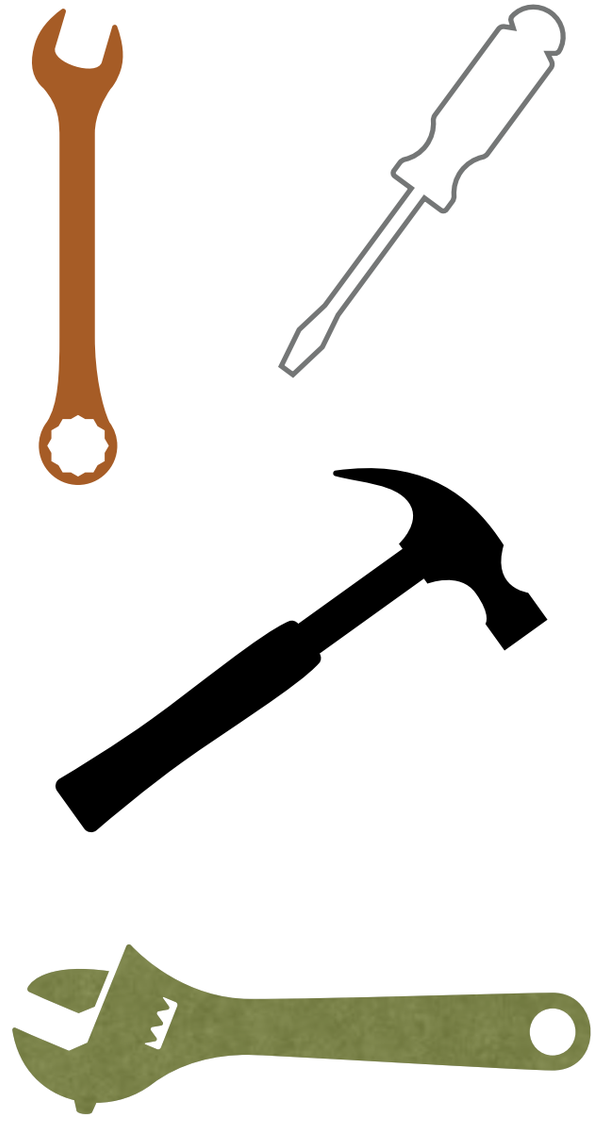
TOOL CHOICE MATTERS

Kavaler, Trockman, Vasilescu, Filkov



SOFTWARE DEVELOPMENT KEEPS CHANGING

- Waterfall
  - OOP
    - flexible off the shelf
      - modular
        - collaborative
          - agile
            - platform independence
              - containers
                - automation, independence
                  - DevOps, CI, CD

time ⟶

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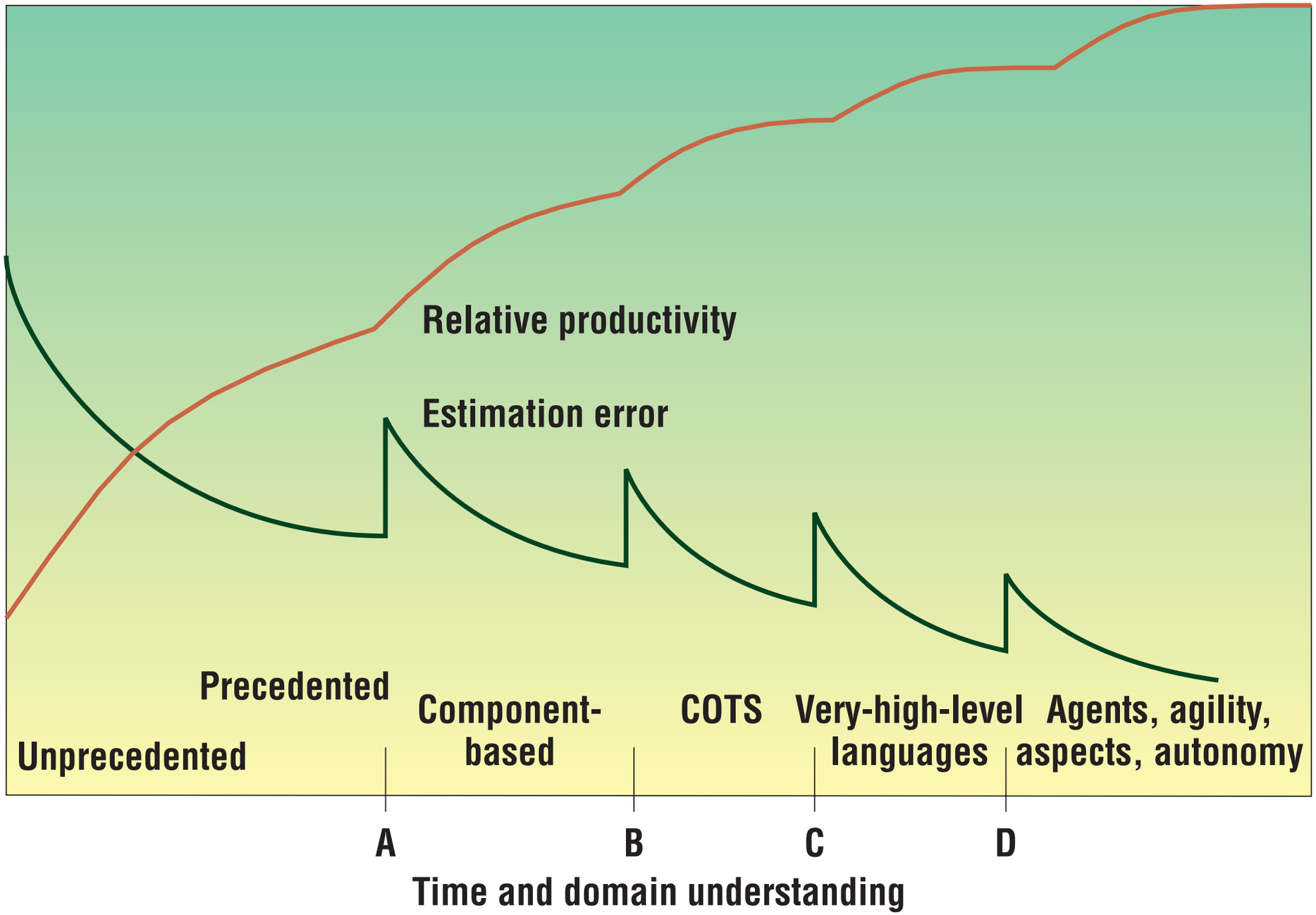
Relies on Tools More and more

time ⟶

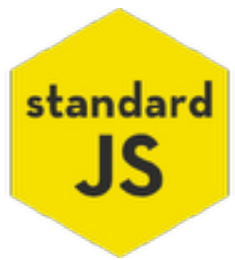
NEW TECH INCREASES PRODUCTIVITY AND PREDICTABILITY



From Boehm and Valerdi, 2008

I GOT TOOLS FOR THIS, I GOT TOOLS FOR THAT

- Tools available for many tasks
  - QA: linters, package managers, coverage, testing, deployment



David.

I GOT MULTIPLE TOOLS FOR THIS

- Many tools available for the same task

- E.g., dependency managers

gemnasium

bitHound

- Projects adopt tools with features needed, presumably

WHICH ONES?

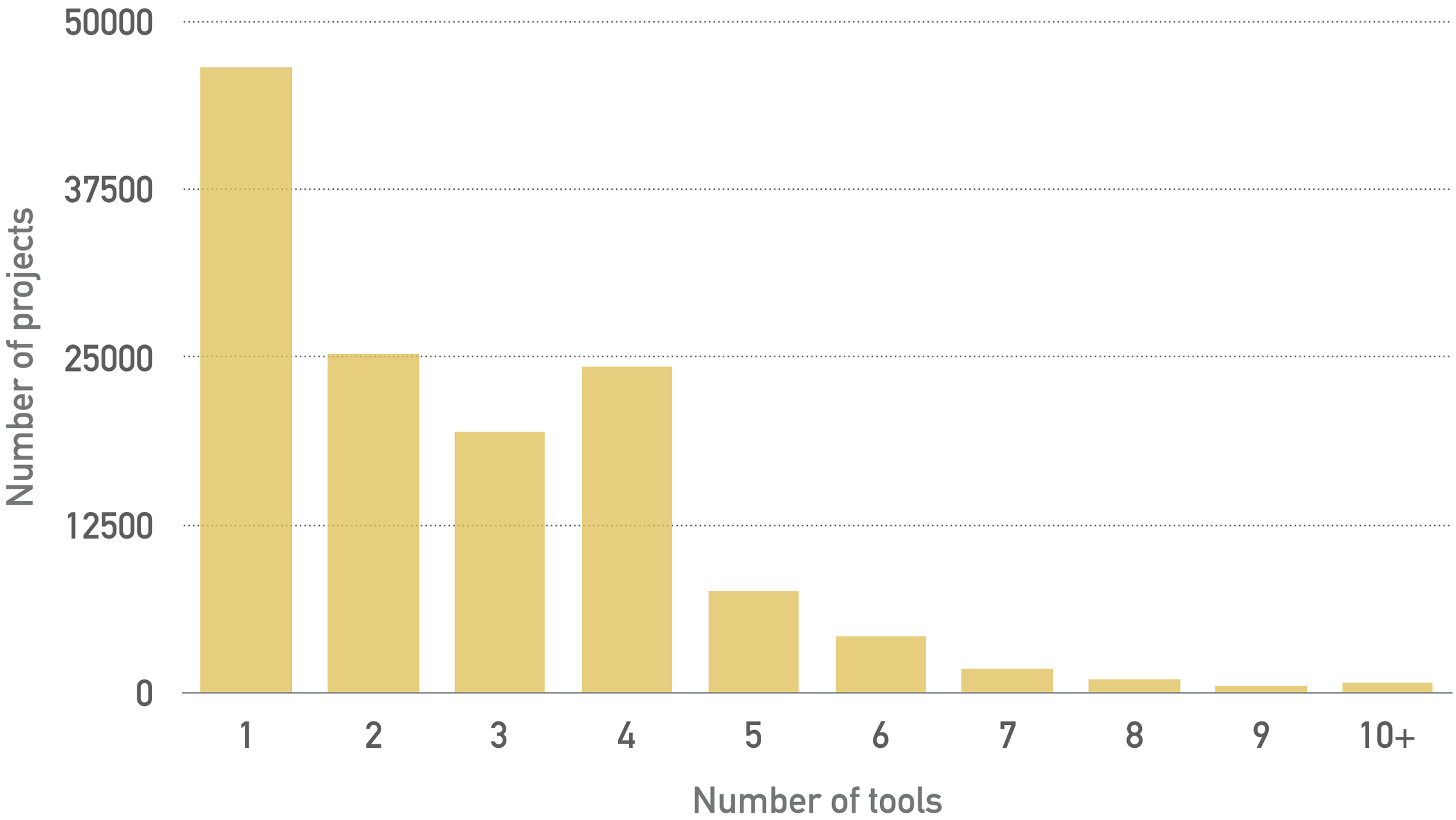
TOOL ADOPTION SUMMARY STATISTICS

Tool	Task class	# Adoption Events Across Projects: Per tool	Per task class
david	Dependency Management	20,763	23,917
bithound		900	
gemnasium		3,093	
codeclimate	Coverage	2,328	15,249
coveralls		11,221	
ESLint	Linter	7,095	12,886
JSHint		2,876	
standardJS		3,435	

Note: 54,440 total projects under study
38,948 projects which adopt tools under study
2,283 projects use different tools in the same task class

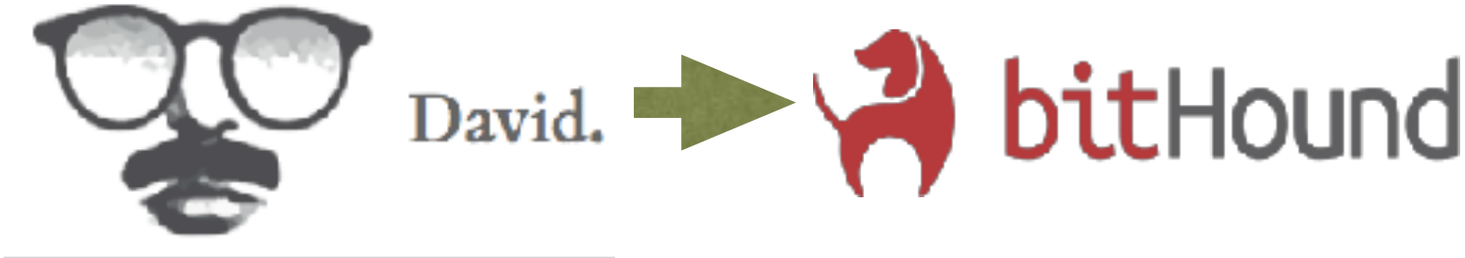
- But how are the tools chosen?
- What discussions precede the choices?
- Are any benefits seen/goals achieved after tool adoption?

PROJECTS USE MULTIPLE TOOLS



PROJECTS SWITCH BETWEEN TOOLS

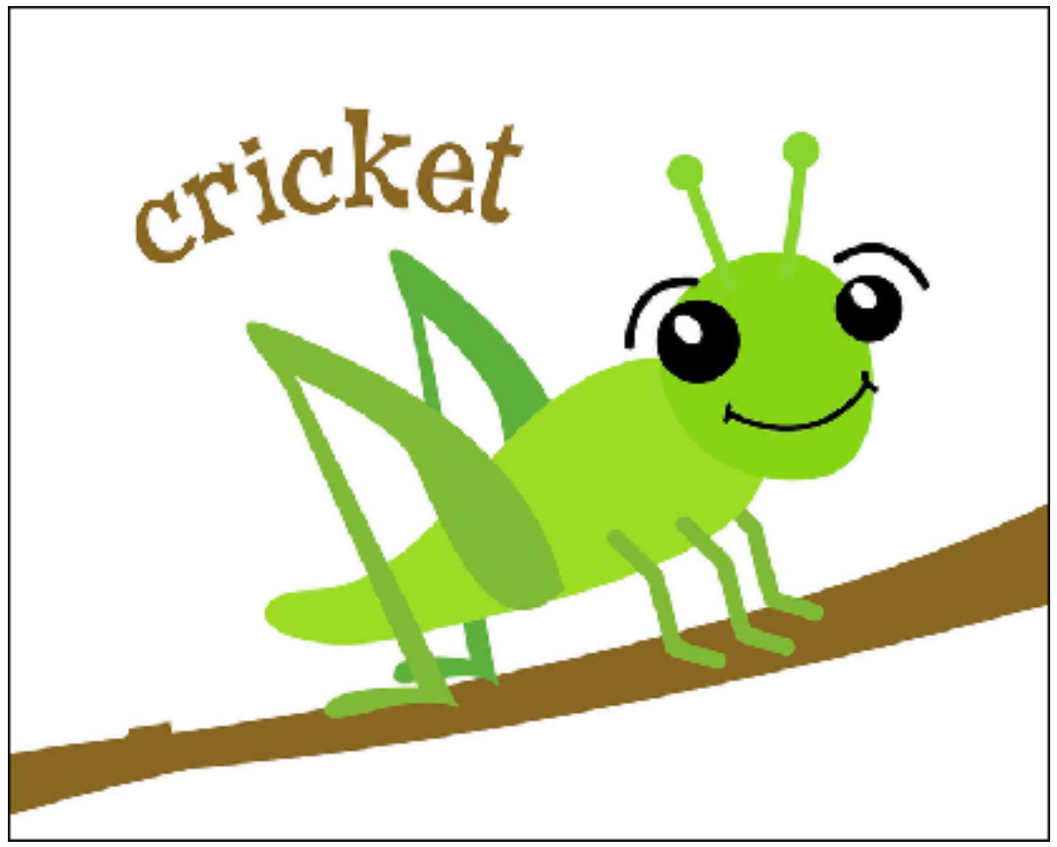
- Sometimes projects switch from one tools to another in the same task class



- Why do they switch? Is there a benefit?

WE LOOKED AT DISCUSSIONS

- We expected to find at least some discussions of the choices



clipart-library.com

'ish

RESEARCH QUESTIONS

➤RQ1: How often do projects change between tools within the same task class?

➤RQ2: Are there measurable changes, in terms of monthly churn, pull requests, number of contributors, and issues, associated with adopting a tool? Are different tools within an equivalence class associated with different outcomes?

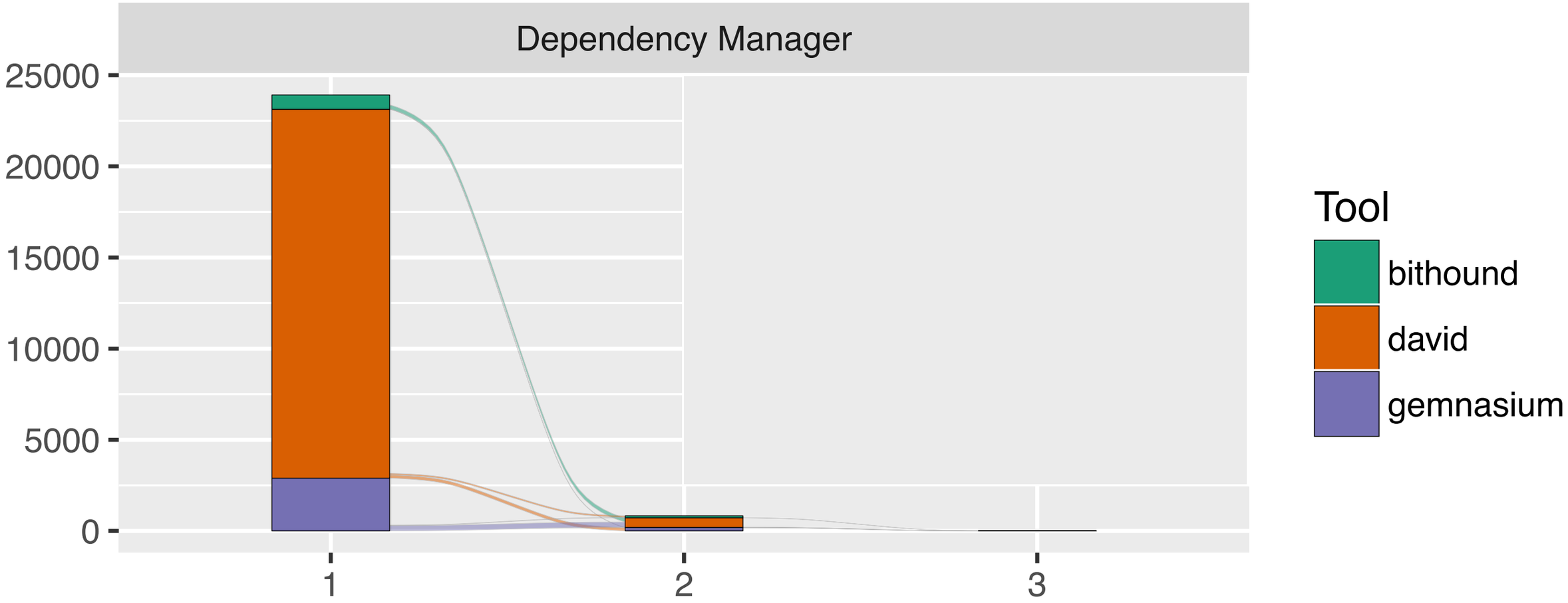
➤RQ3: Are certain tool adoption sequences more associated with changes in our outcomes of interest than others?

STUDY DESIGN

- Research methodology
  - Software Repository mining
  - Quasi-experiments, modeling, hypothesis testing
  - Case studies for triangulation, theory building

- Focus: 3 task classes (linters, dependency managers, code coverage)
- Data: 54,440 projects, 38,948 tool adoptions

RQ1: TOOL SWITCHING ALLUVIAL DIAGRAMS



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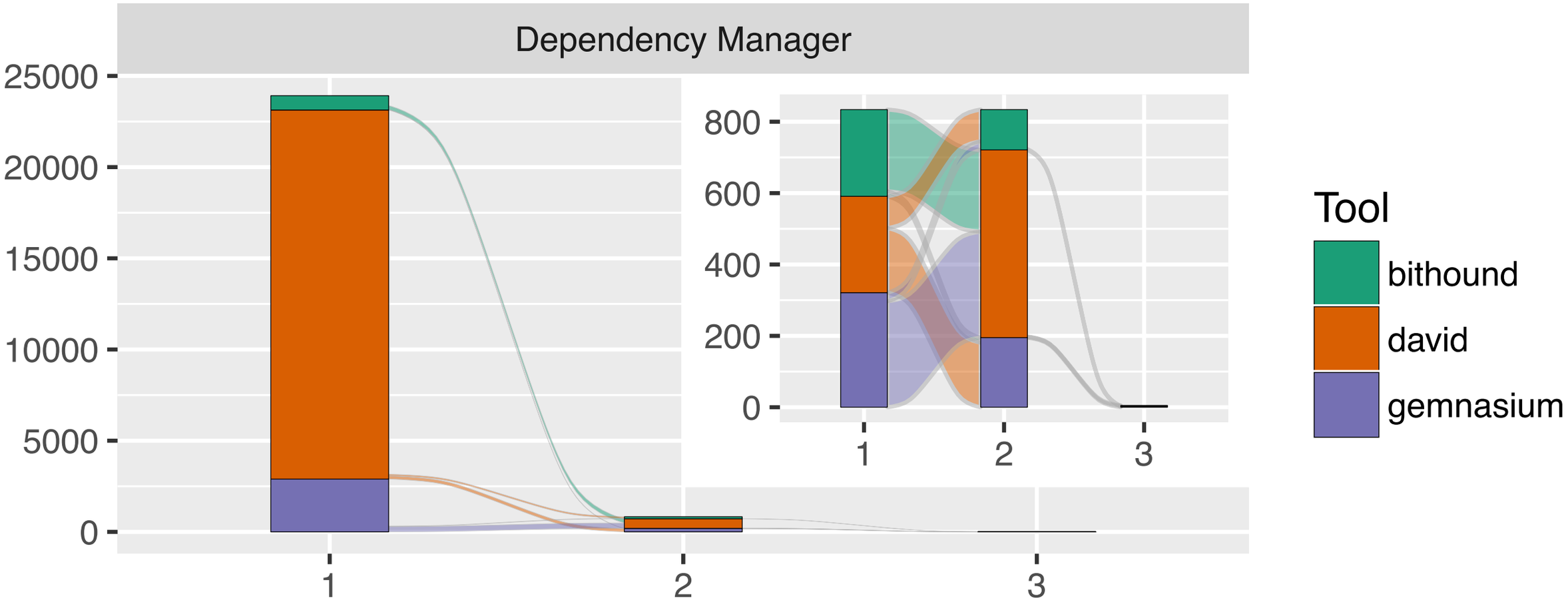
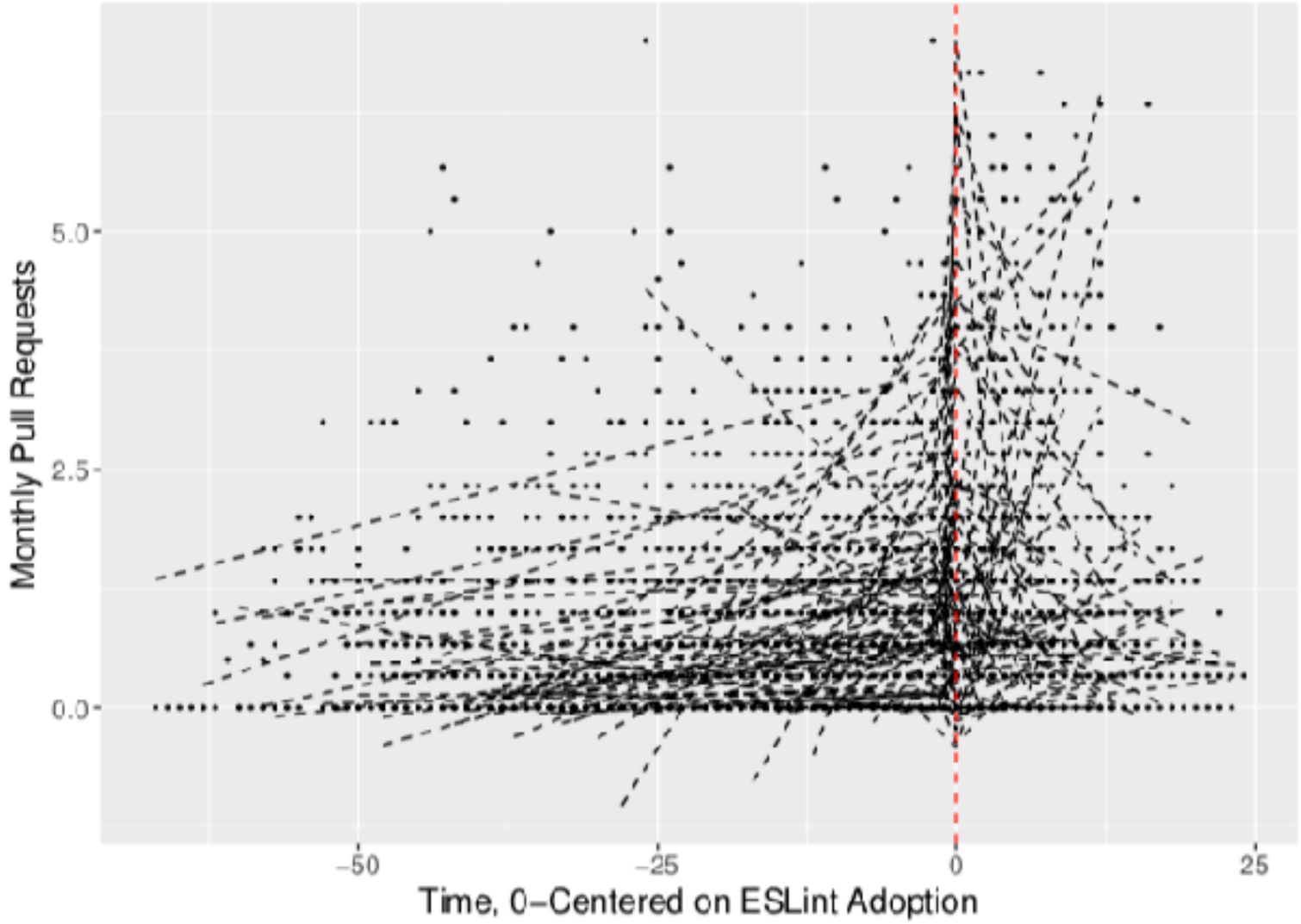


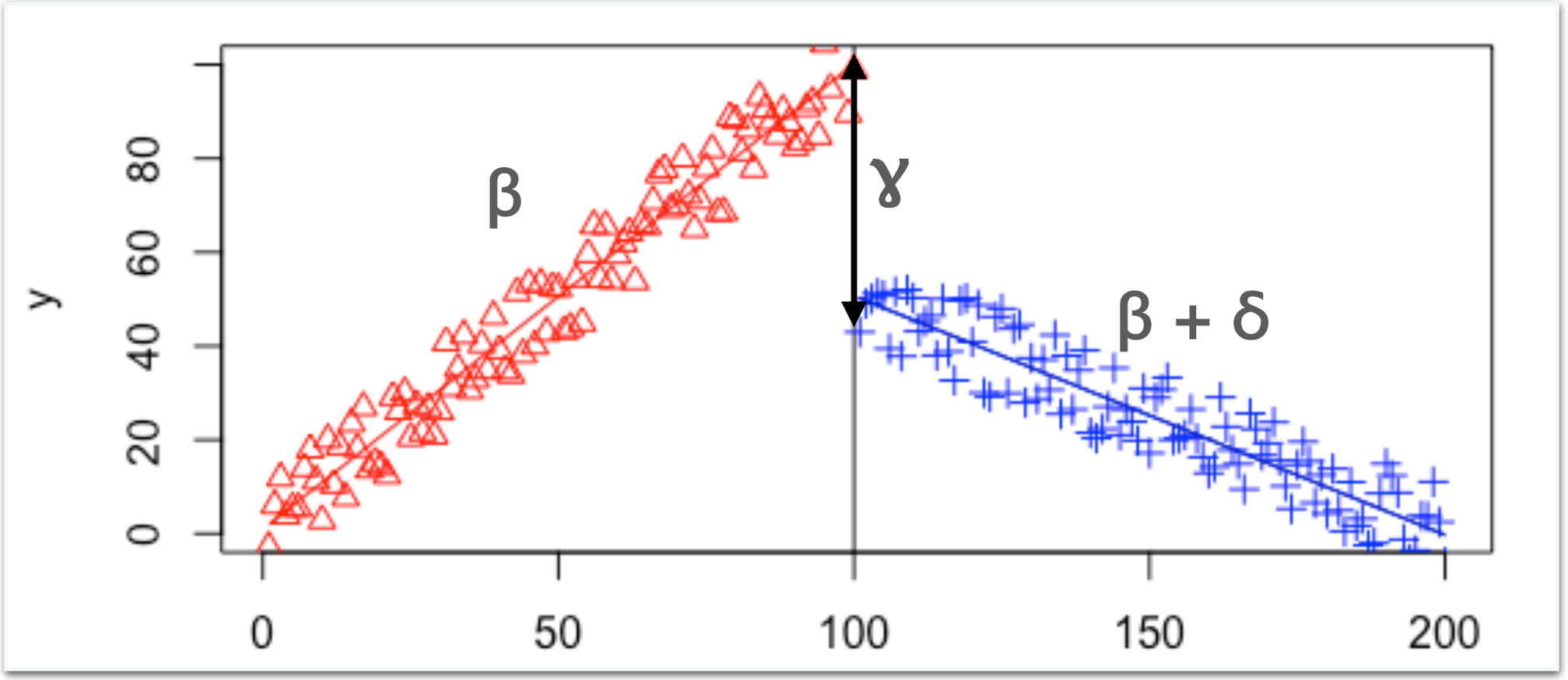
Most projects choose one tool within a task class and stick with it. When projects adopt additional tools within the same task class, they go with the most popular choice.

RQ2: EFFECTIVENESS BEFORE AND AFTER ADOPTION



Effectiveness variables: ***churn, #pull requests, #unique authors, #issues***

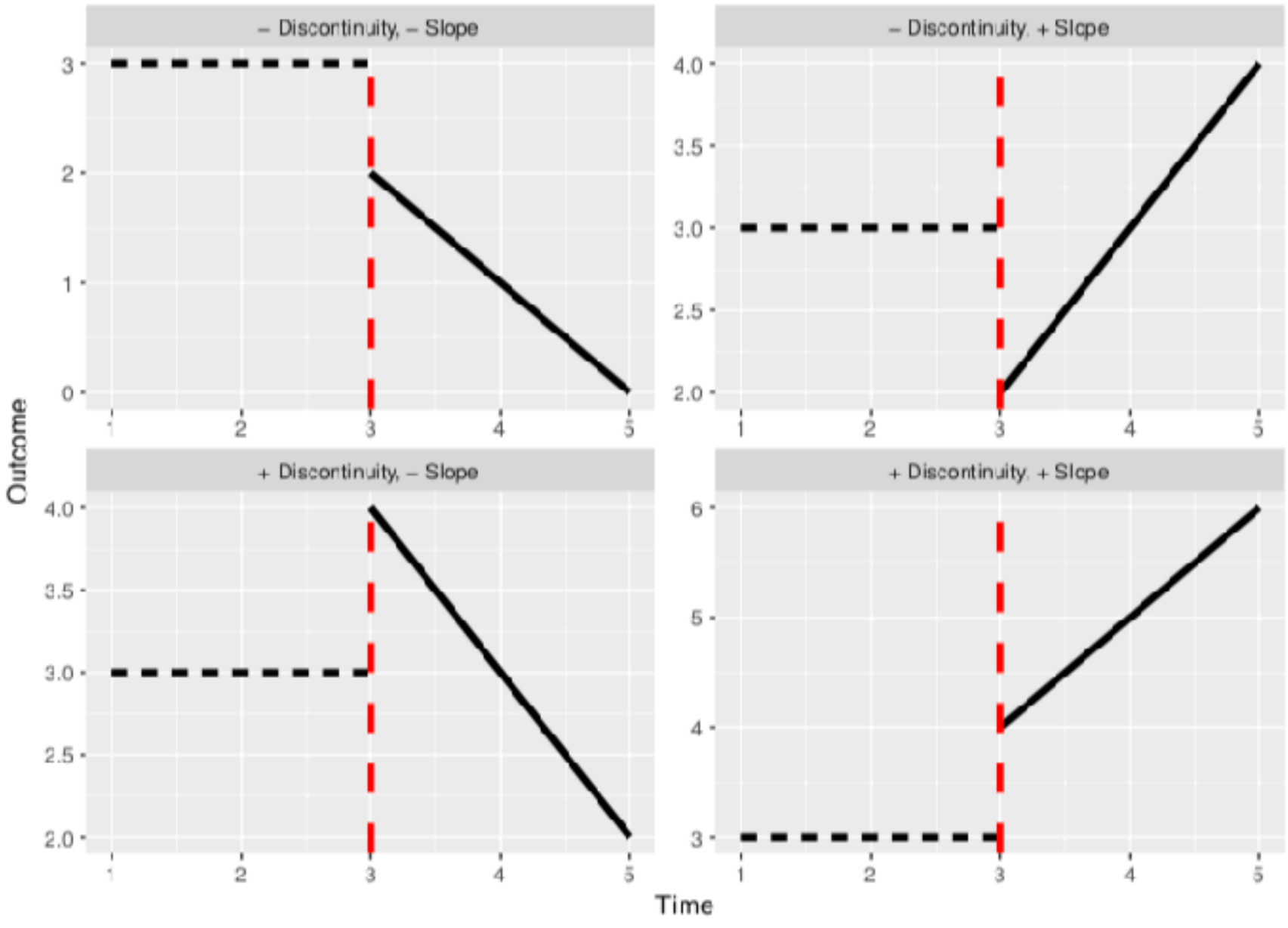
INTERRUPTED TIME SERIES: REGRESSION DISCONTINUITY



time:	1	2	3	…	…	…	100	101	102	…	…	…	200
time after intervention:	0	0	0	…	…	…	1	2	3	…	…	…	100
intervention:	0	0	0	…	…	…	1	1	1	…	…	…	1

$$y_i = \alpha + \beta \cdot \text{time}_i + \gamma \cdot \text{intervention}_i + \delta \cdot \text{time\_after\_intervention}_i + \varepsilon_i$$

SLOPE INCREASES OR DECREASES, AND DISCONTINUITY



SOME RESULTS

DEPENDENCY MANAGER MODELS

	log(Churn + 1)		PRs		Unique Authors		Issues	
	Coeffs	(Err.)	Coeffs	(Err.)	Coeffs	(Err.)	Coeffs	(Err.)
Authors	0.456***	(0.007)	0.383***	(0.004)			0.052***	(0.004)
Commits	0.052***	(0.001)	0.014***	(0.000)	0.009***	(0.000)	0.015***	(0.000)
PRs	−0.078***	(0.003)			0.068***	(0.001)		
Churn			−0.040***	(0.001)			0.009***	(0.001)
time	−0.049***	(0.000)	0.011***	(0.000)	−0.005***	(0.000)	0.013***	(0.000)
gemnasium_int	−0.168***	(0.043)	−0.022	(0.025)	0.048***	(0.010)	0.061	(0.030)
gemnasium_after	−0.003	(0.003)	0.009***	(0.002)	0.001*	(0.001)	−0.001	(0.002)
david_int	−0.182***	(0.021)	0.199***	(0.012)	0.082***	(0.005)	0.138***	(0.015)
david_after	−0.009***	(0.002)	0.005***	(0.001)	−0.001	(0.000)	−0.011***	(0.001)
bithound_int	0.002	(0.107)	0.418***	(0.061)	0.088***	(0.026)	0.078	(0.073)
bithound_after	−0.028*	(0.014)	0.037***	(0.008)	0.000	(0.003)	−0.014	(0.009)
Intercept	4.567***	(0.014)	0.289***	(0.009)	0.998***	(0.003)	0.415***	(0.011)
Marginal R^2	21.6%		7.1%		12.5%		2.4%	
Conditional R^2	54.1%		58.9%		44.8%		56.8%	
Note:							*p<0.05; **p<0.01; ***p<0.001	

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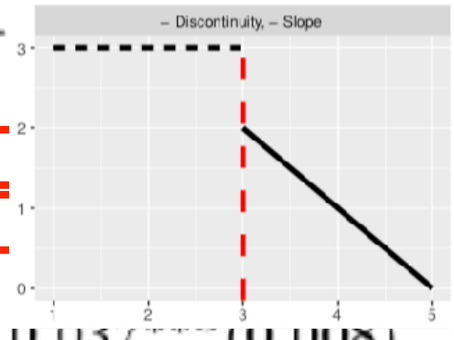
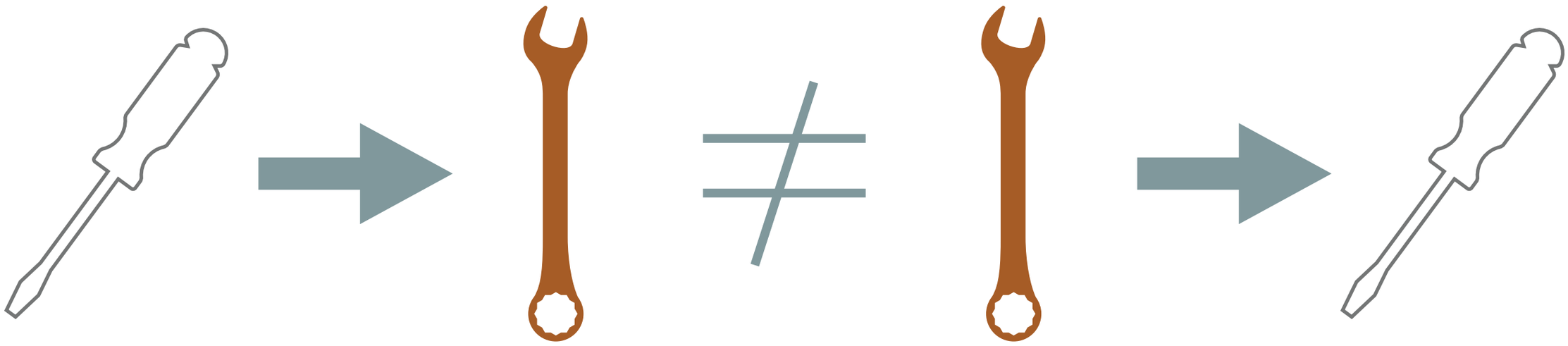
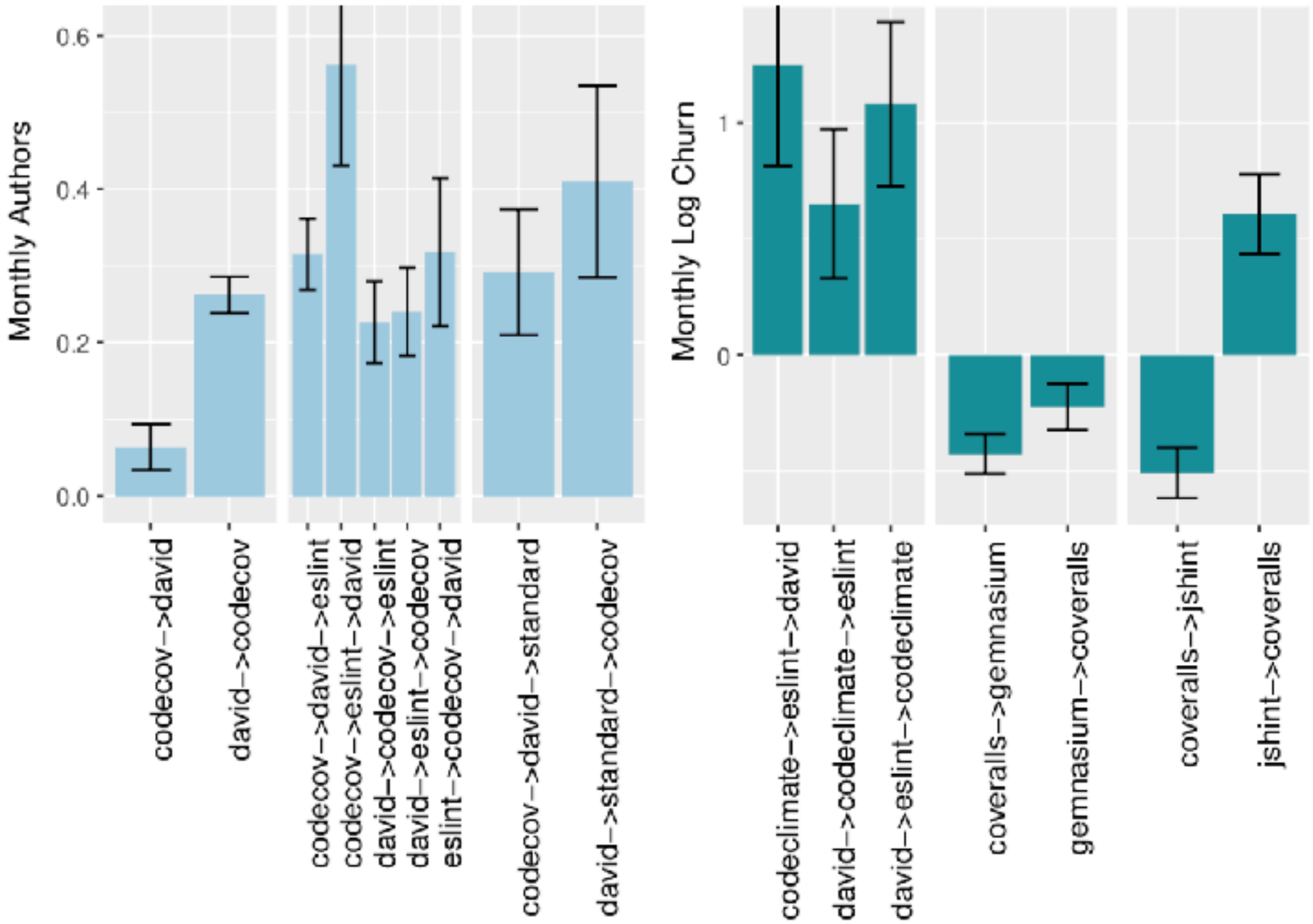


RQ3: ON ADOPTION ORDER



RQ3: SOME RESULTS



CONCLUSION AND FUTURE

- Tool choice matters but it is not discussed much
- Projects can benefit from adopting the right tool
- The order in which tools are adopted matters
- Future goal: bespoke tool pipelines, depending on project context

THANKS!

- NSF
- DECAL @ UCD
- Strudel @ CMU