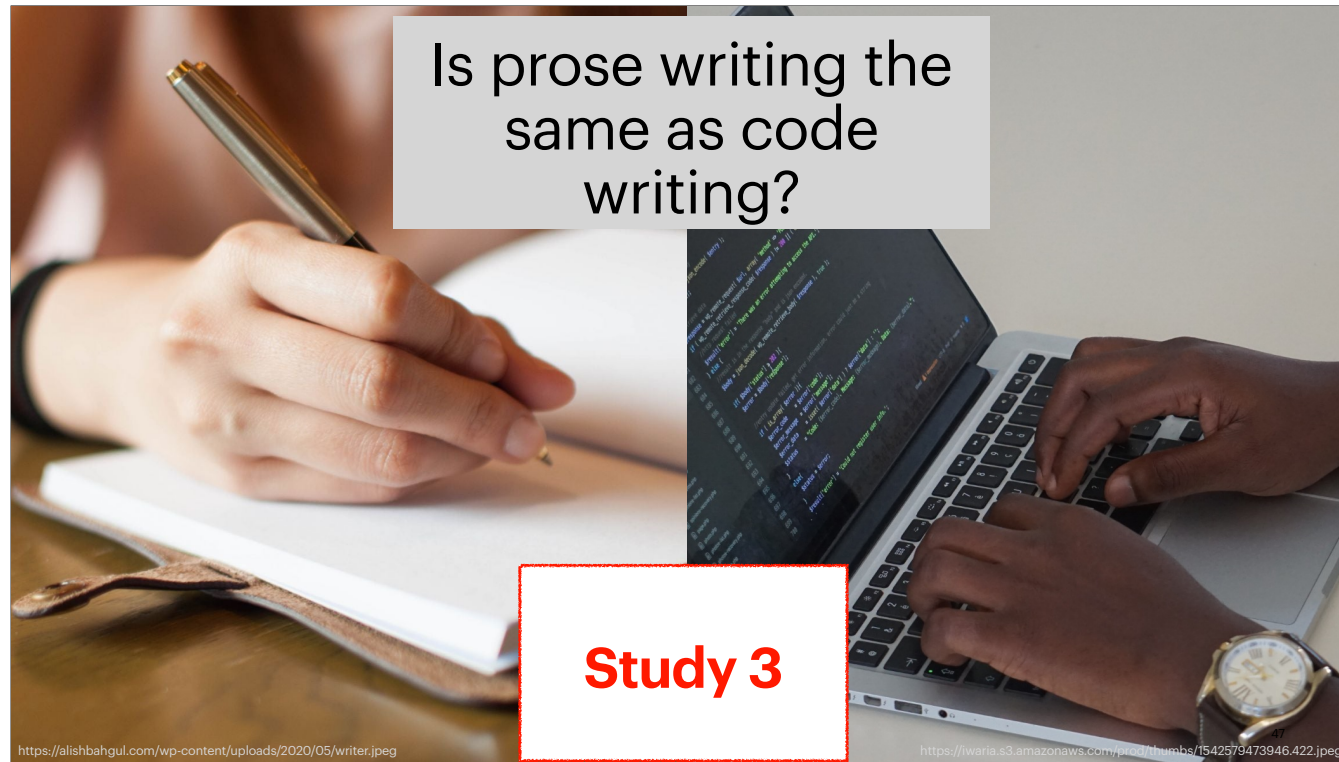
WHICH DATA SCIENCE TECHNIQUES DID THEY USE?



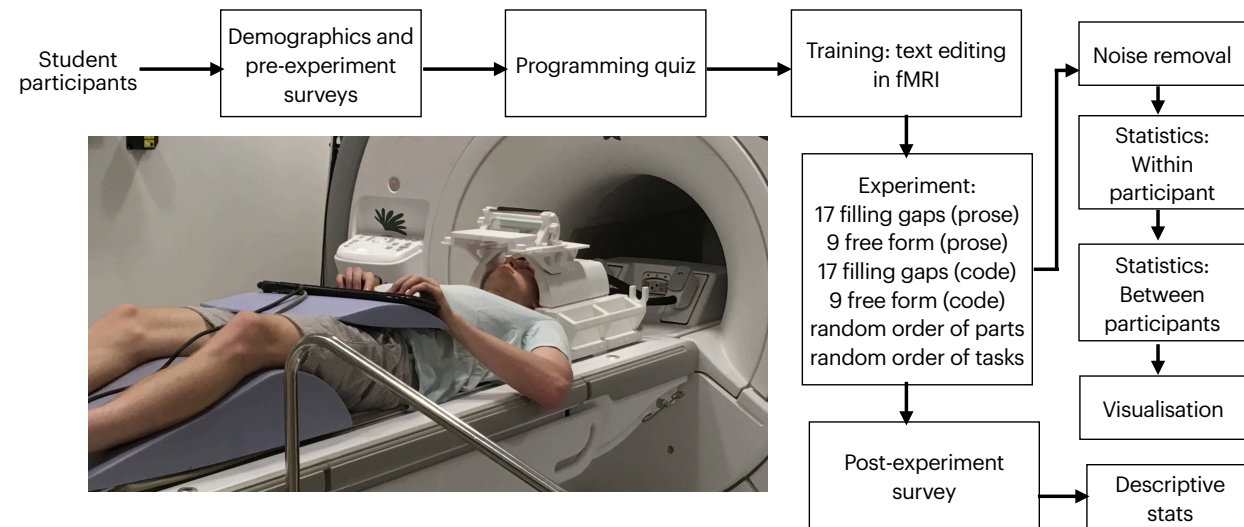
ANDRÉ N. MEYER, EARL T. BARR, CHRISTIAN BIRD, THOMAS ZIMMERMANN: TODAY WAS A GOOD DAY: THE DAILY LIFE OF SOFTWARE DEVELOPERS. IEEE TRANSACTIONS ON SOFTWARE ENGINEERING, 2020

Is prose writing the same as code writing?

Study 3



RESEARCH METHOD



RYAN KRUEGER, YU HUANG, XINYU LIU, TYLER SANTANDER, WESTLEY WEIMER, KEVIN LEACH. NEUROLOGICAL DIVIDE - AN FMRI STUDY OF PROSE AND CODE WRITING. INT CONF SOFTWARE ENGINEERING 2020

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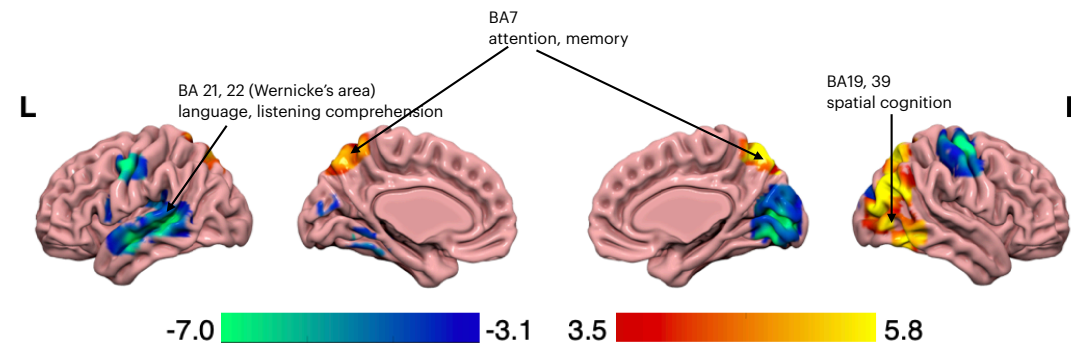
fMRI - functional magnetic resonance imaging

we collected basic demographic data (sex, gender, age, cumulative GPA, and years of experience) and socioeconomic status (SES) data + three standard psychological measurement surveys: Positive and Negative Affect Scale (PANAS, emotional health), Autism Spectrum Disorder (ASD), and Need for Cognition (NFC, inclination for effortful cognition)

programming quiz - knowledge of C/C++

RESULTS: FREE FORM

- Cold: more prose than code
- Hot: more code than prose



RYAN KRUEGER, YU HUANG, XINYU LIU, TYLER SANTANDER, WESTLEY WEIMER, KEVIN LEACH. NEUROLOGICAL DIVIDE - AN FMRI STUDY OF PROSE AND CODE WRITING. INT CONF SOFTWARE ENGINEERING 2020

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BA Brodmann area HEMISPHERE

The authors visualise results of statistical analysis using heat-based representation. Free-form prose writing involves areas associated with language. Coding involves areas associated with attention, memory, planning, and spatial ability.

(1) and (2) are left hemisphere, (3) and (4) are right hemisphere

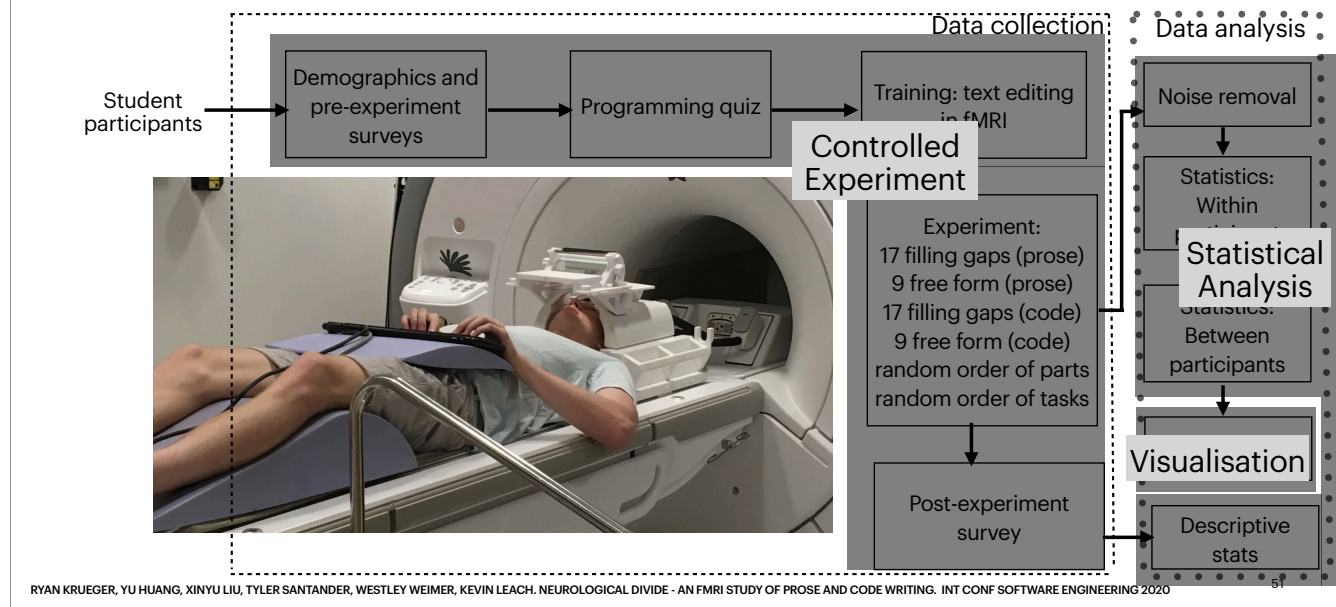
Areas are merely examples, there are more in the paper

WHAT DOES THIS MEAN FOR RESEARCHERS?

- The **brain** does not treat code writing and prose writing as similar
 - Free-form prose writing involves areas associated with language. Coding involves areas associated with attention, memory, planning, and spatial ability.
 - Filling gaps in code requires more activity in areas associated with careful top-down control, planning, and categorisation.
- However, 38.5% **respondents report similarities** between writing code and writing prose
- **Self-reporting is unreliable!** Surveys need to be augmented with objective data analysis.

rename

WHICH DATA SCIENCE TECHNIQUES DID THEY USE?



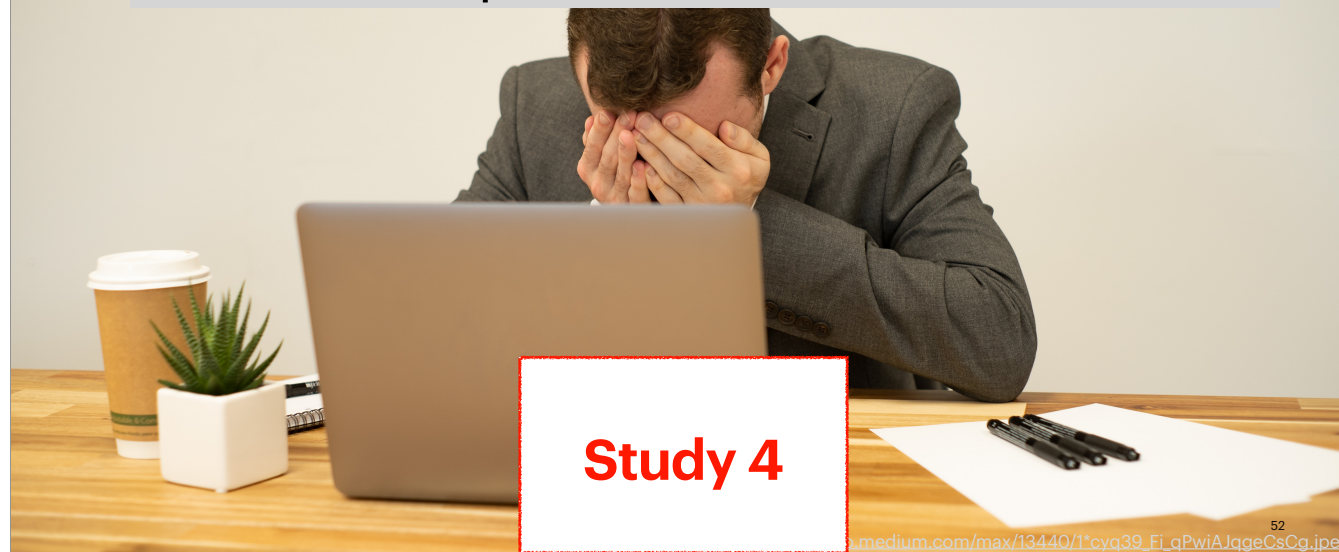
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Participants: students

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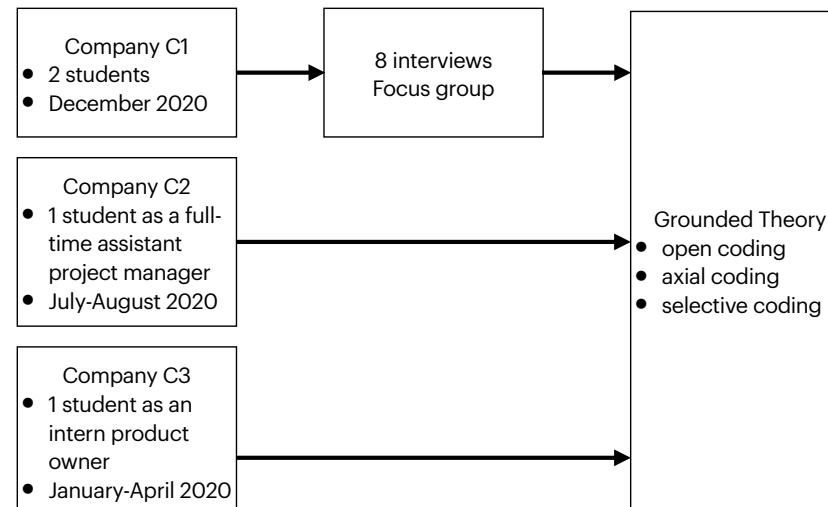
programming quiz - knowledge of C/C++

What issues do these software teams have when adopting DevOps and microservices?



DevOps is a set of practices that combines software development (Dev) and IT operations (Ops). It aims to shorten the systems development life cycle and provide continuous delivery with high software quality. A **microservice** architecture – a variant of the SOA structural style – is an architectural pattern that arranges an application as a collection of loosely-coupled, fine-grained services, communicating through lightweight protocols.

RESEARCH METHOD

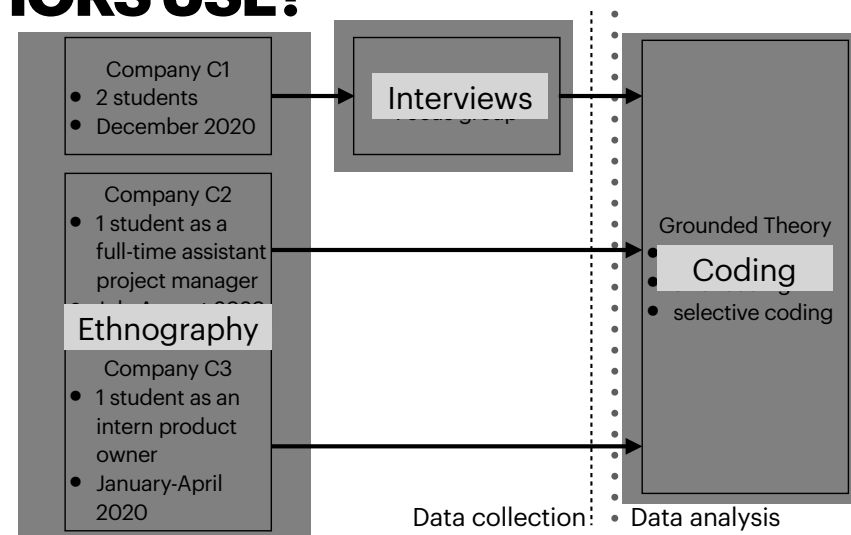


ISSUES IN ADOPTING DEVOPS AND MICROSERVICES?

- Implementation is often **fragmentary**, disconnecting planning and Dev, Dev and Ops, sometimes due to **department boundaries**
- **Abuse of technology** because it is perceived as fancy
- **Recommendations** for practitioners:
 - establish more connections between different phases of the DevOps project
 - reconsider appropriateness of architectural choices

First, software organizations are keen to improve DevOps pipelines (automation, security, etc.), but may have less interest in other essentials (e.g., cross-stream communications) that DevOps advocates for the holistic improvement. The complete DevOps pipeline was detached into several segments that are barely connected to each other (Figure 6). The first chasm is between planning and coding. Although C2 builds an association between JIRA and GitLab, the correlation between requirements and code in the pipeline is elusive. The self-developed project management system in C3 has little to no connection with the code repository. Another chasm is between operations and others. For example, operational issues could only be resolved in weekly operations meetings in C3. Moreover, the operations of the Internet infrastructure produced in C1 and C2 are independent from their development. This chasm raises questions about whether DevOps is indeed adopted in organizations because of the separation of 'Dev' and 'Ops'.

WHICH DATA SCIENCE TECHNIQUES DID THE AUTHORS USE?



XIN ZHOU, HUANG HUANG, HE ZHANG, XIN HUANG, DONG SHAO, CHENXING ZHONG: A CROSS-COMPANY ETHNOGRAPHIC STUDY ON SOFTWARE TEAMS FOR DEVOPS AND MICROSERVICES: ORGANIZATION, BENEFITS, AND ISSUES. ICSE (SEIP) 2022: 1-10

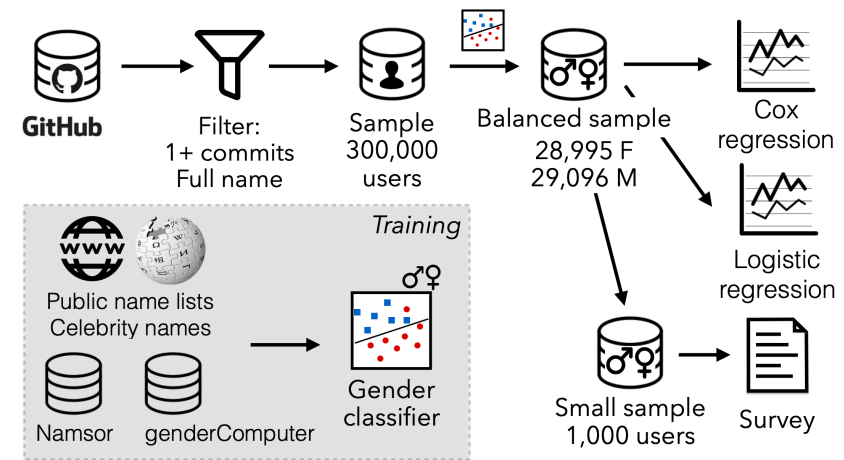
55

Not common in SE: expensive. Refer to Samar Jameel's thesis



OSS

RESEARCH METHOD



HUILIAN SOPHIE QIU, ALEXANDER NOLTE, ANITA BROWN, ALEXANDER SEREBRENIK, BOGDAN VASILESCU. GOING FARTHER TOGETHER - THE IMPACT OF SOCIAL CAPITAL ON SUSTAINED PARTICIPATION IN OPEN SOURCE. INT CONF SOFTWARE ENGINEERING 2019

RESULTS OF STATISTICAL ANALYSIS

TABLE III: Regression models for early-stage disengagement ($N = 29,235$ users; 140,441 data rows) and later-stage disengagement ($N = 26,299$ users; 143,984 data rows).

	Early-stage (GLM)		Later-stage (Cox)	
	response: <i>Disengaged</i> = 1		response: <i>Disengaged</i> = 1	
	Coeffs (Err.)	LR Chisq	Coeffs (Err.)	LR Chisq
(Intercept)	1.61 (0.07)***		0.70 (0.02)***	394.39***
Followers	0.61 (0.02)***	990.53***	0.86 (0.02)***	103.26***
Stars	0.89 (0.02)***	45.18***	0.64 (0.02)***	718.15***
Commits to date	0.63 (0.01)***	1635.38***	0.63 (0.06)***	62.96***
Is major contrib.	0.77 (0.05)***	29.05***	0.51 (0.04)***	310.35***
Is repo owner	0.56 (0.03)***	363.80***	0.54 (0.05)***	132.70***
Niche width	0.47 (0.05)***	244.20***	1.32 (0.04)***	59.96***
Is female	1.27 (0.03)***	68.79***	0.79 (0.09)**	13.22***
Team familiarity	0.84 (0.08)*	4.83*	0.86 (0.04)***	28.46***
Rec. cohesion	0.85 (0.04)***	30.77***	0.78 (0.04)***	35.70***
Share newcomers	1.07 (0.04)	3.37	0.63 (0.14)***	44.43***
Lang. heterogen.	0.70 (0.11)**	44.44***	0.69 (0.18)*	4.30*
Lang. heter.:Female	0.73 (0.15)*	4.36*		
Female:Team fam.	1.09 (0.11)		1.05 (0.17)	
Female:Cohesion	1.02 (0.05)		1.01 (0.04)	

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Early - logistic regression for contributors who disengage within their first three months of activity

Late - a Cox regression for contributors who disengage later

Interpretation: if the coefficient < 1 then “more X less likely to disengage”, if the coefficient > 1 “more X more likely to disengage”

More popular (i.e., followers), active (i.e., commits to date) and versatile (i.e., niche width) developers are less likely to disengage. Similarly, project owners, major contributors and contributors to highly starred projects are less likely to disengage. Moreover, as expected, female contributors are at higher risk of disengagement than males.

Contributing to projects where team members are more familiar pairwise with each other from prior collaborations (Team familiarity), or projects where cliques of three or more developers recur from prior projects (Recurring cohesion), is associated with decreased risk of disengagement.

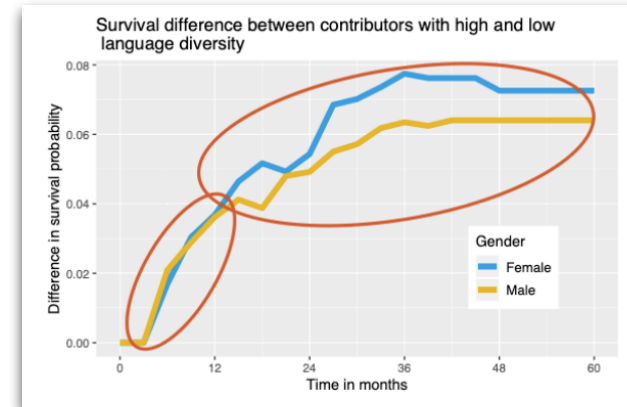
The variables related to team diversity also have statistically significant effects. Heterogeneity in the programming language backgrounds of project team members is associated with decreased risk of disengagement both short and long term. Moreover, language heterogeneity has a statistically significant interaction with gender: women are more likely to disengage when language heterogeneity is low. Contributing to projects with high turnover (Share of newcomers) is associated with higher risk of disengagement after the first three months.

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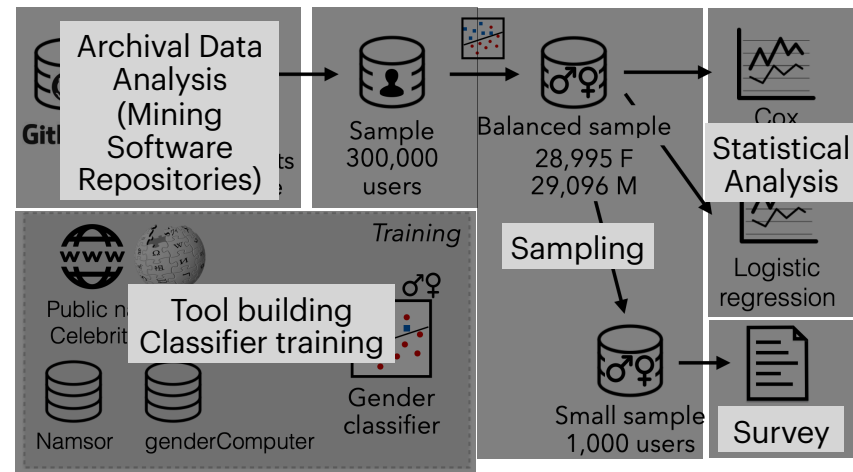
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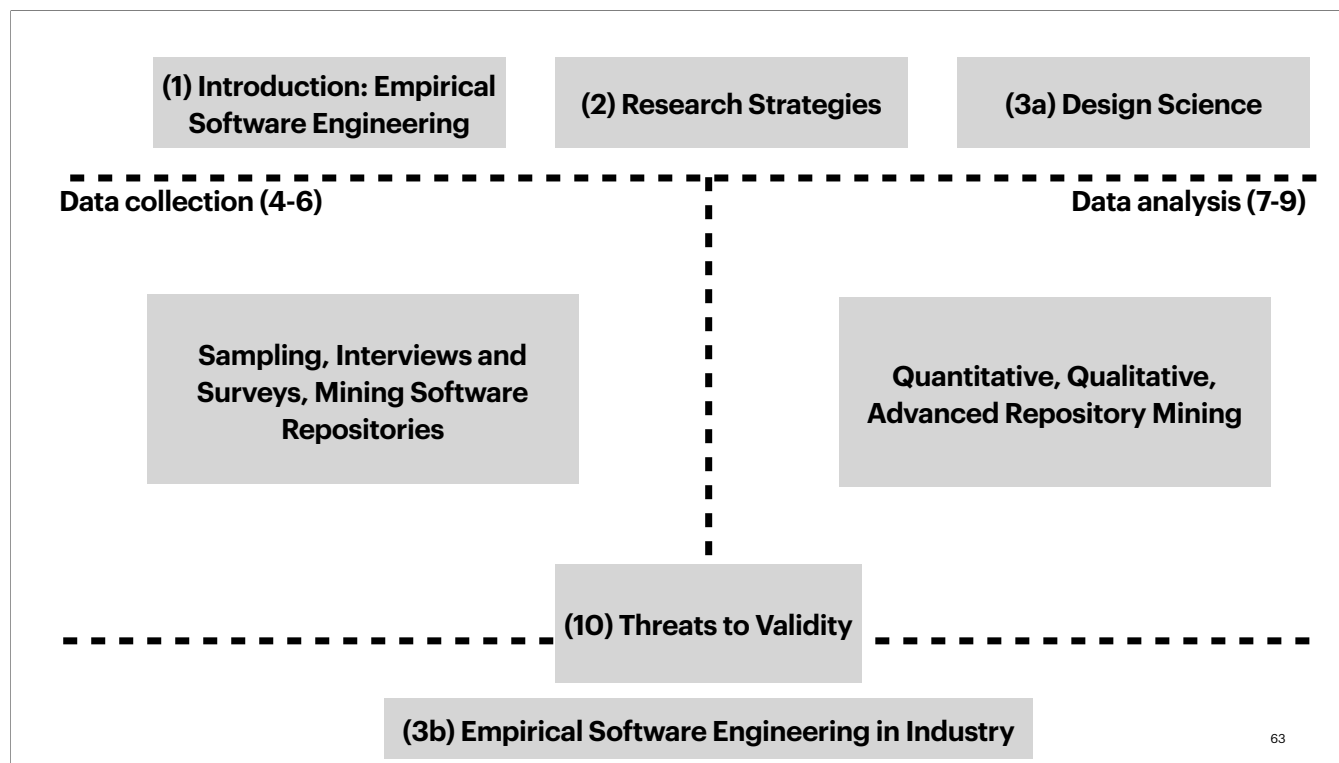
SUMMARY OF THE STUDIES

	App reviews	Good day/ Typical day	Code and prose	DevOps and microservices	Gender and GitHub
Data source	Apple app store	Experiences of developers	Brain activity of developers	Communication and development	GitHub
Data collection	Archival data analysis (Repository mining), sampling	Interviews, surveys	Controlled experiment, post-experiment survey	Ethnography, interviews	Archival data analysis (Repository mining), sampling, survey
Data analysis	Open coding	Open coding	Statistical analysis, visualisation	Ground Theory	Statistical analysis, machine learning
Beneficiaries	Developers	Managers	Researchers	Architects	Developers, women in particular
Recommendation	Focus on the most impactful complaints	Make good days typical and atypical days good	Surveys should be augmented with objective measures	Reconsider appropriateness of the solution and add connections	Join projects that use different programming languages

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Recommendation	Focus on the most impactful complaints	and atypical days good	augmented with objective measures	the solution and add connections	Join projects that use different programming languages

So many methods...
Which one to choose?
Next lecture...



Plus three workshops and a coffee-hour

EMPIRICAL PEOPLE @ CS

- **Software engineering:** Serebrenik, Chaudron, Cleophas, Krüger, Nolte, Ochoa
 - **PhD students:** Cassee, van den Haak, Mohayеji, Paganini, Rukmono
- **Security:** Allodi, Zannone
- **Databases:** Fletcher

SUMMARY

- Empirical Methods in Software Engineering
 - **empiricism** vs. rationalism: observation vs. intuition/reason as a source of knowledge
 - **research**: not all questions are meaningful in all paradigms!
 - **practice**: we need to understand what works/what does not
 - evidence-based medicine, reproducibility crisis in psychology, ...
 - **Data collection**: repository mining, interviews, surveys, controlled experiment, ethnography...
 - **Data analysis**: statistical analysis, visualisation, open coding, machine learning, ...