# It's Easier to Translate *out of* English than *into* it: Measuring Neural Translation Difficulty by Cross-Mutual Information

ACL 2020

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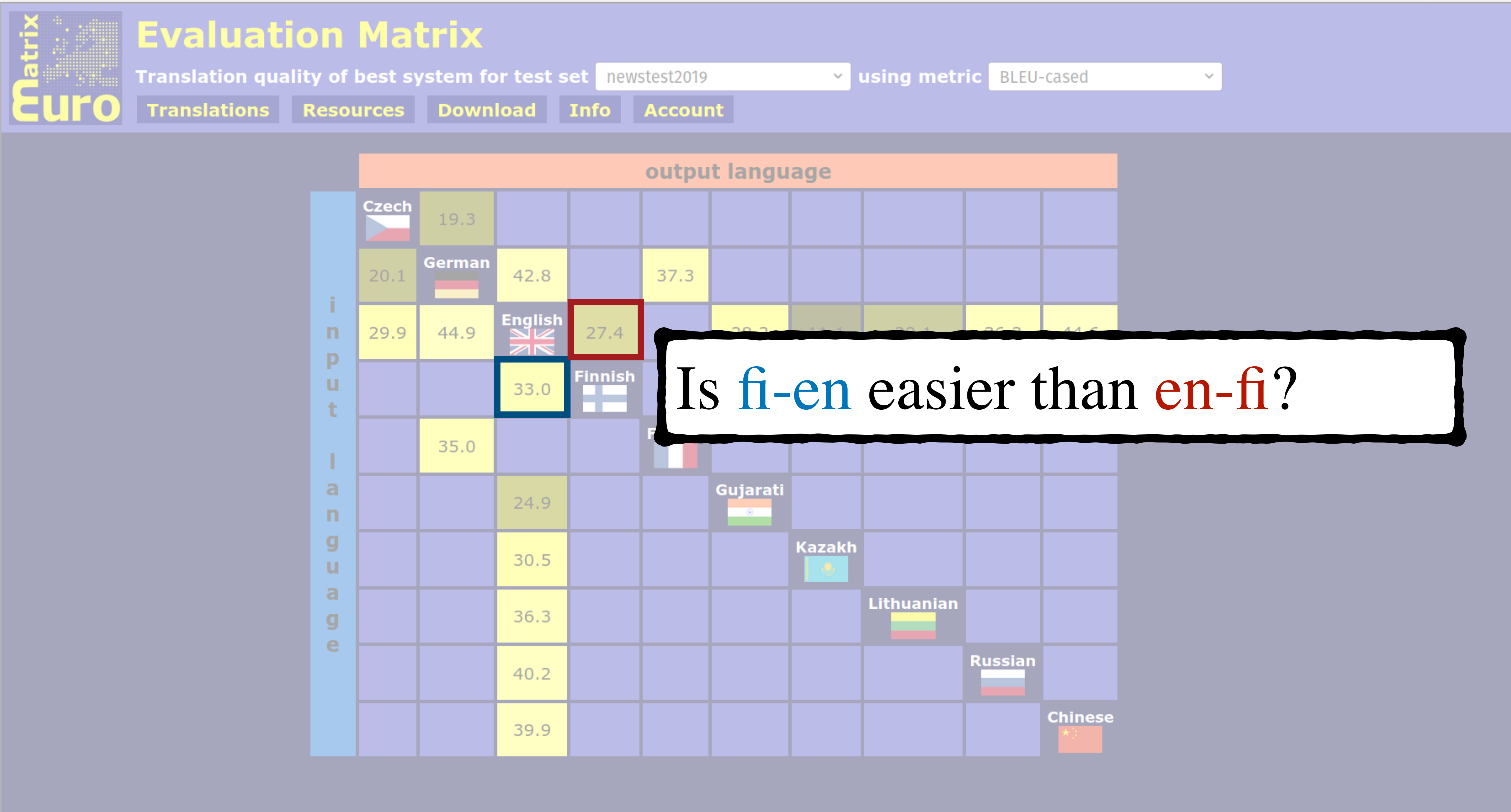
# Evaluation Matrix

Translation quality of best system for test set newstest2019 using metric BLEU-cased

Translations | Resources | Download | Info | Account

output language

| input language \ output language | Czech | German | English | Finnish | French | Gujarati | Kazakh | Lithuanian | Russian | Chinese |
|---|---|---|---|---|---|---|---|---|---|---|
| Czech | | 19.3 | | | | | | | | |
| German | 20.1 | | 42.8 | | 37.3 | | | | | |
| English | 29.9 | 44.9 | | 27.4 | | 28.2 | 11.1 | 20.1 | 36.3 | 44.6 |
| Finnish | | | 33.0 | | | | | | | |
| French | | 35.0 | | | | | | | | |
| Gujarati | | | 24.9 | | | | | | | |
| Kazakh | | | 30.5 | | | | | | | |
| Lithuanian | | | 36.3 | | | | | | | |
| Russian | | | 40.2 | | | | | | | |
| Chinese | | | 39.9 | | | | | | | |

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We can't tell based on BLEU!

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2. We are still measuring: difficulty of **translation** *and* **generation**

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**Entropy:** $\mathrm{H}(T) = \mathbb{E}_{t \sim p(T)}[-\log_2(p(t))]$ uncertainty

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*a priori*

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| H(谢谢 I Thanks) | uncertainty about “谢谢” after knowing its translation |
| MI(Thanks;谢谢) | how much easier it has become to predict “谢谢” |

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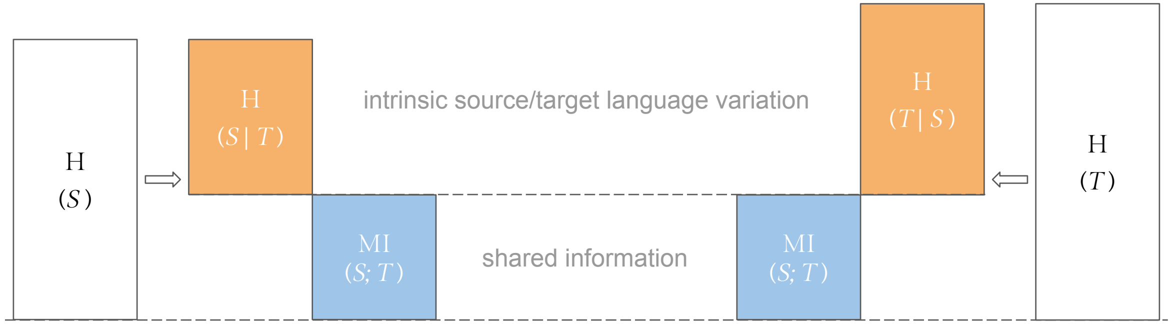


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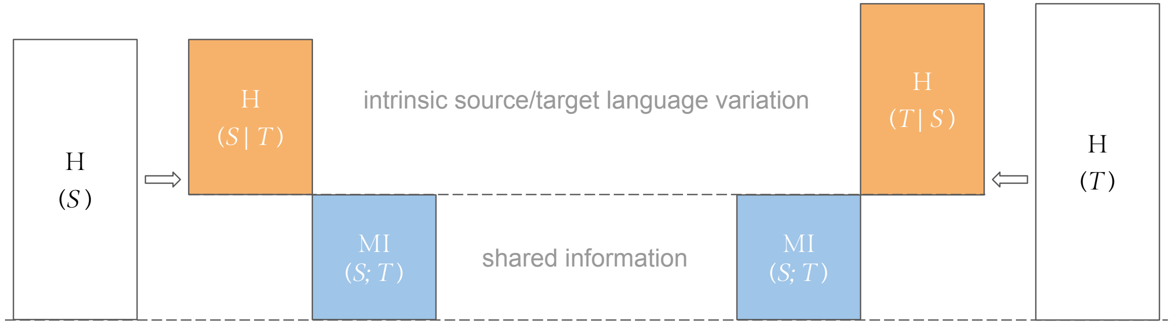


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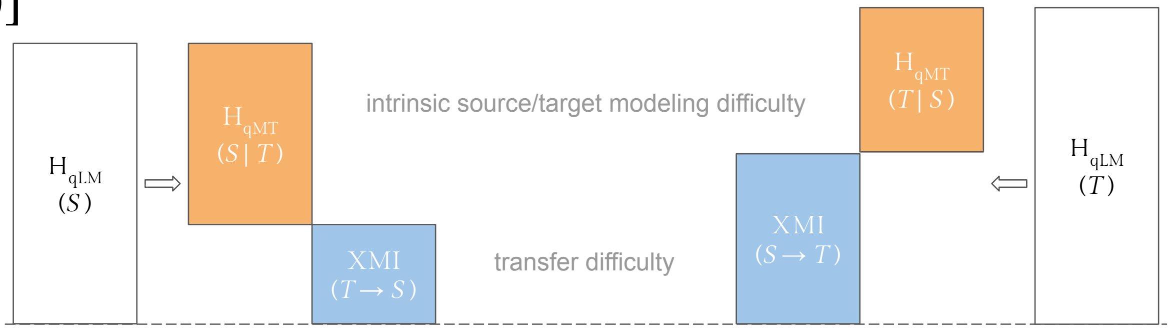

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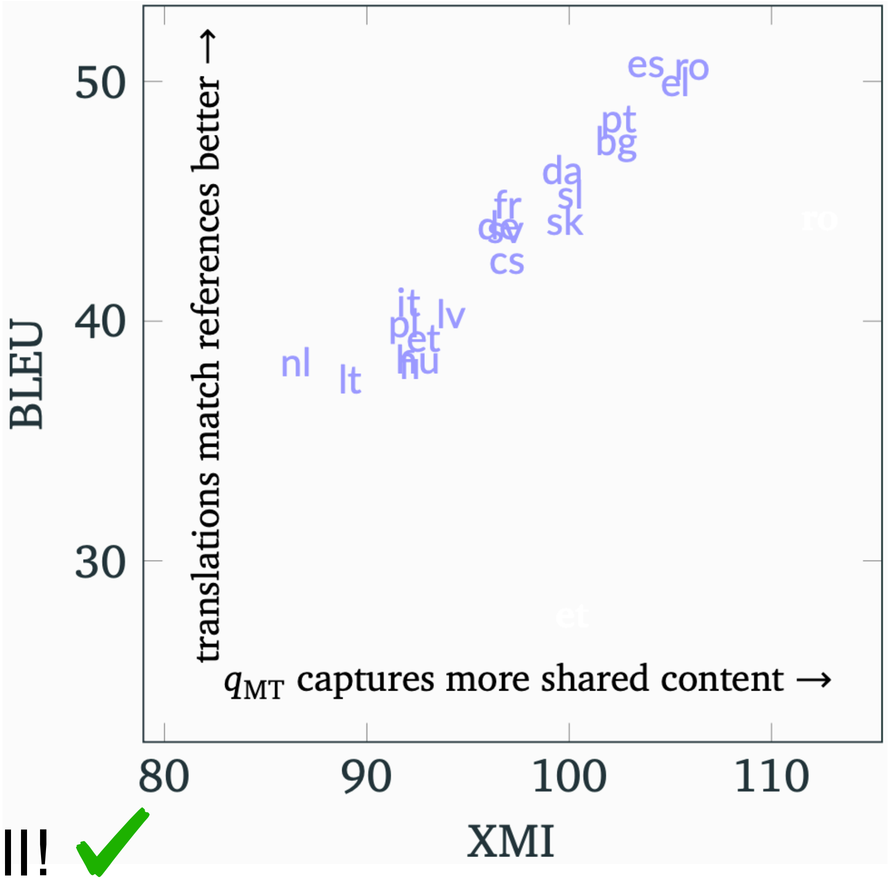


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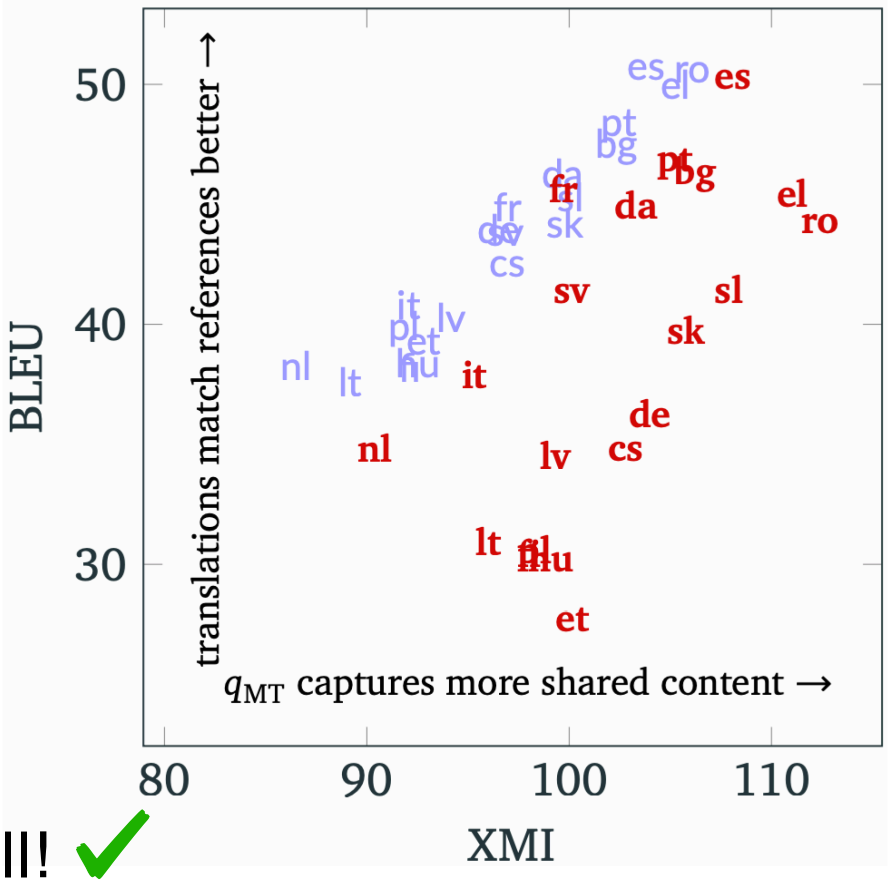


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- Check our paper for more correlations

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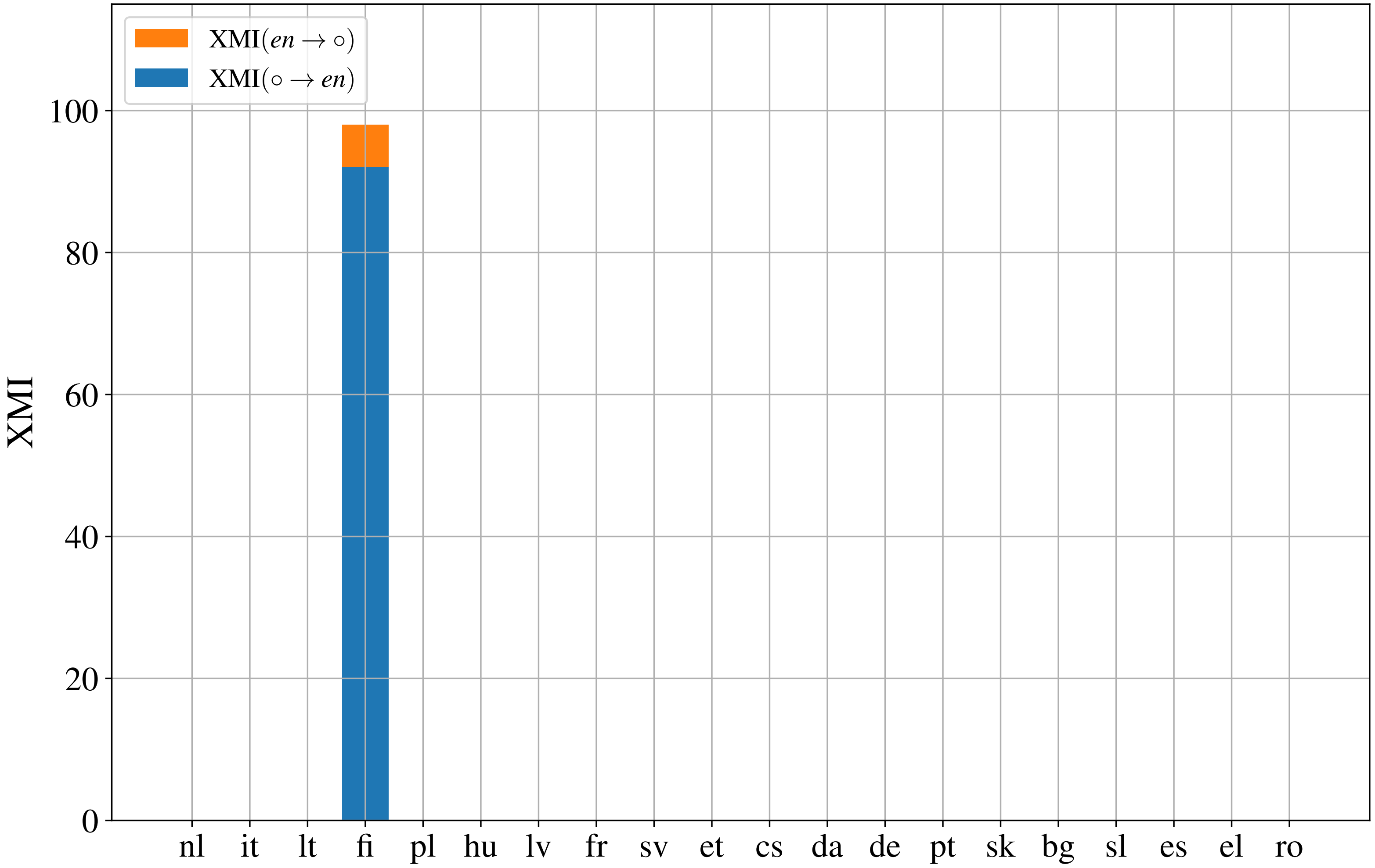

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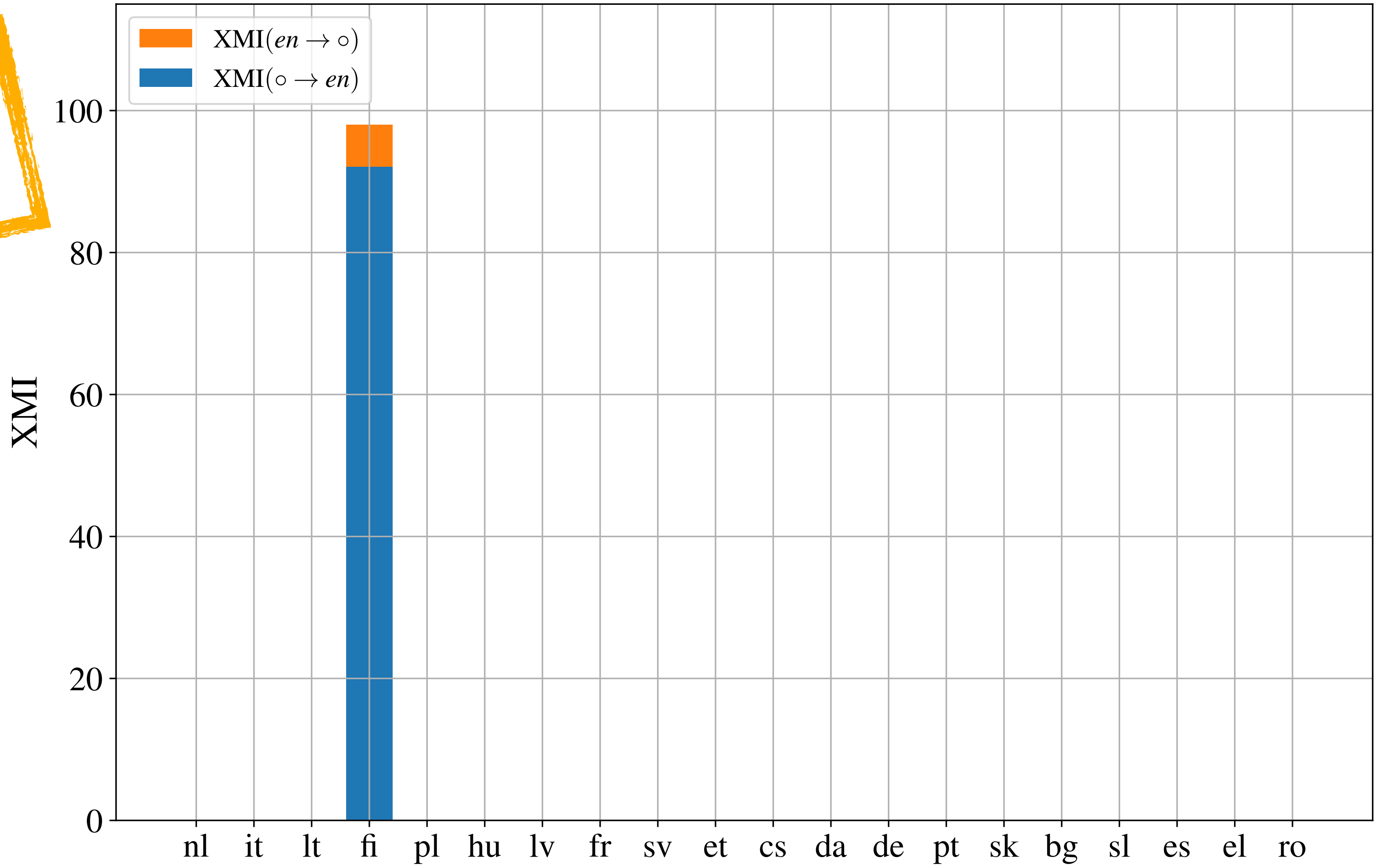

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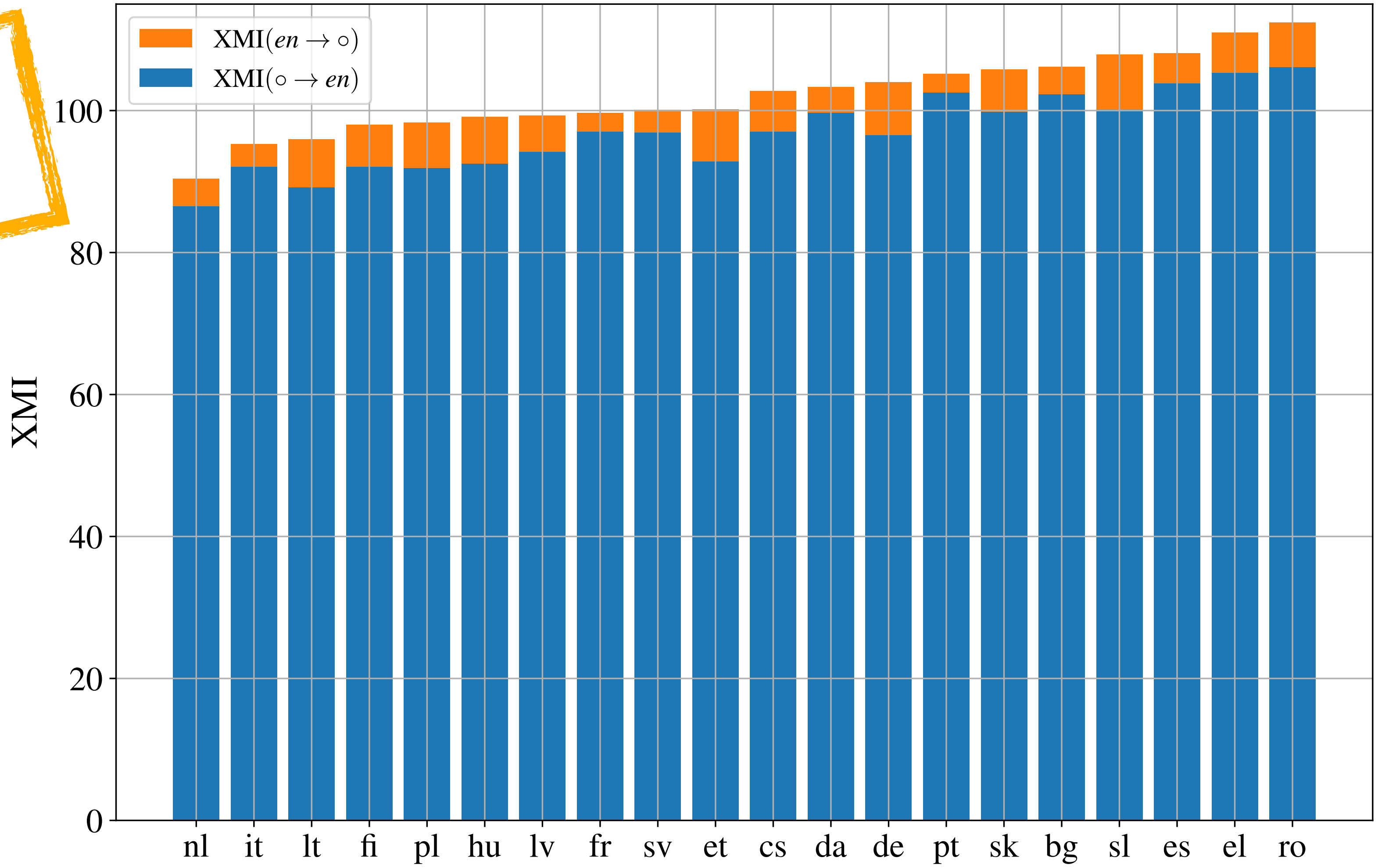

# Correlations with XMI?

The usual: type-token ratio…

but on the source side!

| Spearman's $\rho$ | Metric | ◌ → en | en → ◌ | both |
|---|---|---|---|---|
| Mielke et al. (2019) | $\mathrm{MCC}_{\mathrm{src}}$ | nope | nope | maybe? |
| | $\mathrm{MCC}_{\mathrm{tgt}}$ | nope | nope | maybe? |
| | $\mathrm{ADL}_{\mathrm{src}}$ | nope | nope | nope |
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| | $\text{HPE-mean}_{\mathrm{src}}$ | nope | nope | maybe? |
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| Lin et al. (2019) | genetic | nope | nope | nope |
| | syntactic | nope | nope | nope |
| | featural | nope | nope | nope |
| | phonological | nope | nope | nope |
| | inventory | nope | nope | nope |
| | geographic | nope | nope | nope |
| Lin et al. (2019) | word number ratio | maybe? | nope | maybe? |
| | $\mathrm{TTR}_{\mathrm{src}}$ | maybe? | – | **-0.51** |
| | $\mathrm{TTR}_{\mathrm{tgt}}$ | – | nope | maybe? |
| | $d_{\mathrm{TTR}}$ | maybe? | nope | **-0.47** |
| | word overlap ratio | nope | nope | nope |

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Code available online at https://github.com/e-bug/nmt-difficulty