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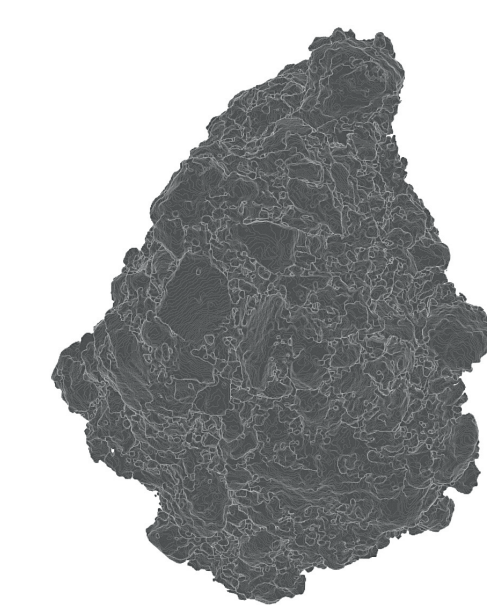


vote here

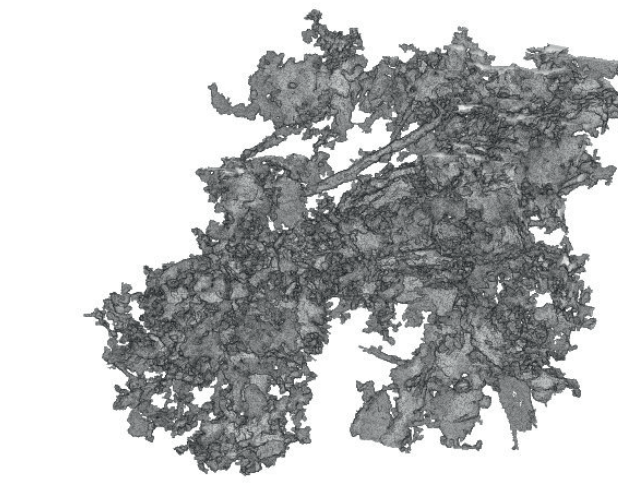
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# Aggregates vs pores?



A survey among soil scientists about perspectives on soil structure

Svenja Roosch

## Introduction

Two perspectives on soil structure have been juxtaposed in the past: the *aggregate perspective* and the *pore perspective*. The debate intensified recently with several opinion papers and letters to the editor being published<sup>1,2</sup>. There even seems to be no consensus whether the two perspectives are complementary or exclusive.

## Hypotheses

- 1) The opinions in the soil science community are not as polarised as the ones published in opinion papers.
- 2) The majority of researchers consider the perspectives compatible.

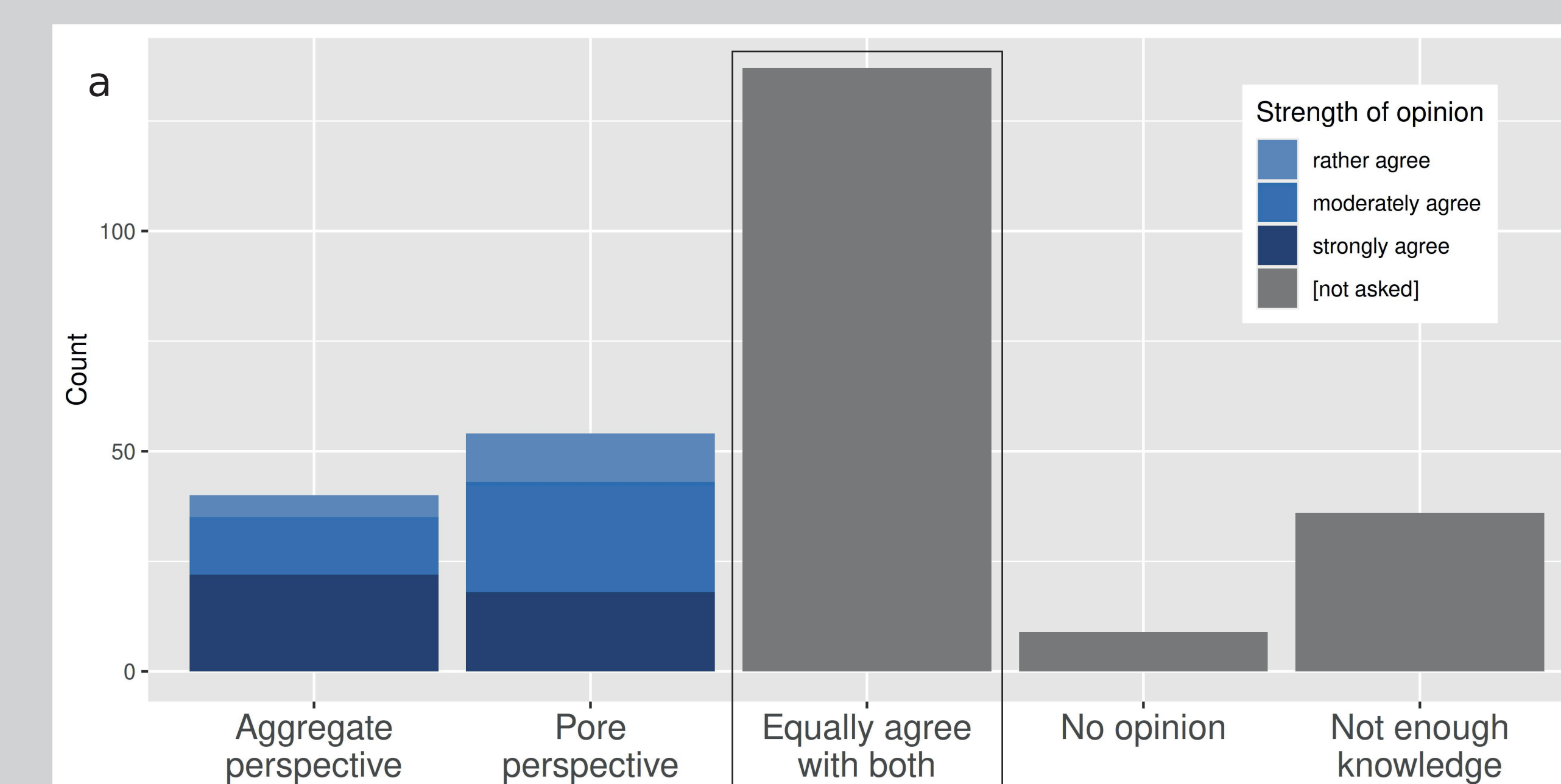
## Methods

An online survey was ...

- sent via email to members of the DBG (German soil science society) 17<sup>th</sup> Feb 2023 and closed 20<sup>th</sup> March 2023.
  - published on Twitter on 6<sup>th</sup> Apr 2023 and closed on 20<sup>th</sup> Apr 2023 to address international soil scientists.
- The datasets were merged for the presentation here.

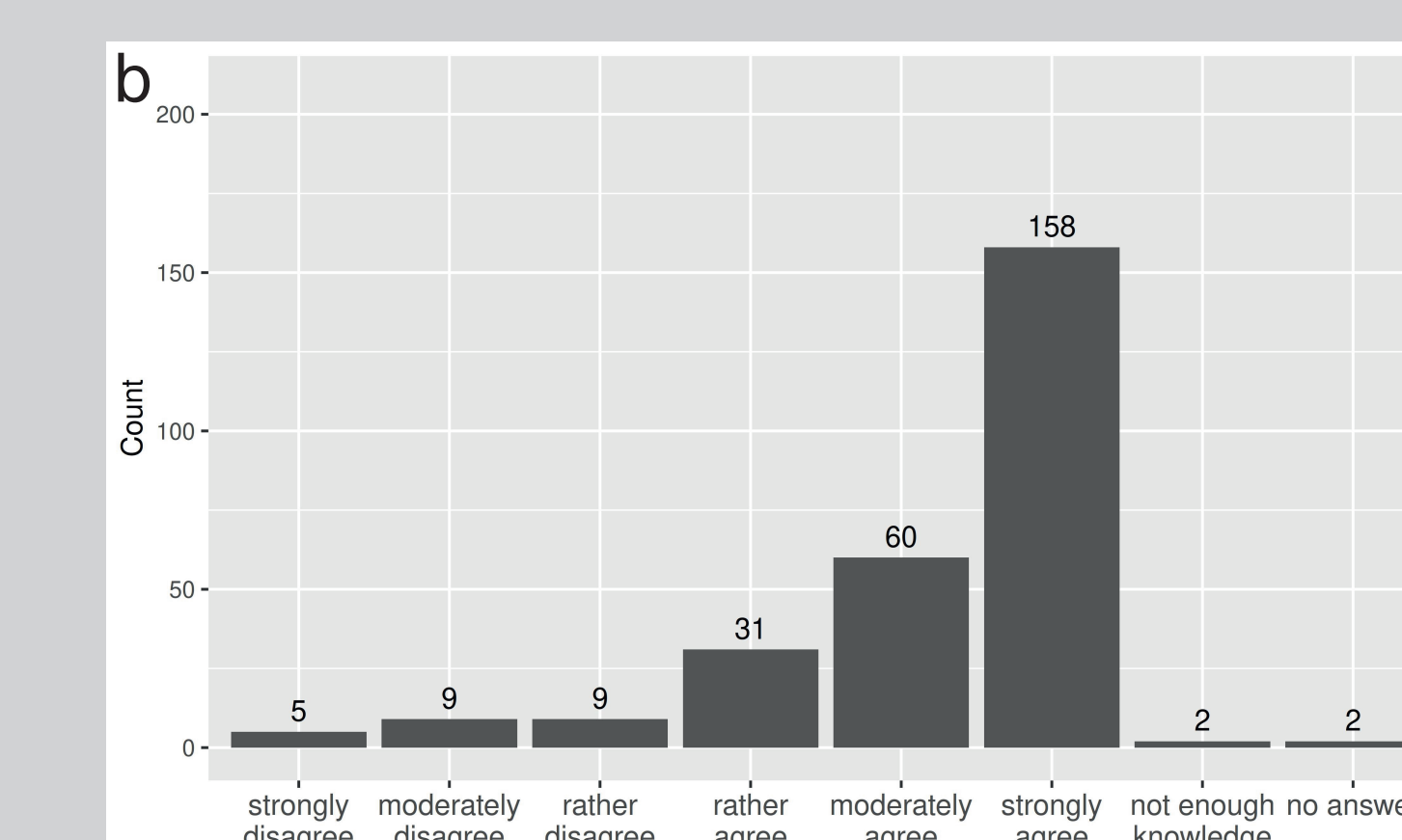
### Approval of pore or aggregate perspective

"[...], which perspective do you agree with more?"

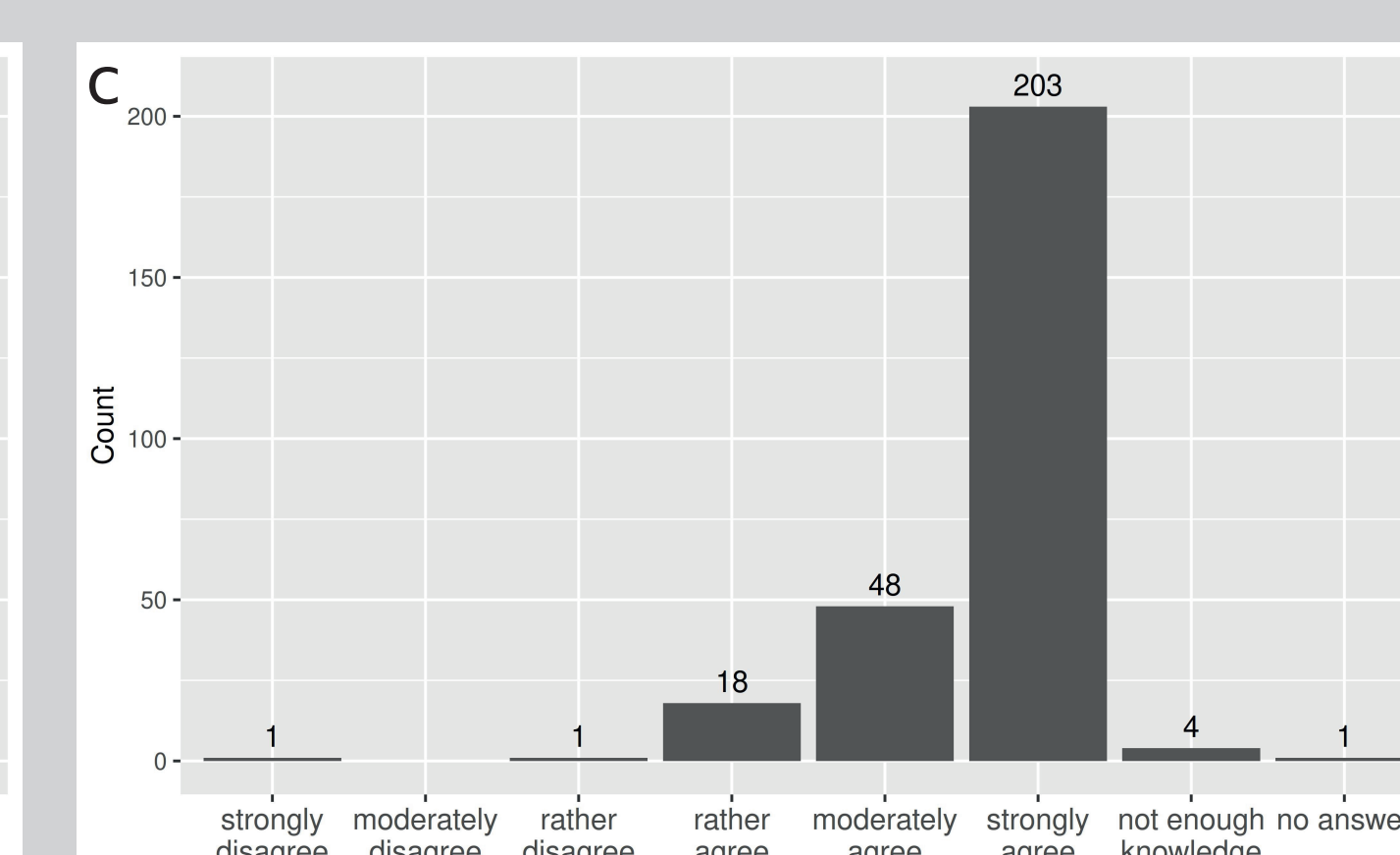


"In order to understand soils, the concept of ...

... aggregates is important."

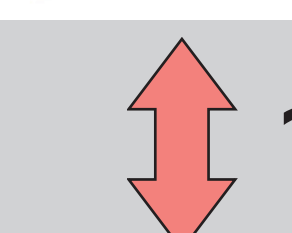
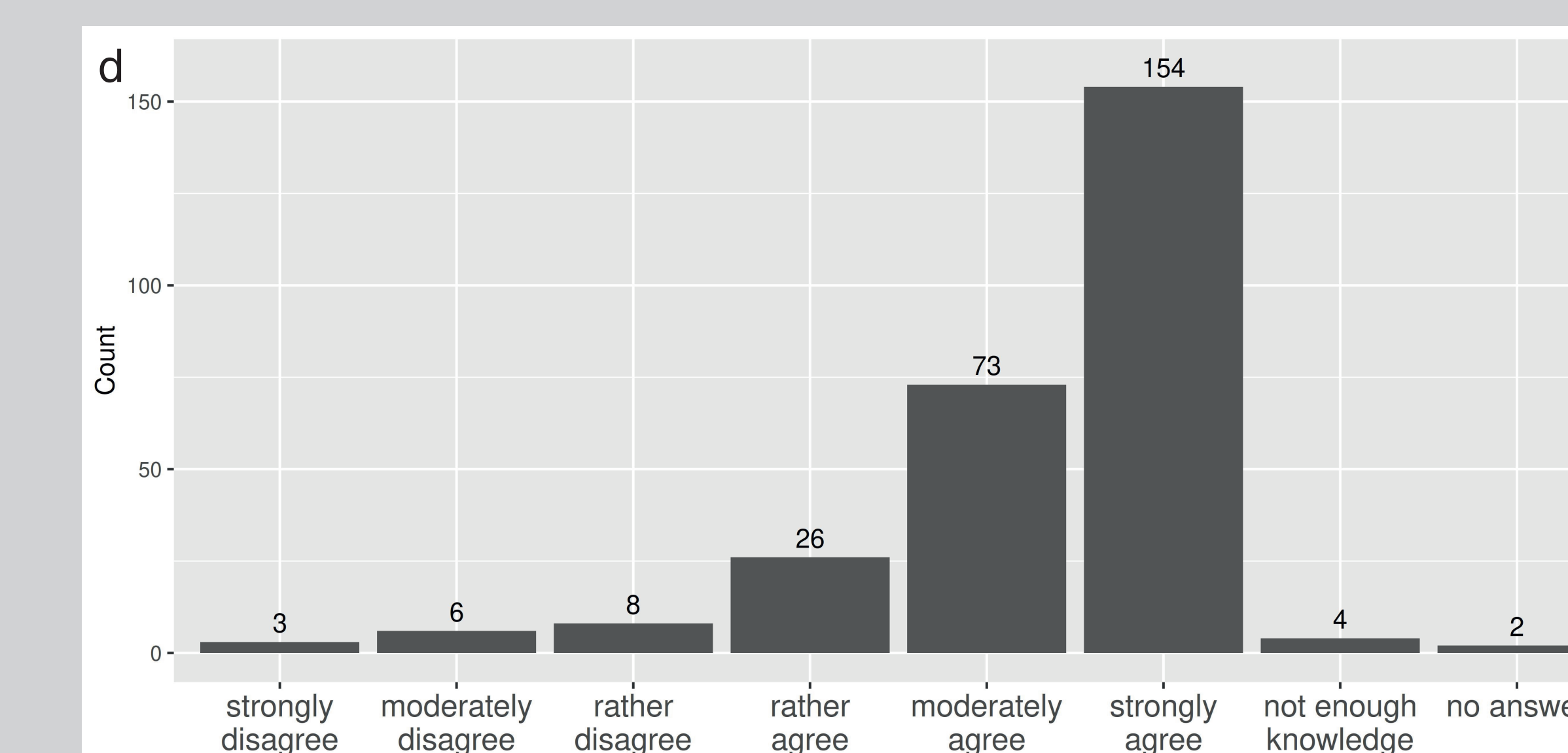


... pore systems is important."



### Judgement of compatibility

"The pore and aggregate perspective are conflicting."



"The aggregate and pore perspective are two sides of one coin."

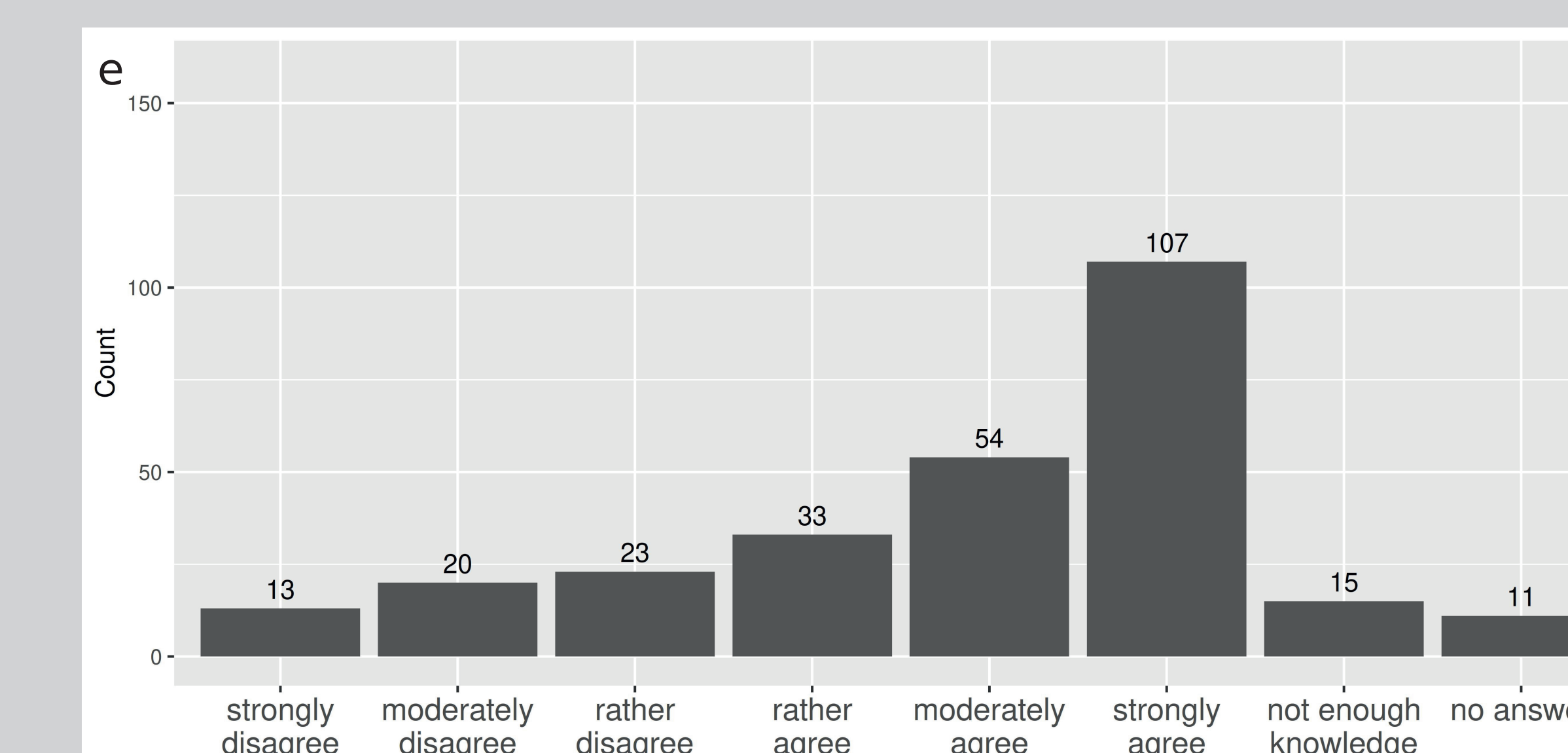


Fig. 1: Exemplary results of the combined data sets from the two (identical) surveys published via email and Twitter. a) Preference for aggregate or pore perspective or both (single choice). If aggregate or pore perspective was chosen, the next question was on the strength of this preference (blue shades). b) and c) Agreement with the phrases that the concept of aggregates resp. pores is important to understand soils. d) and e) Agreement with the phrases that the aggregate and pore perspective are conflicting resp. complementary.

### Results: Who participated?

Completed surveys: 276  
Countries: Germany (55 %)  
US (12 %)  
Switzerland (7 %)  
...  
Career stages: PhDs (25 %)  
PostDocs (28 %)  
Professors (21 %)  
...

### Results: What were the answers?

- Majority "equally agree with both" (in all career stages, most countries)
- Support of aggregate and pore perspective roughly equal but different between countries
- Preference for pore perspective in US, Switzerland, and Germany, opposite trend in sum of remaining countries (data not shown)
- Contradictory results on judgement of compatibility of the two perspectives
- Relevance to own research rated lower than to soil science in general (data not shown)

## Discussion

- Most people agreed with both perspectives. Broad spectrum of perspectives was present and no big divide.  
→ hypothesis 1 confirmed

- Contradictory results regarding compatibility: "two sides of one coin" ambiguous?  
→ hypothesis 2: unclear

- Most participants from Germany, so not representative of soil science community world-wide

- The survey is not meant to decide democratically on the appropriateness of any perspective!

## Conclusion

The survey results disclosed a variety of perspectives on soil structure that may not always fit into a dual "aggregate vs pore perspective" scale. Although the relevance of this topic to soil science in general remained contested, the interest in the survey was high.

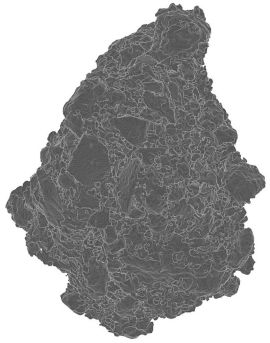
### Acknowledgements

I gratefully acknowledge financial support from the Deutsche Forschungsgemeinschaft (DFG) within the framework of the research unit "MAD Soil - Microaggregates: Formation and turnover of the structural building blocks of soils" (DFG RU 2179). Thanks go to Franziska Bucka and Simone Kilian for fruitful discussions on the matter.

### References

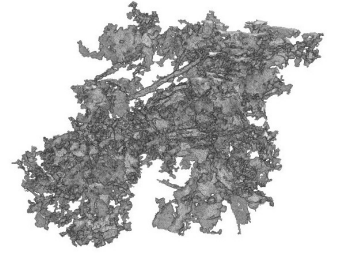
- 1) Kravchenko et al. 2019: Soil aggregates as biogeochemical reactors: Not a way forward in the research on soil-atmosphere exchange of greenhouse gases. Glob. Change Biol. 25:2205-2208.
- 2) Yudina / Kuzyakov 2019: Saving the face of soil aggregates. Glob. Change Biol. 25: 3574-3577.





# Aggregates vs Pores?

A survey among soil scientists about perspectives on soil structure



## Supplementary material

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Attribution  
required!

Survey "Perspectives on soil structure" - Svenja Roosch - EGU 2023

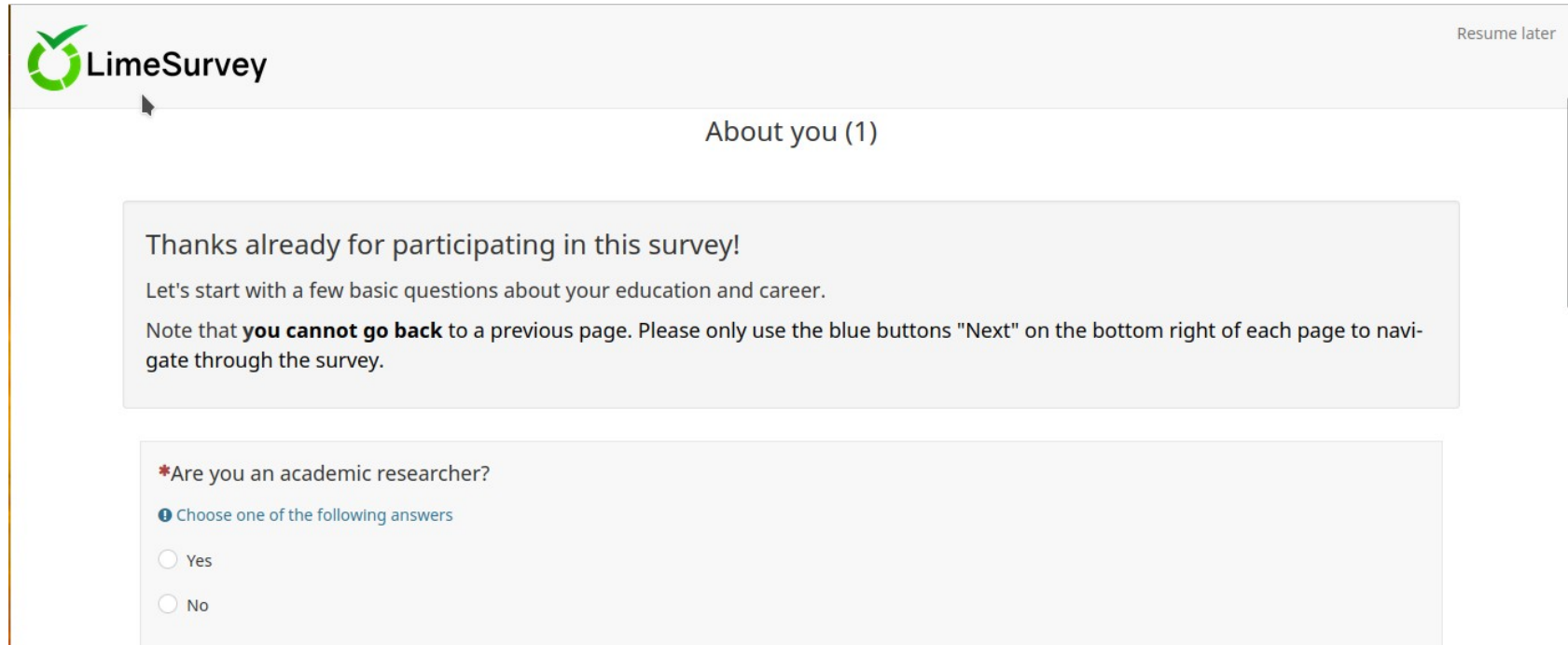
# The survey

- Online survey conducted with LimeSurvey
- English language
- Technically separated into two surveys with different access paths:
  - Invitation email via mailing list of the DBG (German soil science society)
  - Tweet from the Soil Biophysics working group of the Institute of Soil Science, Leibniz University Hannover
- Lottery to increase motivation to participate
- Demo version available here:  
<https://survey.uni-hannover.de/index.php/578971>



Fig. 1: Screenshot of the Tweet publishing the survey on 6<sup>th</sup> April 2023 (re-posted on 13<sup>th</sup> April)  
[https://twitter.com/peth\\_lab/status/1646510183517138945](https://twitter.com/peth_lab/status/1646510183517138945)

# Impression of the survey I



The screenshot shows the LimeSurvey interface. At the top left is the LimeSurvey logo, and at the top right is a "Resume later" link. The survey title "About you (1)" is centered. A large grey box contains the following text: "Thanks already for participating in this survey! Let's start with a few basic questions about your education and career. Note that **you cannot go back** to a previous page. Please only use the blue buttons "Next" on the bottom right of each page to navigate through the survey." Below this is the first question: "\*Are you an academic researcher?". It includes a blue information icon and the instruction "Choose one of the following answers". Two radio button options are listed: "Yes" and "No".

Fig. 2: Screenshot of the first question of the survey



# Impression of the survey II



Resume later

## Your view on soil structure (1)

\*There are (at least) two broad perspectives on soil structure, the aggregate perspective and the pore perspective.

Please indicate how much you agree or disagree with the following phrases.  
If you feel you do not have enough knowledge to judge a statement, choose "not enough knowledge".

	strongly disagree	moderately disagree	rather disagree	rather agree	moderately agree	strongly agree	not enough knowledge	no answer
"In order to understand soils, the concept of pore systems is important."	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
"Aggregates do exist and have a size, form and stability that is typical for individual soils."	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
"The pore and aggregate perspective are conflicting."	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Fig. 3: Screenshot of a different question type (array) in the main part

# In this Supplementary Material

- Statements from the free text fields
- Comparison between results from the DBG mailing list and Twitter
  - Mostly in the order the questions were asked
  - Only completed surveys
  - All answers, including non-academics
  - N=185 (DBG) and n=91 (international)



# Voices from the free text fields

# Voices from the free text fields

## Importance / soundness of the debate

“Didn’t know that there was this apparently huge debate [...]”

I have a strong feeling that it is an academic orchid (nevertheless interesting)

“[...] is an interesting topic and worth a thorough academic discussion [...]”

“Its a pretty silly debate, but can be useful for thought exercises. [...]”

“It’s rather idiologies than a fundermental debate. [...]”

“I never came across this debate but see the point of it.”



# Voices from the free text fields

What the perspective might depend on

## Research question

“For hydrolics, plant nutrition, and many other functions the pore space attributes are more important, while for erosion and compaction, the former processes should be treated as measure of structure stability”

## Field vs lab methods

“In the field aggregates are the observable structure and the pore space can only be observed in the lab”

## Scale

“I guess the different perspectives may derive from different scales considered and different technical approaches used. [...]”

## Soil type

“In some soils aggregates are easily visible by the naked eye in soil pits [...] Other soils only "free" their aggregates by exerting some stress [...]”

# Voices from the free text fields

## Complexity

“[...] aren't these all limited representations of an utterly complex system?”

“[...] Scientists should preferably be able to adopt more than one perspective towards their object of research [...]”

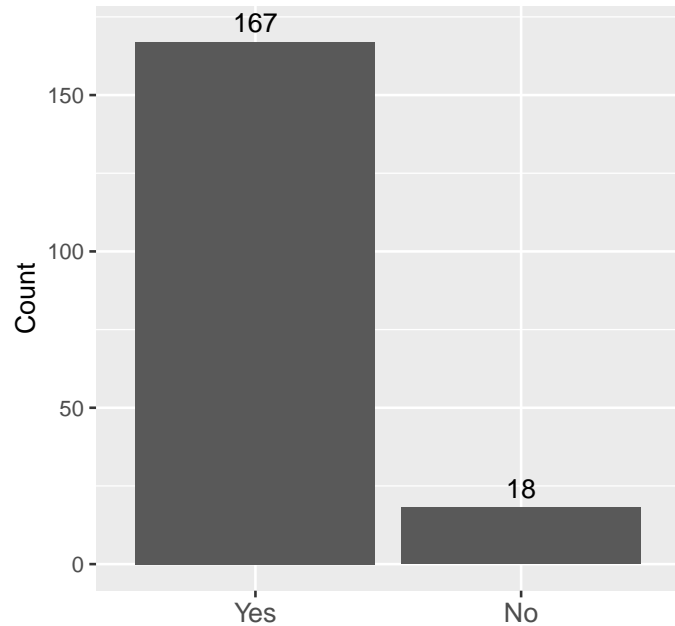
“Stop being so binary [...]”

“[...] aggregates are not static structures, they are continuously formed and destroyed [...]”

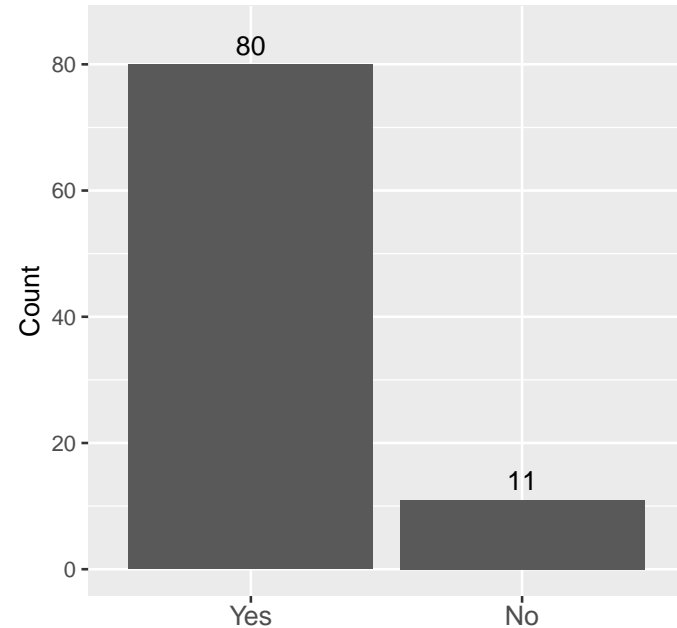


# Comparison: results from the DBG mailing list and Twitter

# Are you an academic researcher?



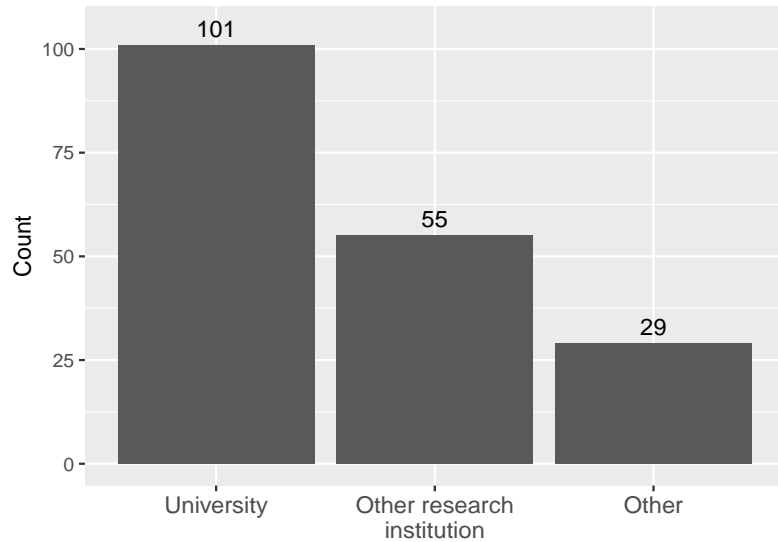
DBG (mostly Germany)



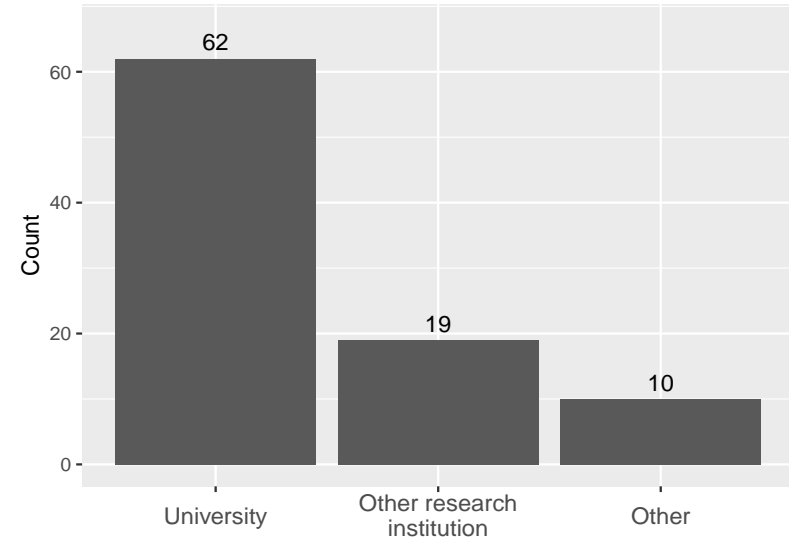
Twitter (international)



# What type of institution do you work at (mainly)?

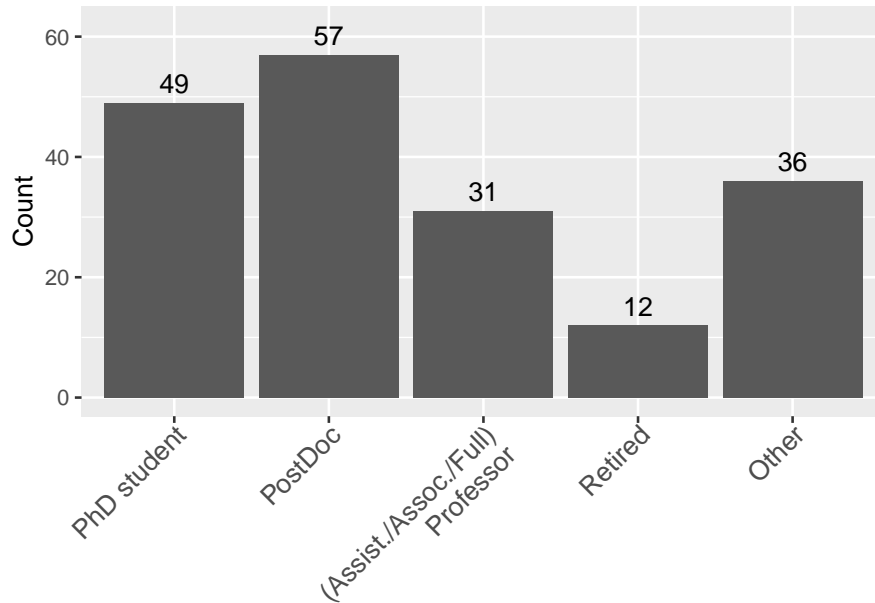


DBG (mostly Germany)

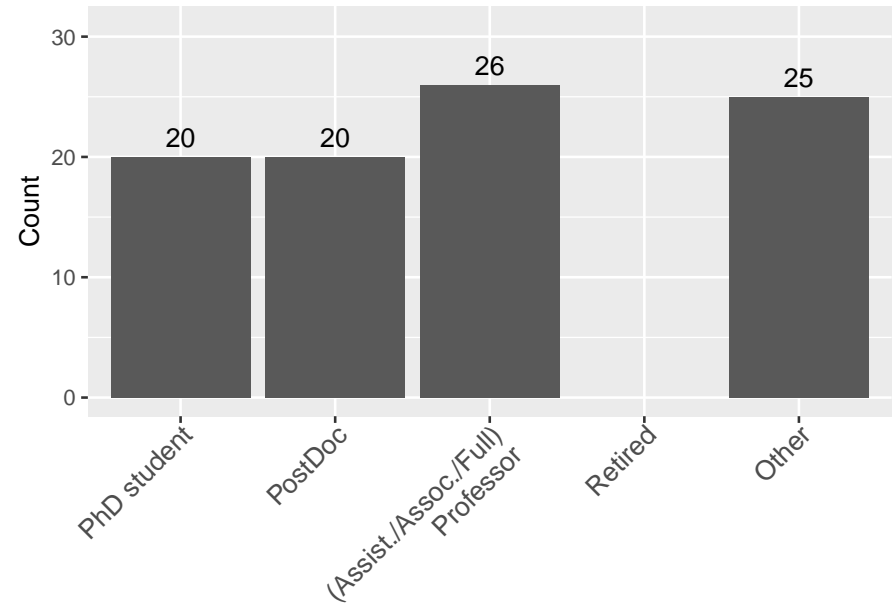


Twitter (international)

# What is your career stage?

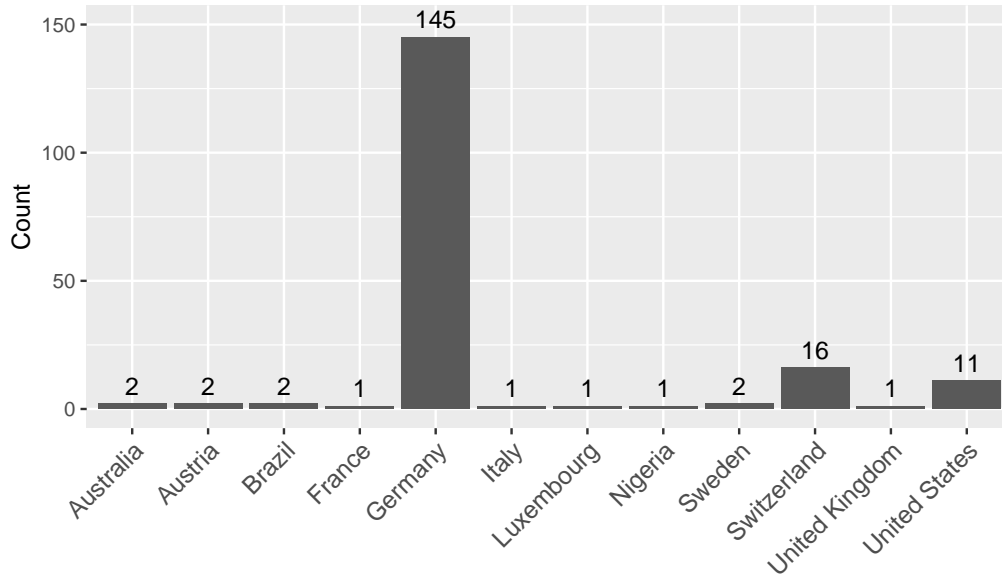


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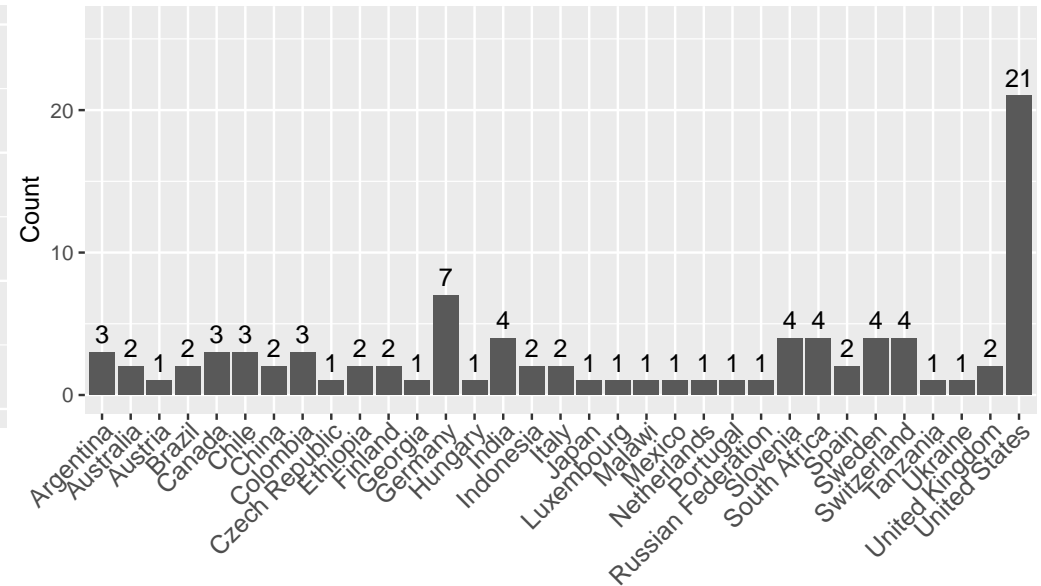


Twitter (international)

# Which country is your (main) research institution located in?



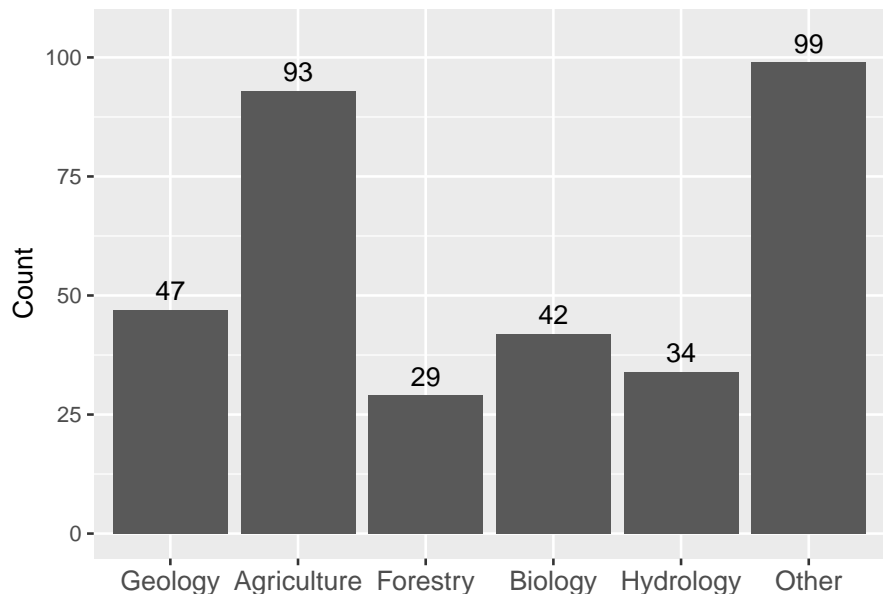
DBG (mostly Germany)



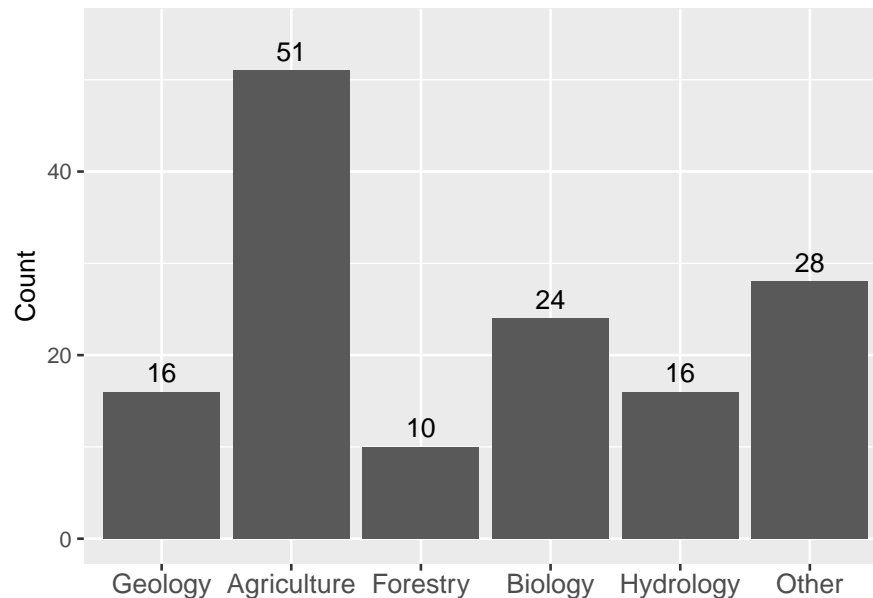
Twitter (international)

# Which areas were you educated in?

(multiple choice)



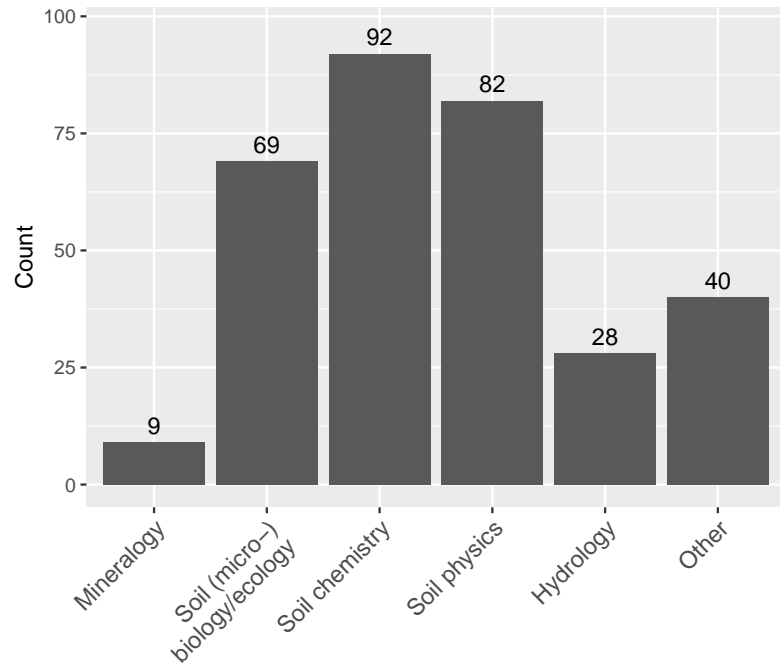
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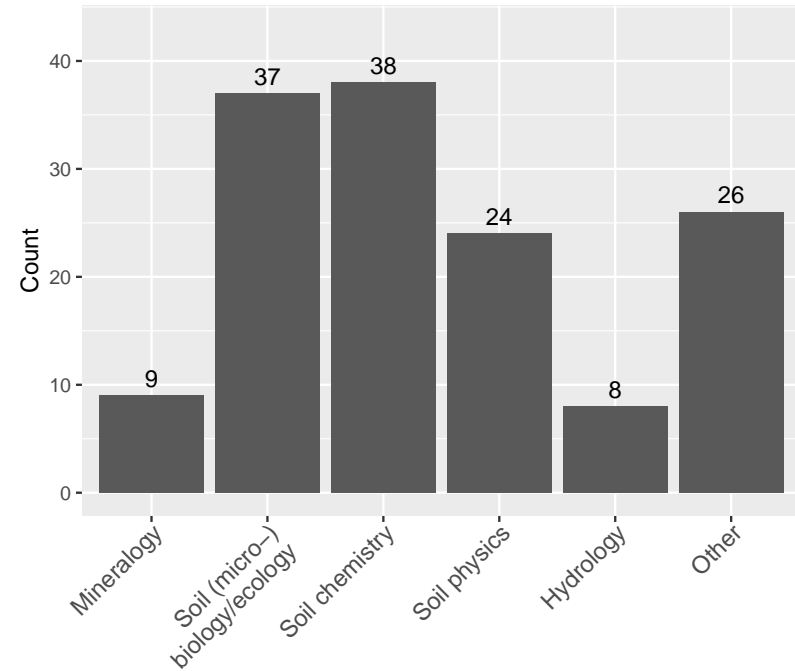
Twitter (international)



# In which field is your research focus area? (multiple choice)

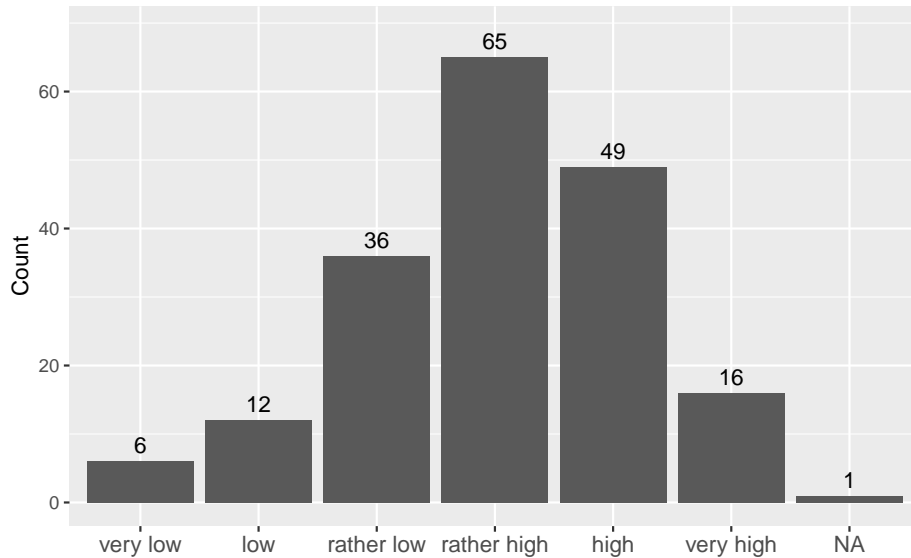


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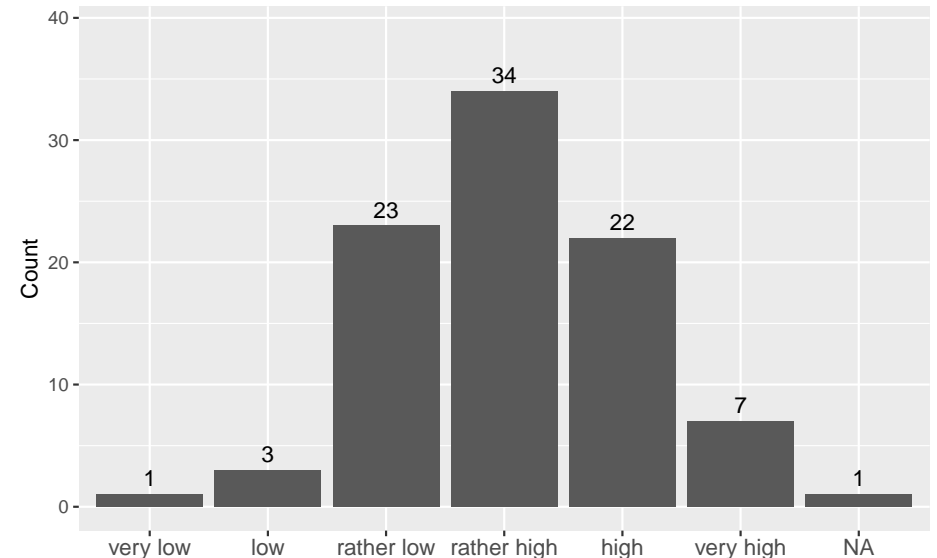


Twitter (international)

# How do you rate your expertise about different perspectives on soil structure?

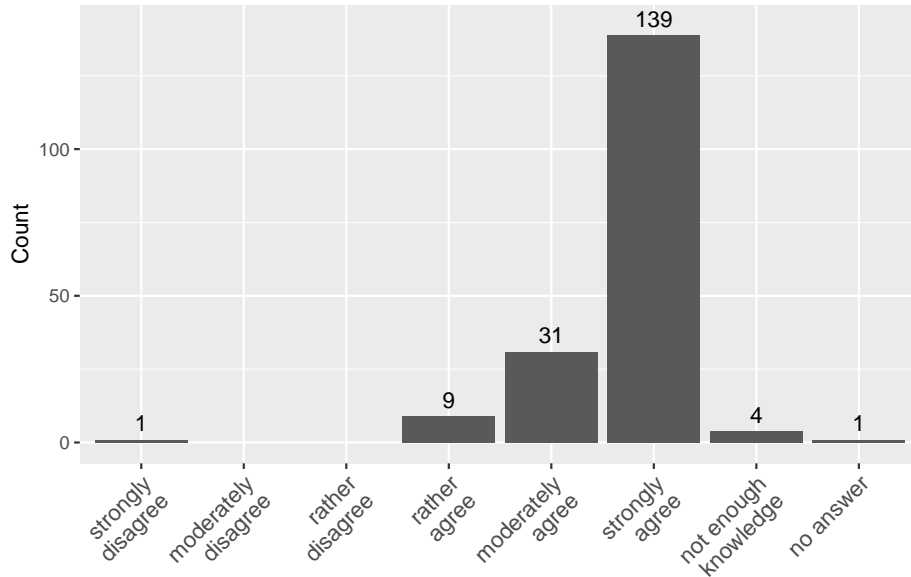


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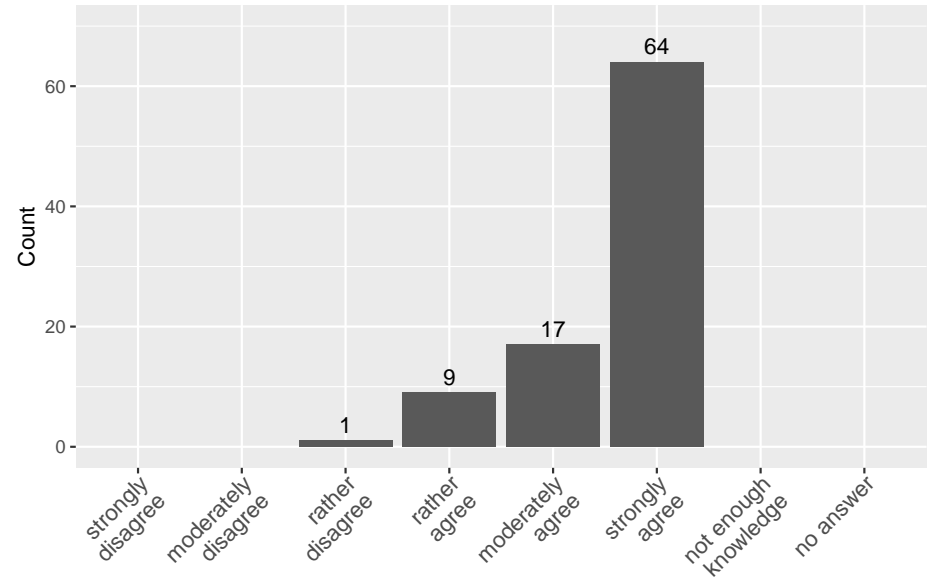


Twitter (international)

# 'In order to understand soils, the concept of *pore systems* is important'

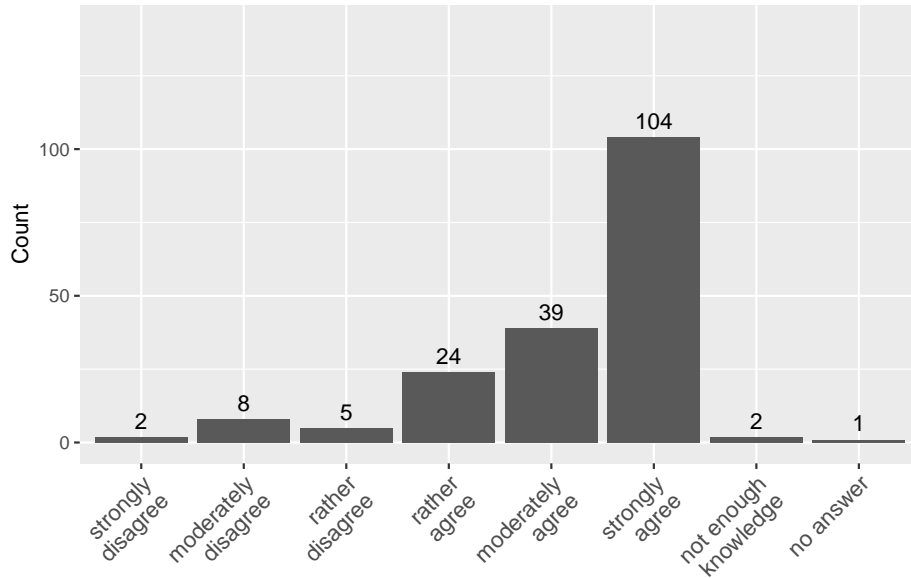


DBG (mostly Germany)

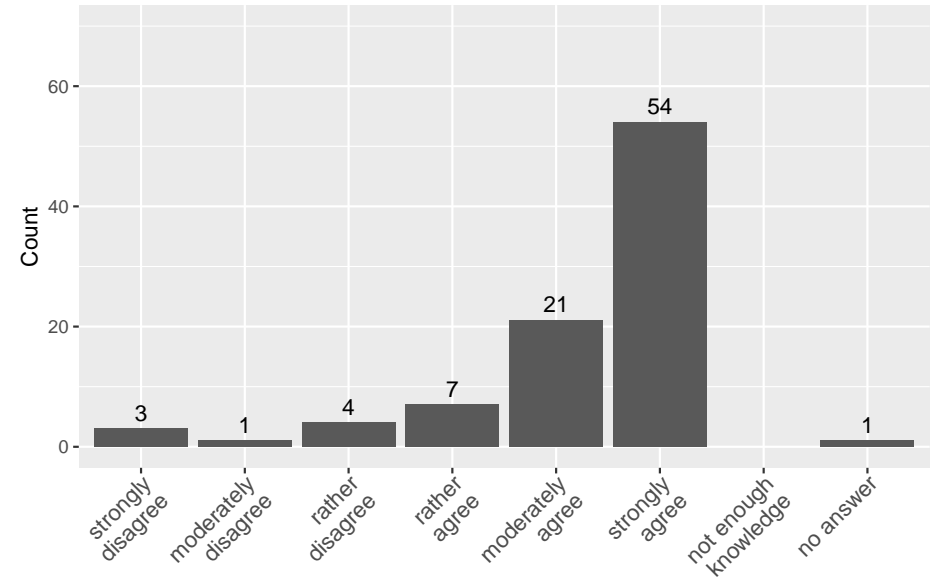


Twitter (international)

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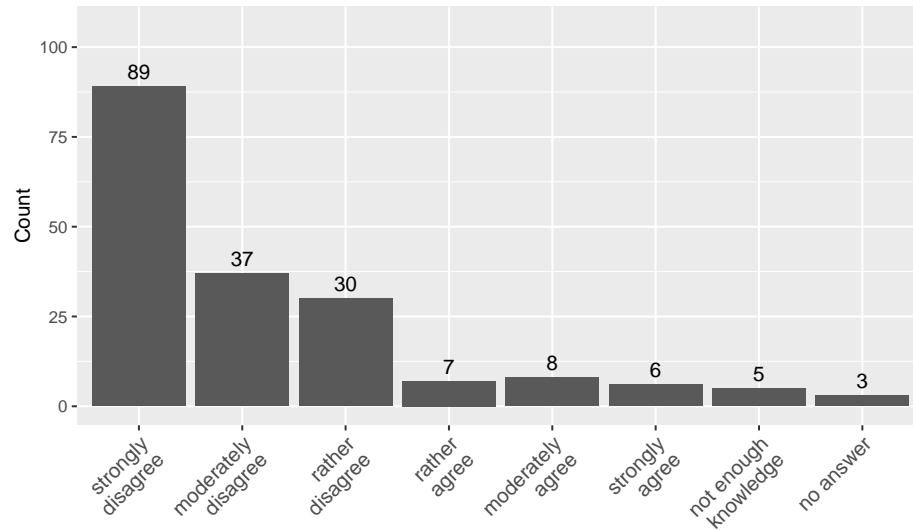


Twitter (international)

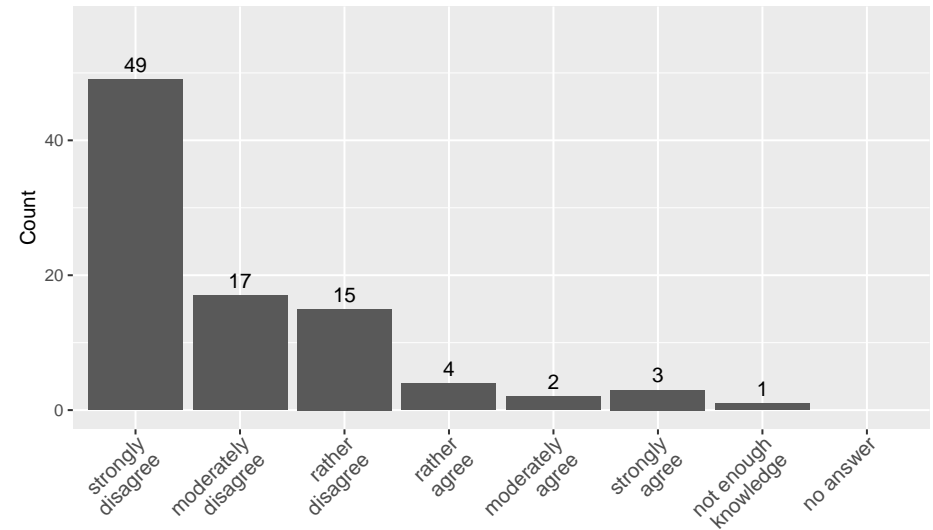


# “Aggregates are merely artifacts and do not exist in their natural state”

(Kravchenko et al. 2019)



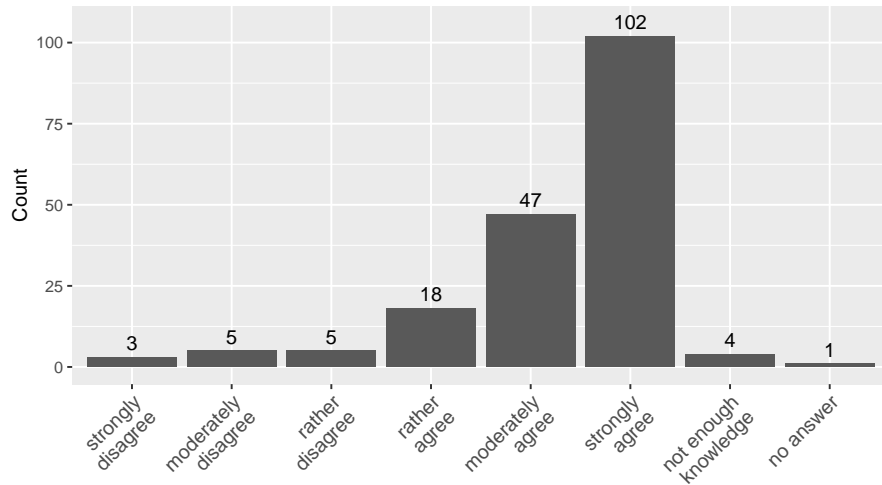
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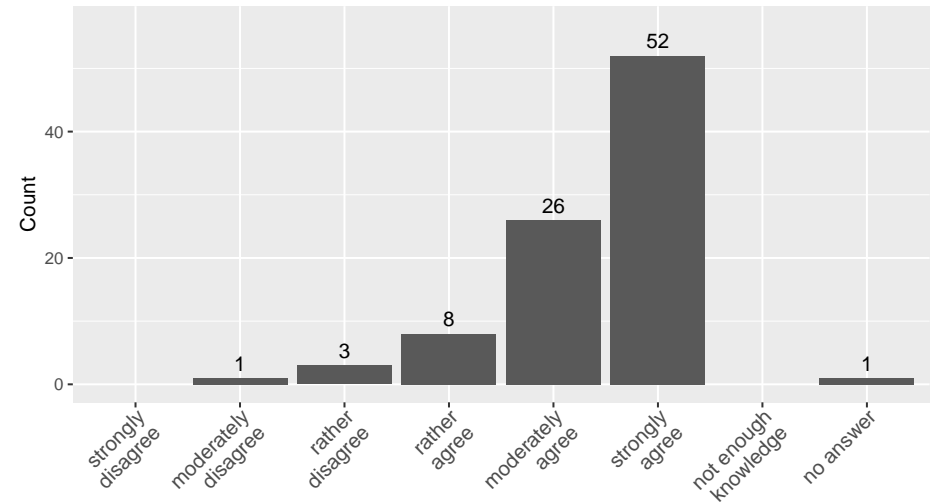
Twitter (international)

# “Aggregates do exist and have a size, form and stability that is typical for individual soils”

(Yudina and Kuzyakov 2019)

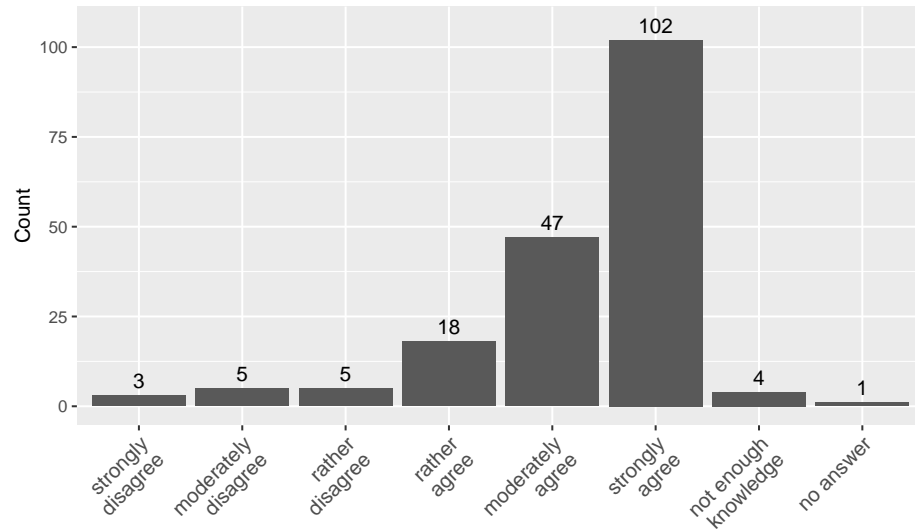


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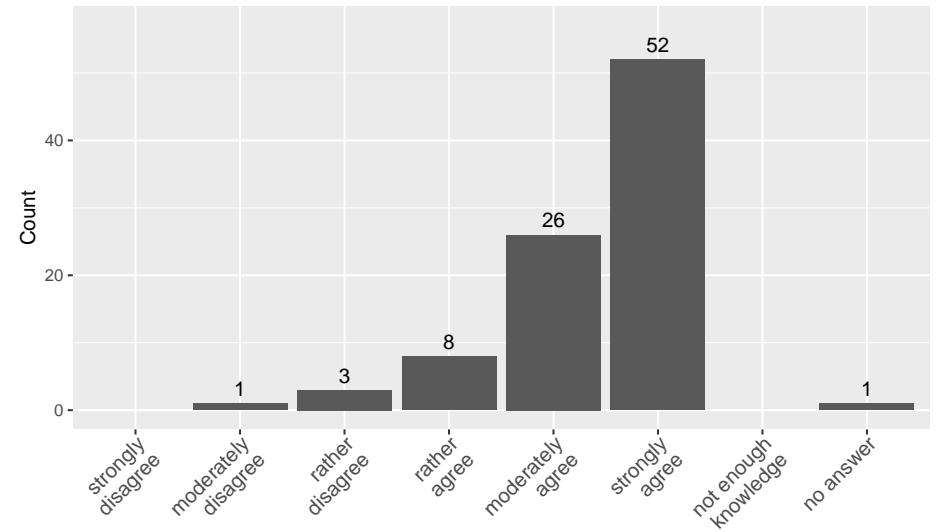


Twitter (international)

# 'The pore and aggregate perspective are conflicting'

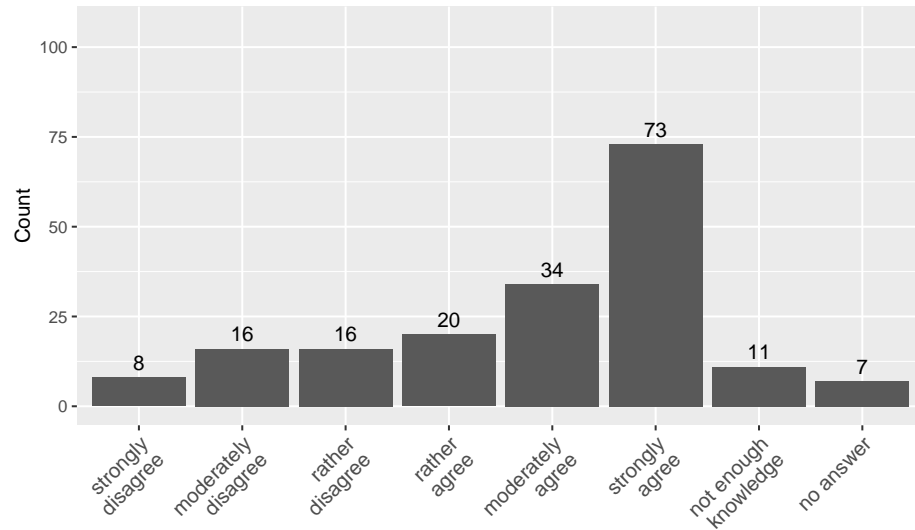


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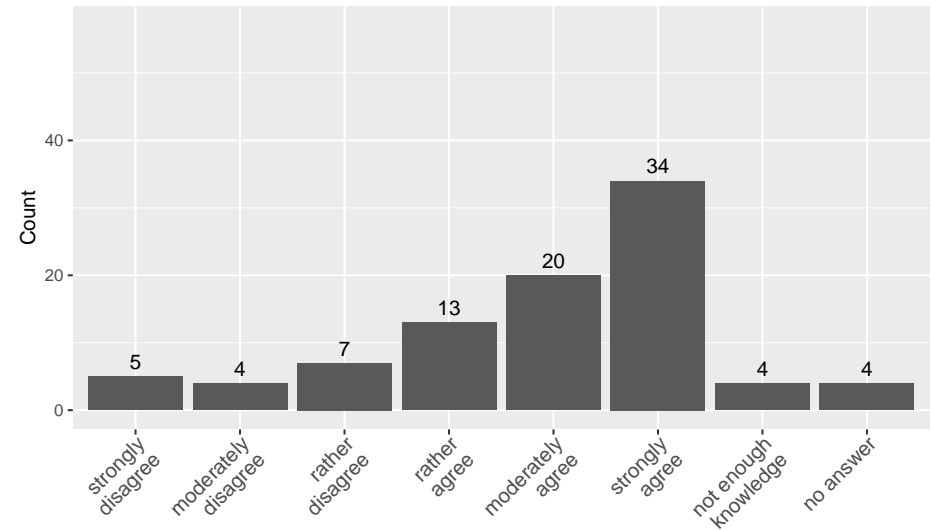


Twitter (international)

# 'The aggregate and pore perspective are two sides of one coin'



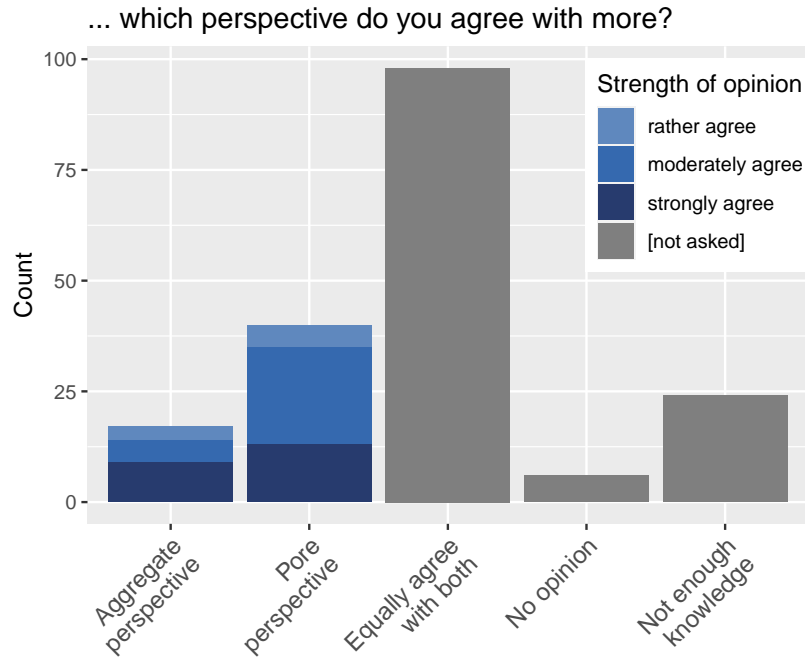
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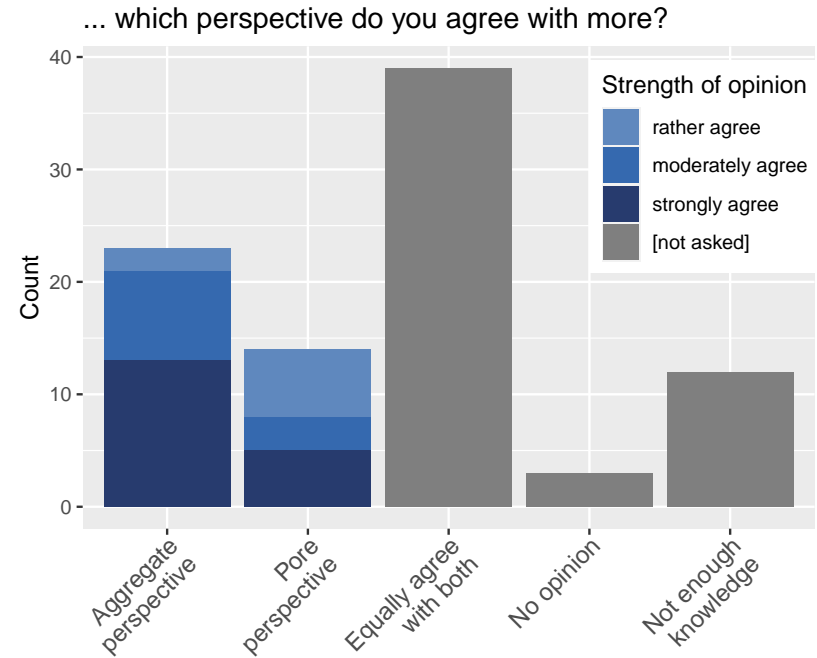
Twitter (international)



As mentioned, there are (at least) two broad perspectives on soil structure, the aggregate and the pore perspective. Using your own definitions of them, ...



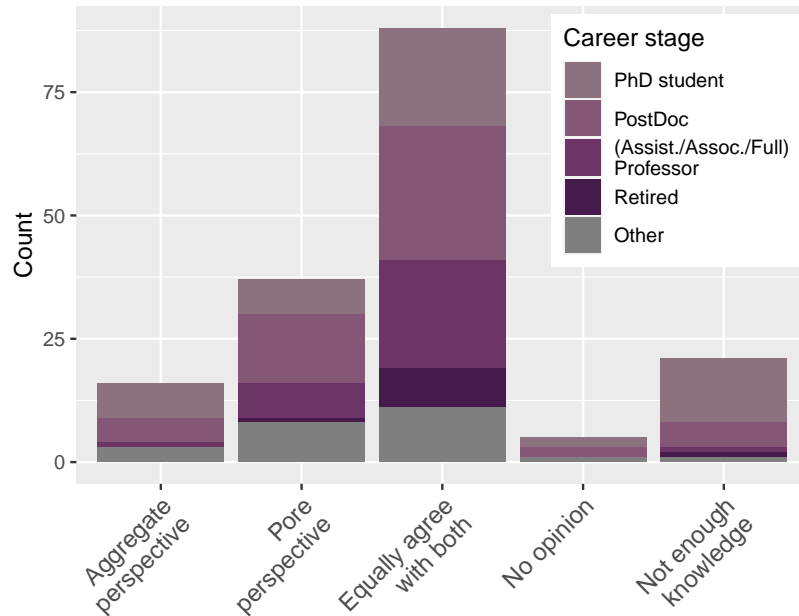
DBG (mostly Germany)



Twitter (international)

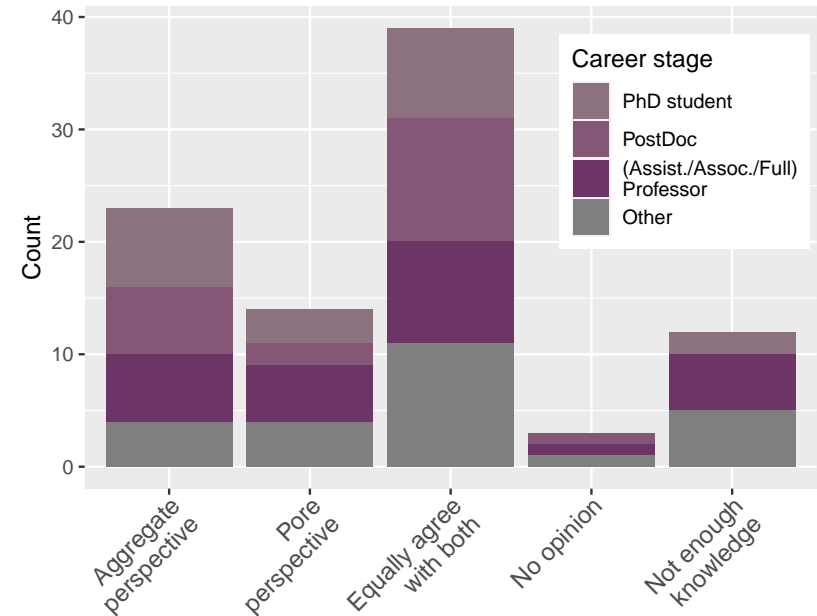
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... which perspective do you agree with more?



DBG (mostly Germany)

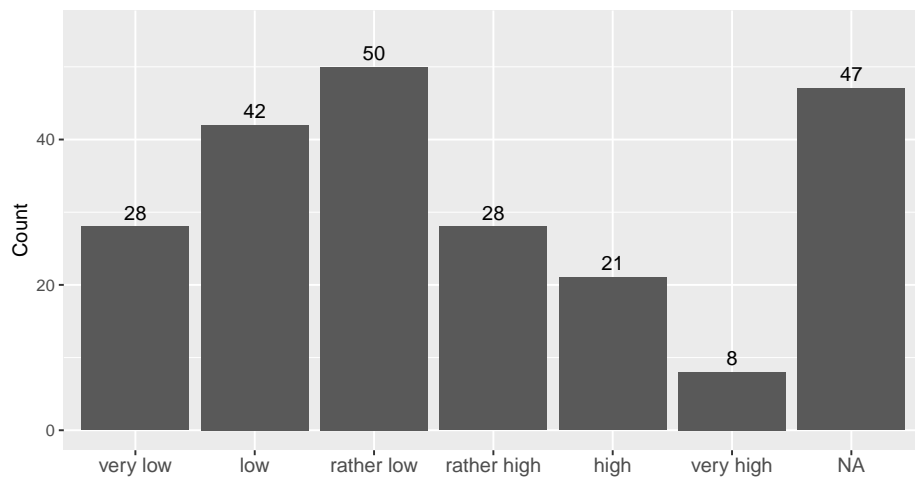
... which perspective do you agree with more?



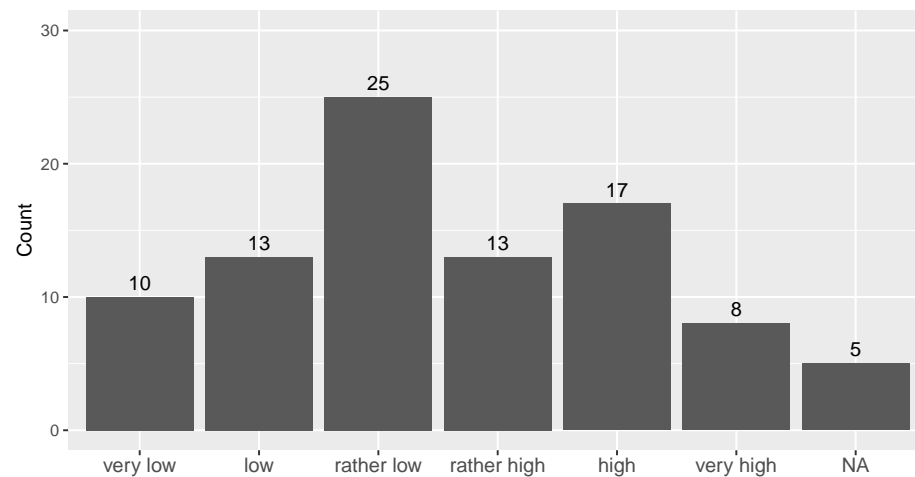
Twitter (international)

Assist. = assistant,  
 assoc. = associate  
 (types of professorships)

# The adequacy of aggregate and pore perspective is a matter of scientific debate. How do you rate the relevance of this debate to *your personal research*?

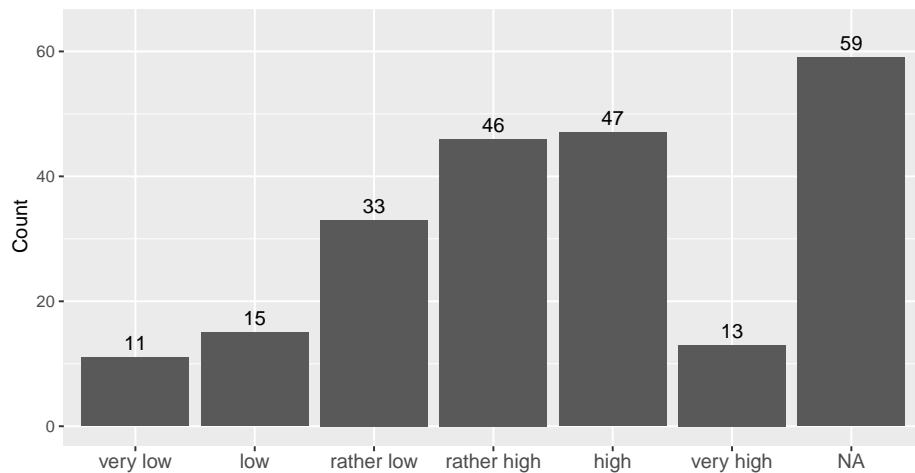


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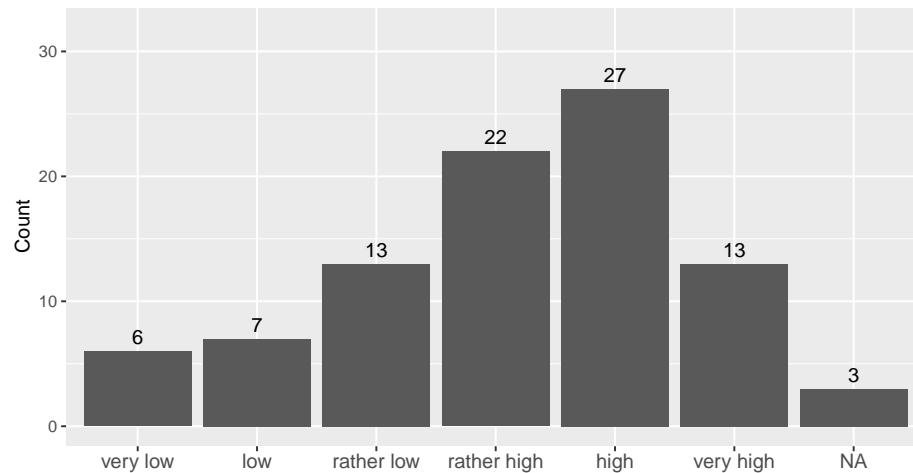


Twitter (international)

# The adequacy of aggregate and pore perspective is a matter of scientific debate. How do you rate the relevance of this debate to *soil science in general*?



DBG (mostly Germany)



Twitter (international)



# Want to reach out?



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... or come visit me in Hannover! :-)