

Impact of Question Difficulty on Engagement and Learning

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Example scenario

Example scenario



Example scenario



What is highlighted?

 Ireland

 Latvia

 Lithuania

 Don't know

 Continue

Example scenario

Scenario A: 10% errors



Scenario B: 50% errors



What is optimal question
difficulty?

...for engagement vs. for
learning

Prior research

- Inverted U hypothesis (Abuhamdeh et al., 2012)
- Educational game: easier problems lead to higher engagement, but lower learning. (Lomas et al., 2013)
- Math tutor: easiest condition leads to the best learning (Jansen et al., 2013)

Experimental setting



What is highlighted?



Argentina



Greenland



Libya



Don't know

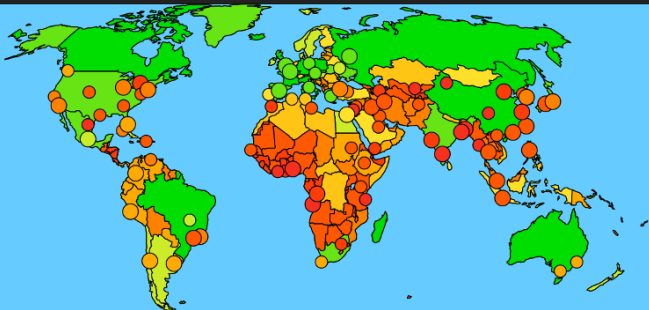


Continue

World



Feedback



Political map

Practice

Water

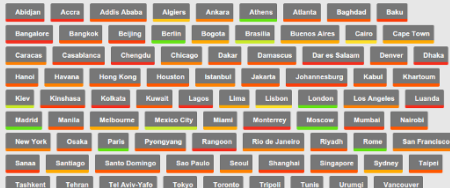
Surface

States

Practice

Cities

Practice



How do we aim?

- Prediction from a model
 - Russia vs. Serbia
- Number of options
 - Open question vs. 2-options MCQ

Experimental setting

- online AB experiment
- new learners were randomly assigned to one of the studied conditions

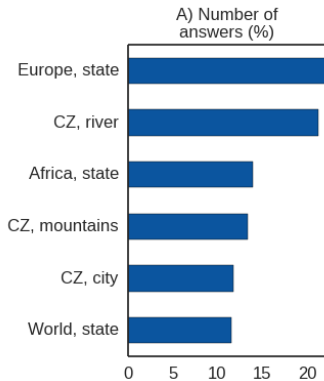
Target error rate	notation
5%	C05
20%	C20
35%	C35
50%	C50

Collected data

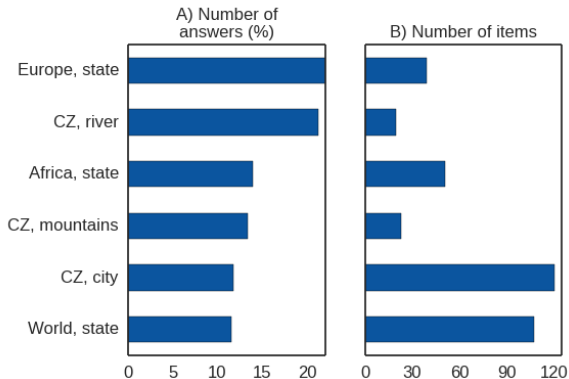
Collected data

- November 2015 to January 2016
- 3,300,000 answers from 37,000 learners
- Majority of learners:
 - Czech Republic (84 %)
 - Slovakia (8 %)

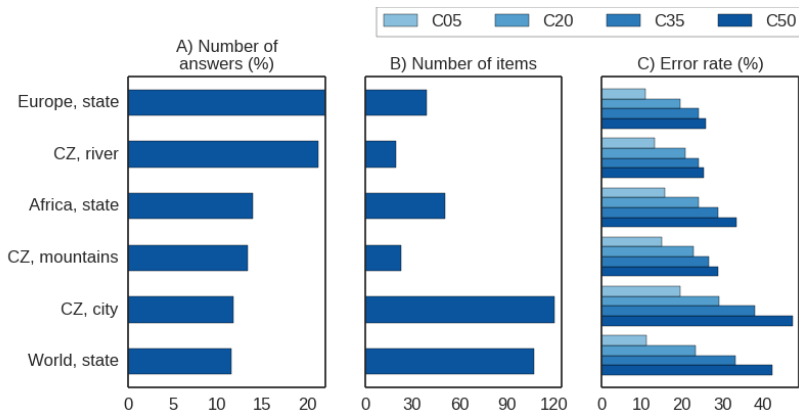
Contexts



Contexts

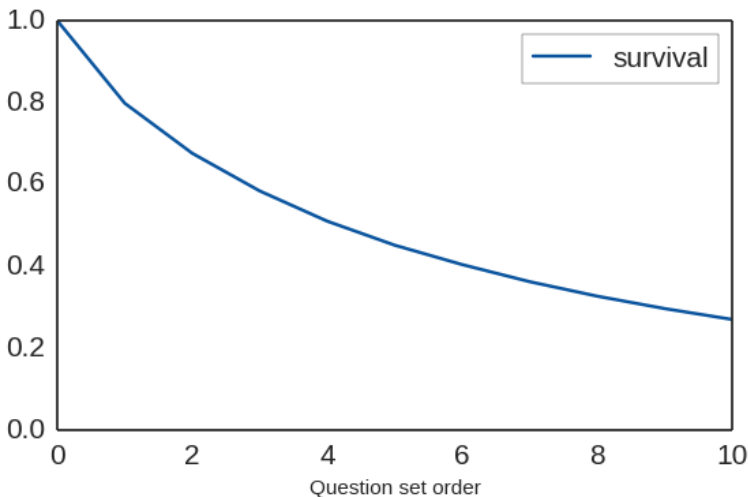


Contexts

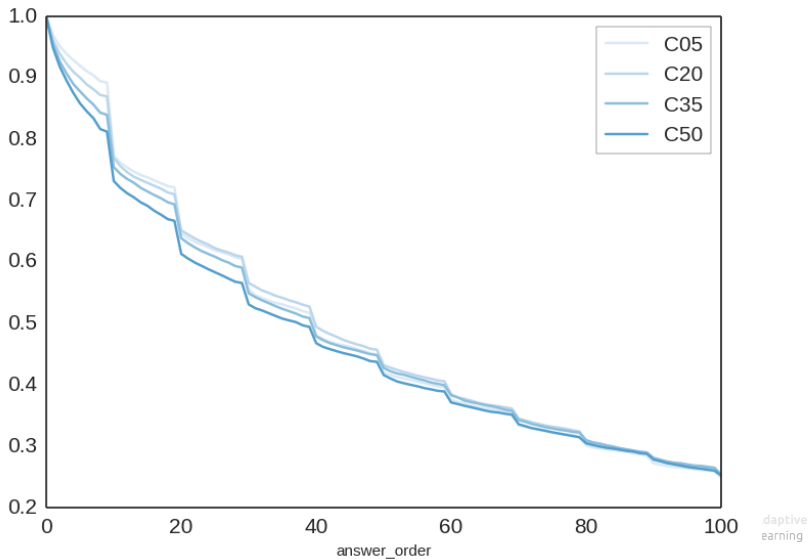


Impact on Engagement

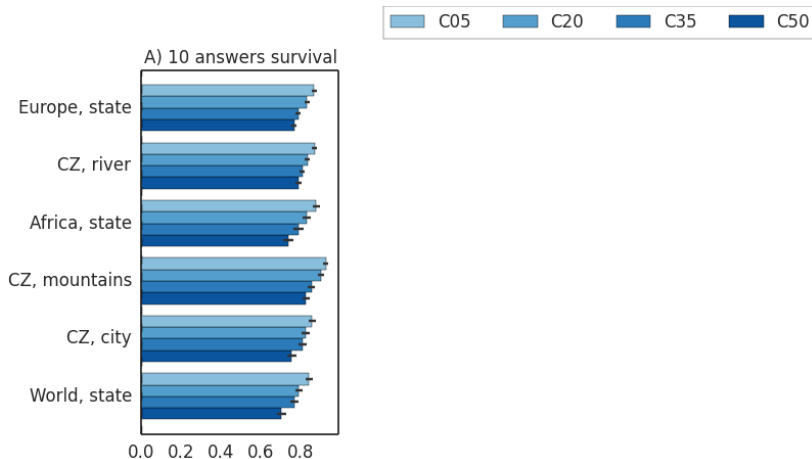
Survival curve



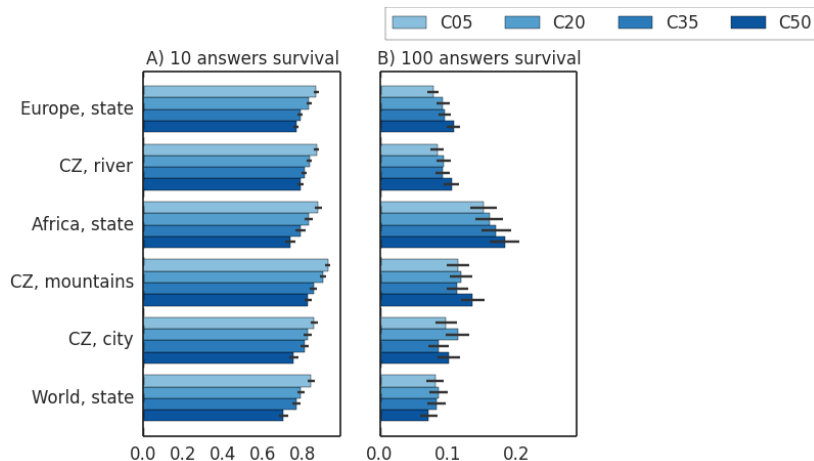
Survival curve



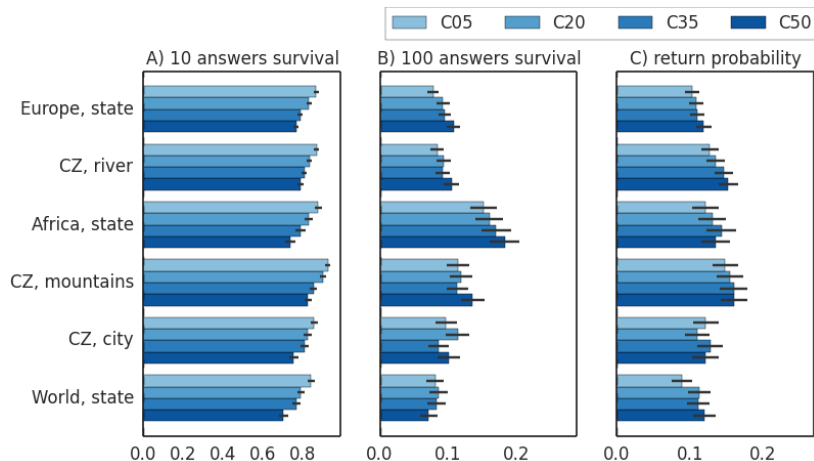
Survival



Survival



Survival



Impact on Learning

Reference questions

User A Europe, countries



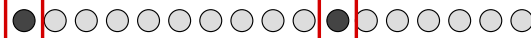
Africa, cities



User B CZ, rivers



User C Africa, cities



...

1

...

2

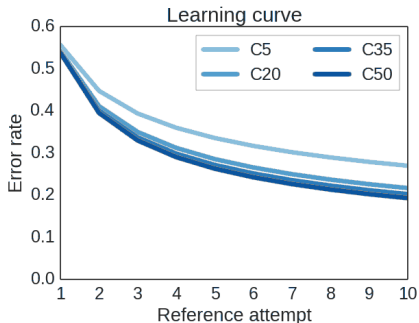
...

3

...

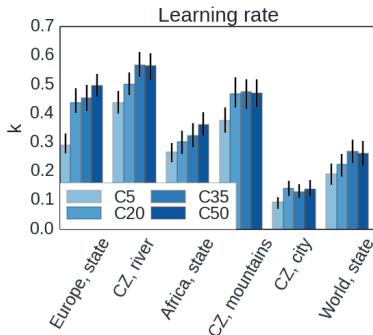
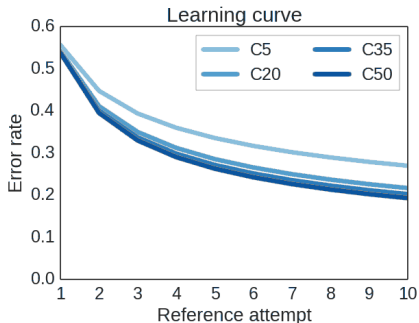
Learning curve

- Power law: $f(x) = ax^{-k}$
- x - number of attempts
- a - initial error rate
- k - learning rate

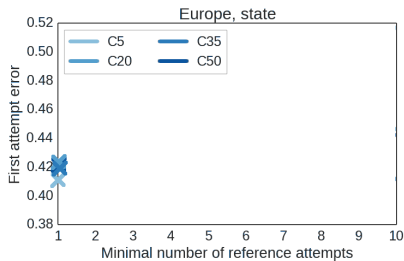


Learning curve

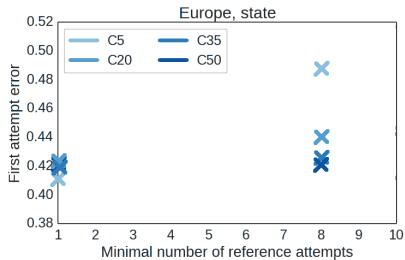
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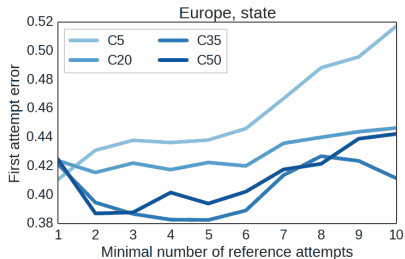
Attrition bias



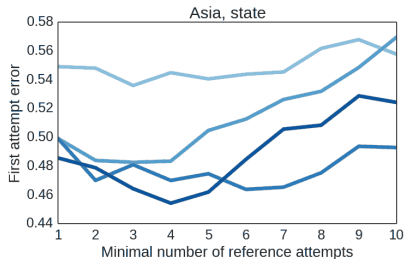
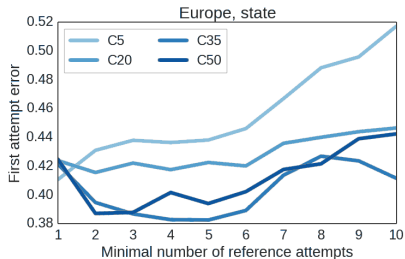
Attrition bias



Attrition bias



Attrition bias



Conclusion

- Easy questions good for
 - Short-term engagement
- Difficult questions good for
 - Long-term engagement
 - Learning
- Methodological issues:
 - Short-term vs. long-term engagement
 - Attrition bias

Thank you

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