Neural Network-based exploration of construct validity for Russian version of the 10-item Big Five Inventory

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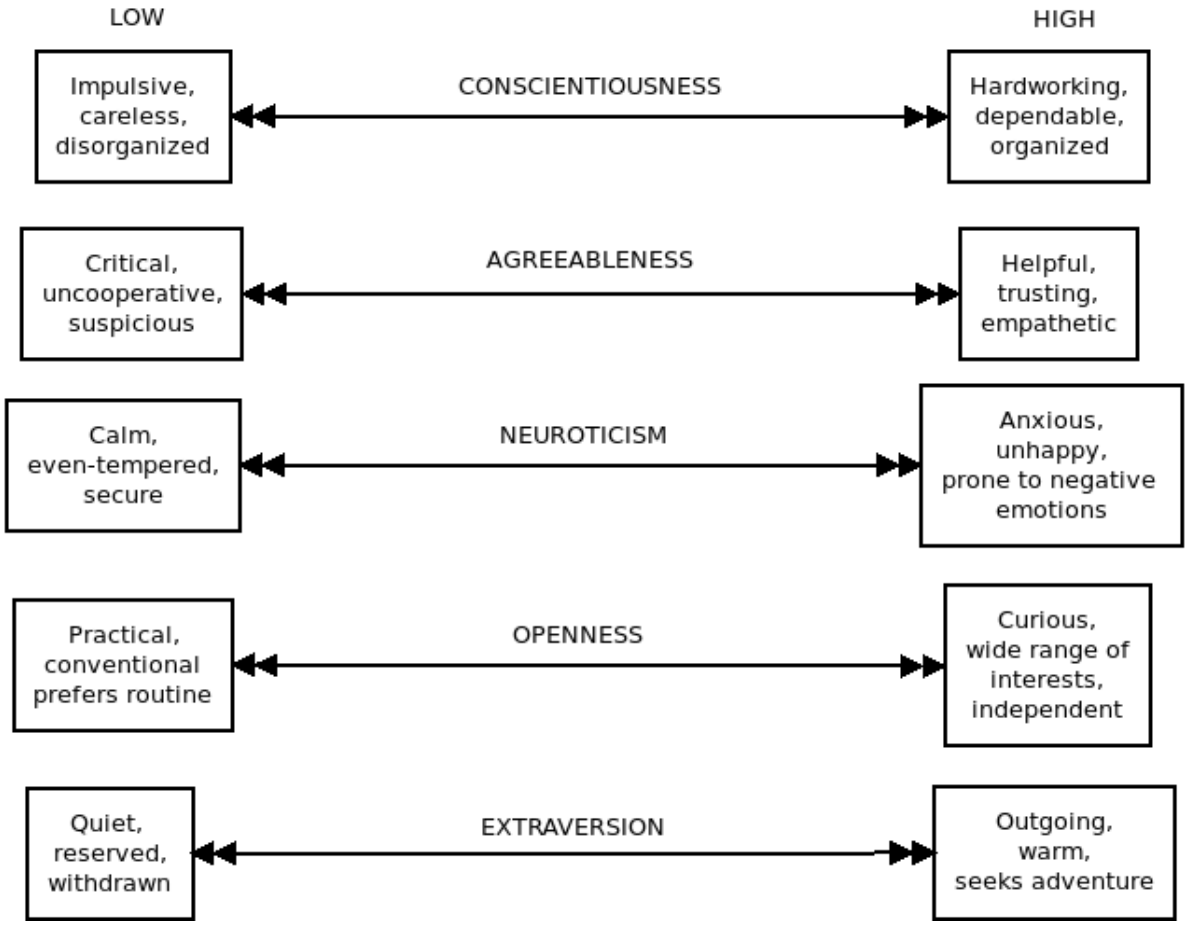
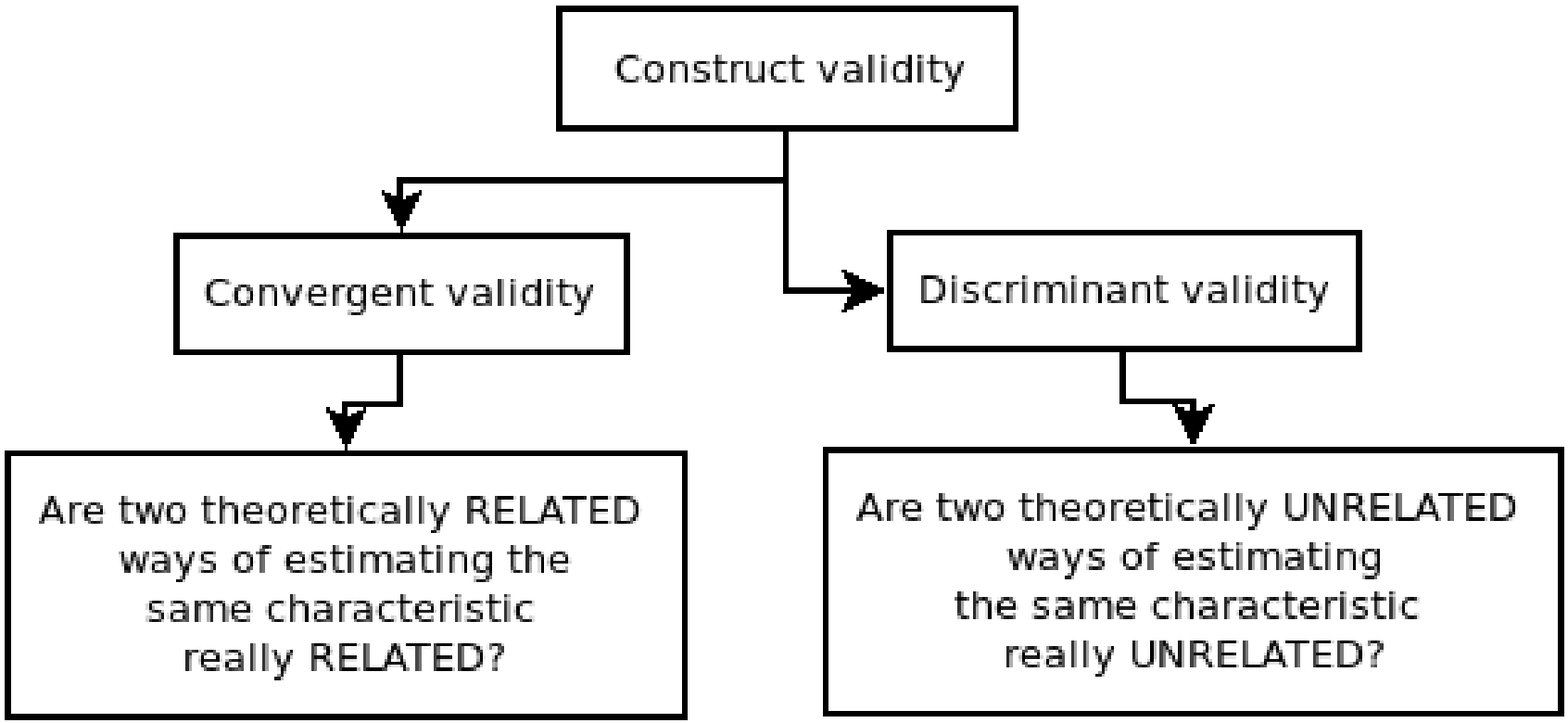
Big Five model



Construct validity

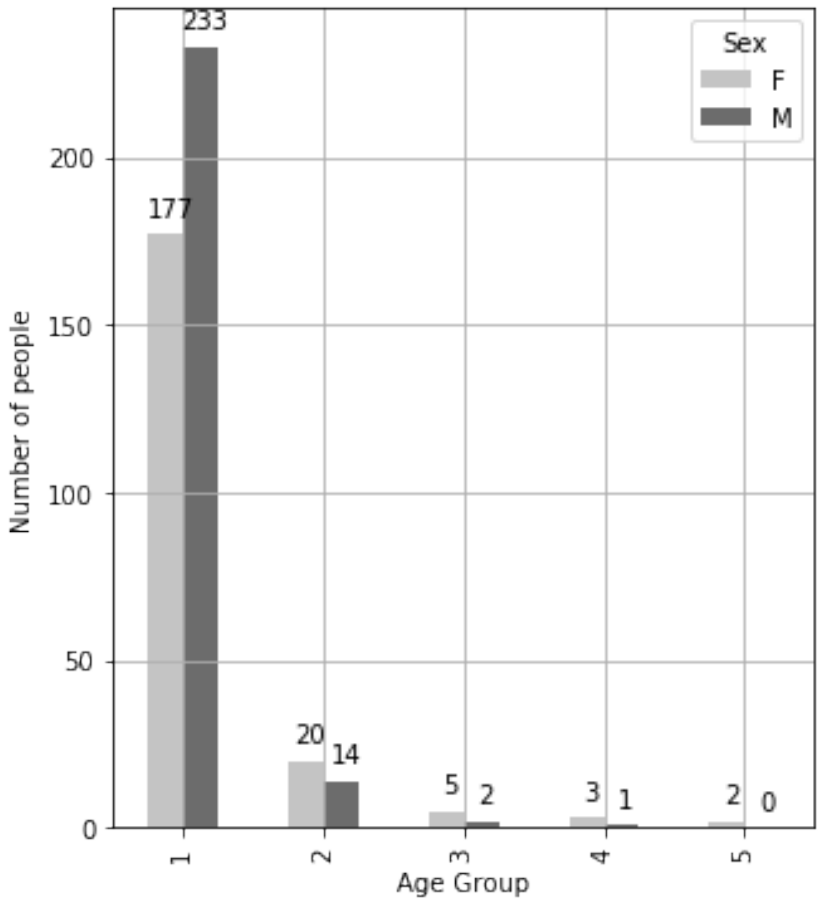


Main contributions

- First ever attempt to apply neural networks for construct validity evaluation;
- Simple qualitative approach to investigate convergent validity of questionnaire via permutation testing;
- Test of convergent and discriminant validity using interpretation of trained convolutional weights.

The data and source code are freely available at https://github.com/bakirillov/neurovalidation.

Sample



- 457 participants;
- 218 of them were taken from (Sergeeva et. al, 2016), available at https://github.com/bakirillov/tipiru.;
- Age groups:
  1. 10-19 years;
  2. 20-29 years;
  3. 30-39 years;
  4. 40-49 years;
  5. 50-59 years.

TIPI computation as neural network

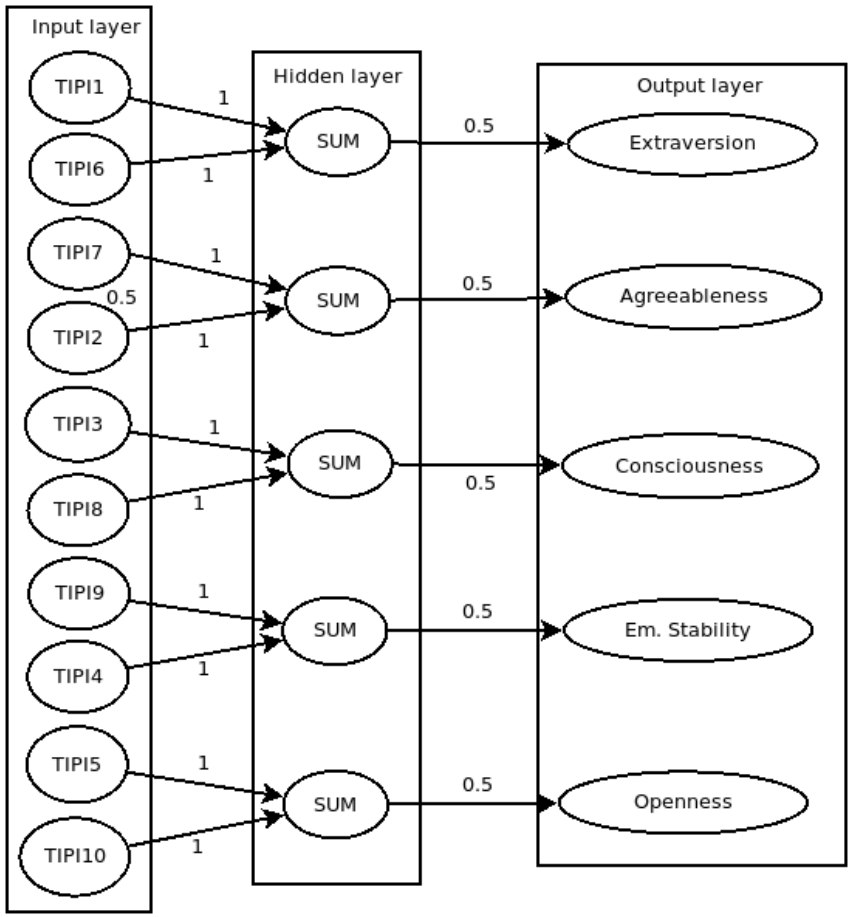
$$\mathrm{E} = 0.5(\mathrm{TIPI}_1 + \mathrm{reverse}(\mathrm{TIPI}_6)) \quad (1)$$

$$\mathrm{A} = 0.5(\mathrm{TIPI}_7 + \mathrm{reverse}(\mathrm{TIPI}_2)) \quad (2)$$

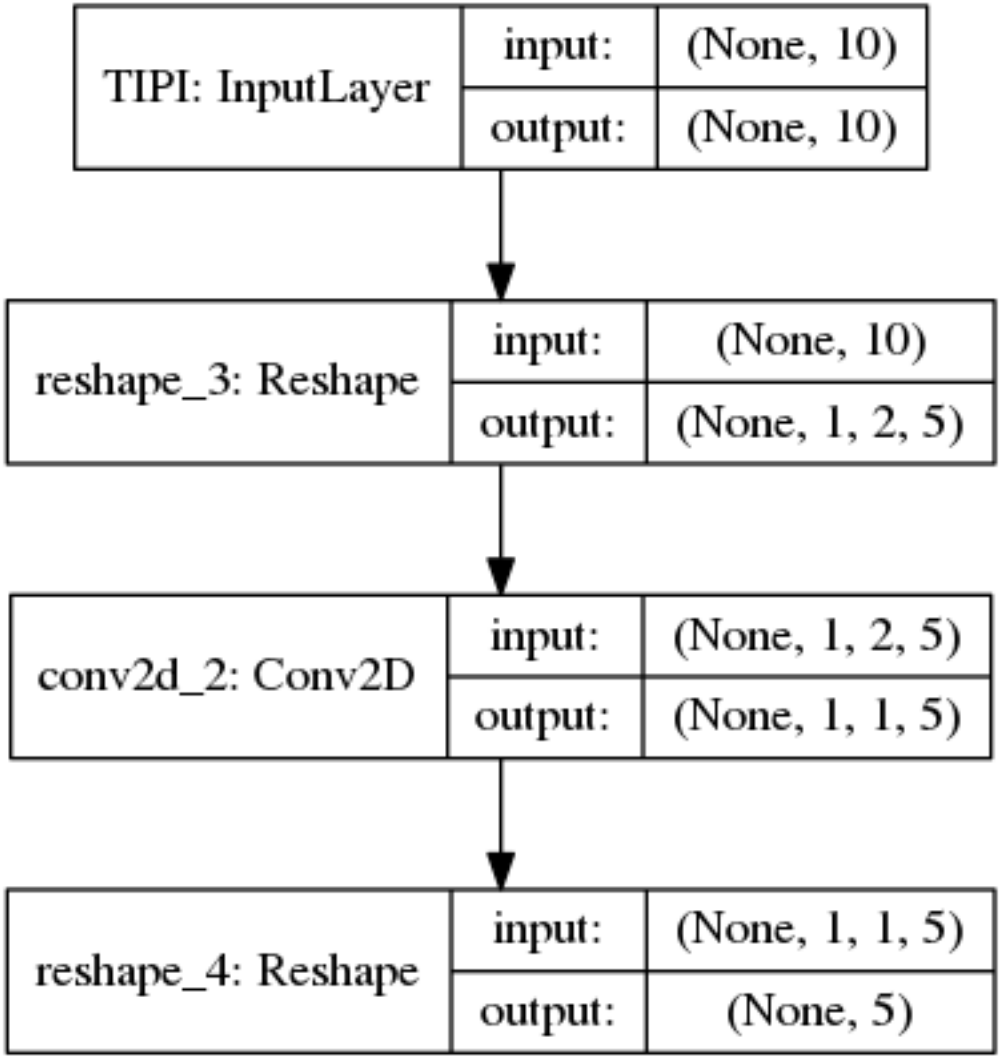
$$\mathrm{C} = 0.5(\mathrm{TIPI}_3 + \mathrm{reverse}(\mathrm{TIPI}_8)) \quad (3)$$

$$\mathrm{ES} = 0.5(\mathrm{TIPI}_9 + \mathrm{reverse}(\mathrm{TIPI}_4)) \quad (4)$$

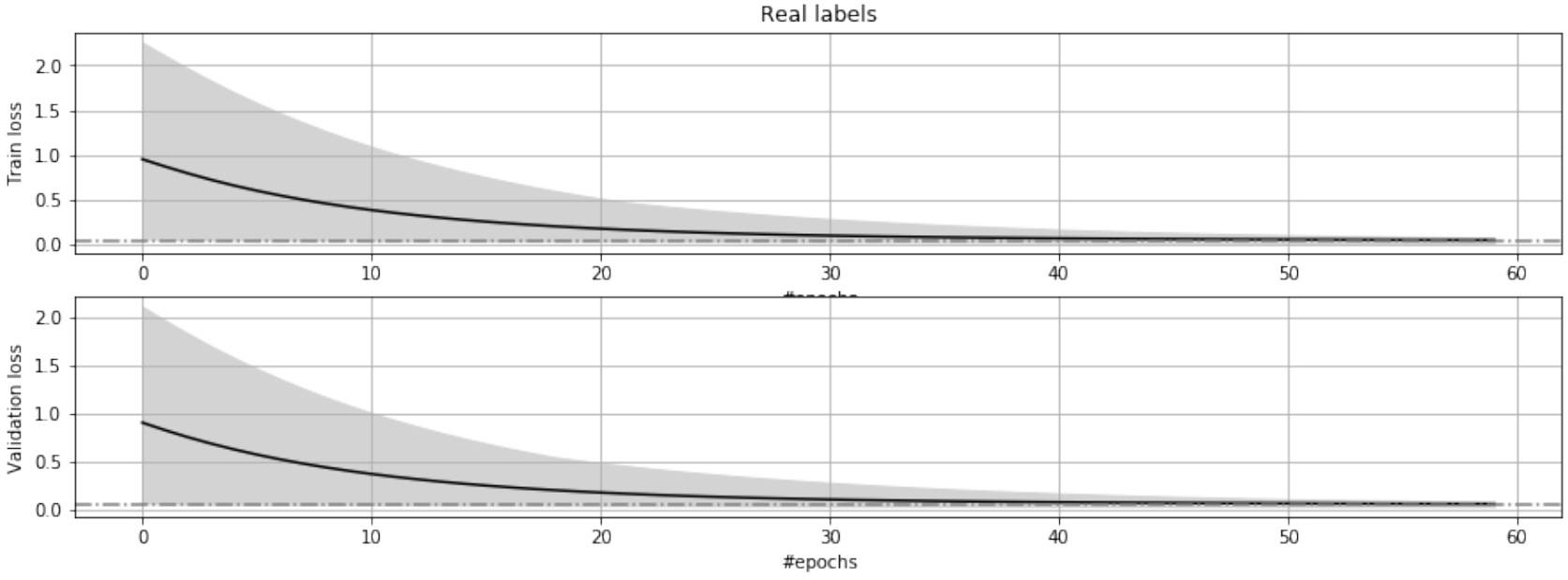
$$\mathrm{O} = 0.5(\mathrm{TIPI}_5 + \mathrm{reverse}(\mathrm{TIPI}_{10})) \quad (5)$$



Actual network that learns TIPI-5PFQ connection

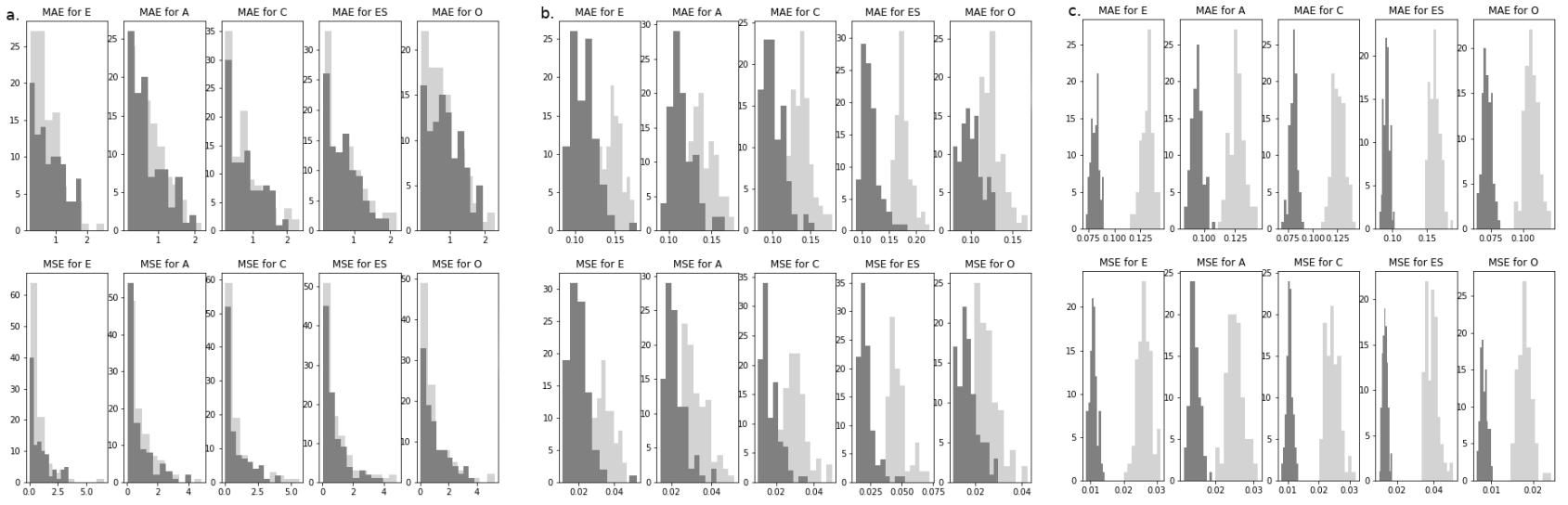


Training behavior of the network



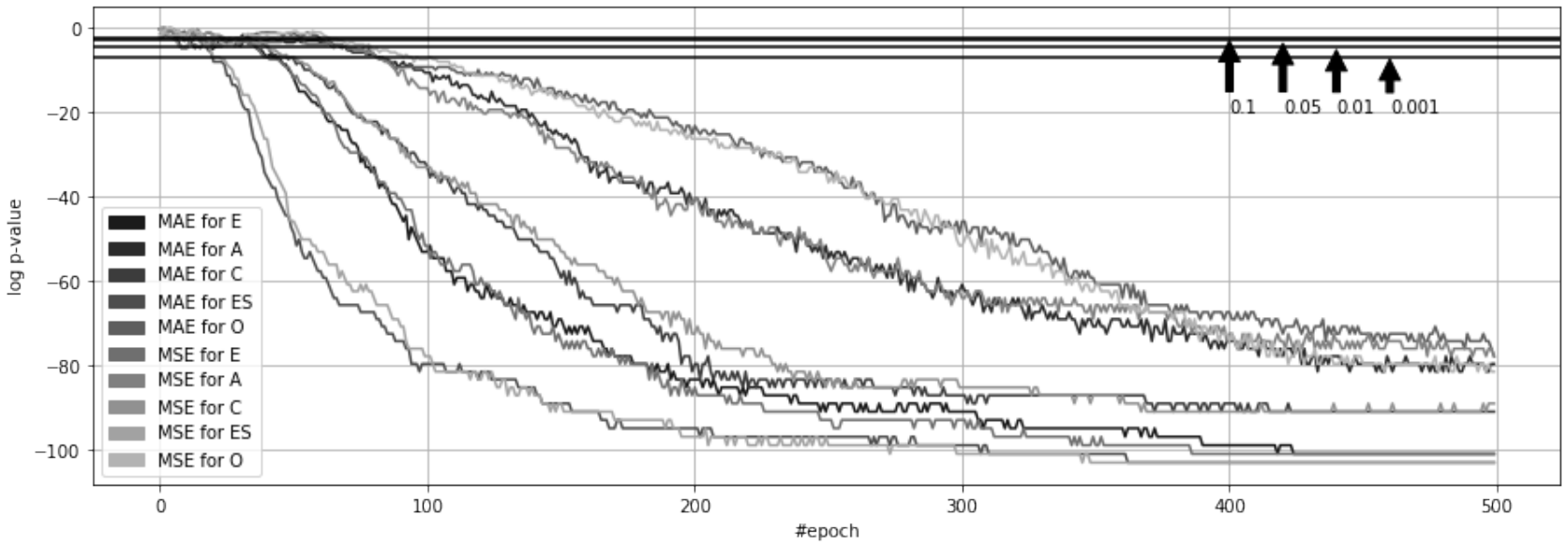
Key assumption: best possible predictions of 5PFQ that a generalizable (not overfitted) model can make from the TIPI-RU data are actually the TIPI-RU values themselves.

Permutation testing



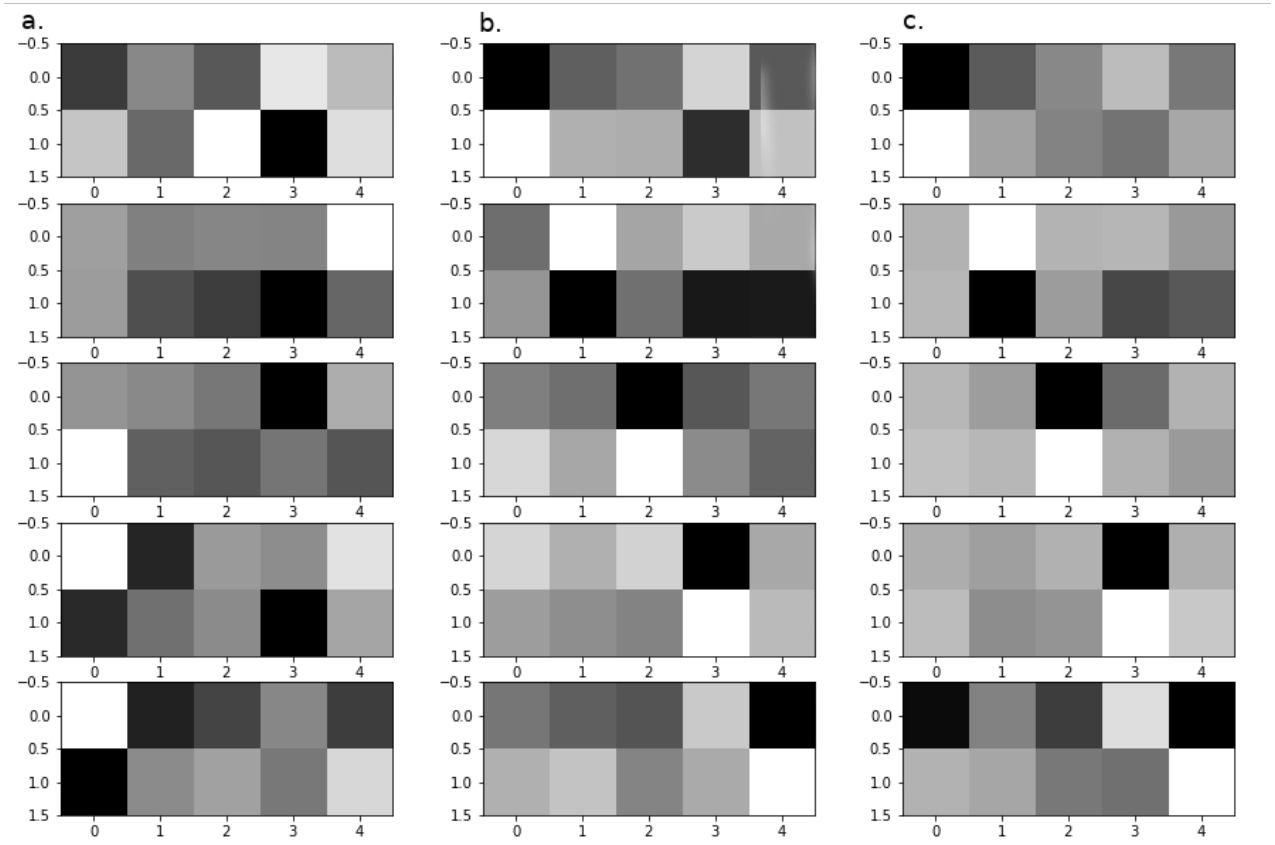
Divergence of two distributions shows presence of learnable connection between TIPI-RU and 5PFQ.

Kolmogorov-Smirnov test



KS-test converges with the graphical comparison: the p-values go down during the training.

Interpretation of trained weights



Visualized convolutional weights mimic structure of data. Sign reversal in Agreableness is captured. Openness is inconsistent.

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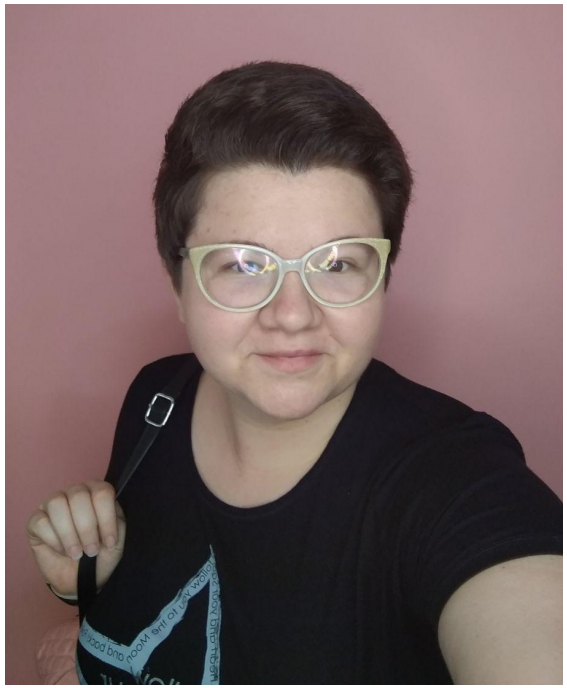

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