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Learning Task-Specific Scene Gist Representations from Low-Level Image Statistics

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What did you see?



The gist of a scene

- Holistic meaning and layout of a scene
 - aka “category of a scene”
- Extracted in a single glance ($< 100\text{ms}$)
- Gist extraction improves with experience in a visual task

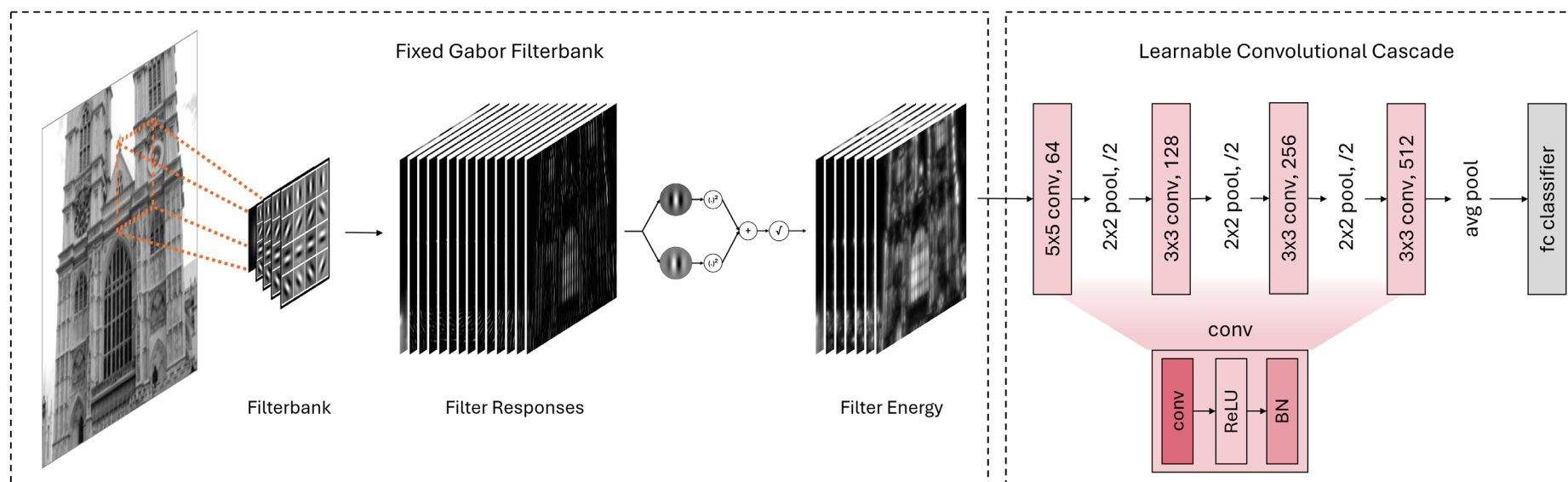


Source: Maarten van den Heuvel, Unsplash.

How to model task-specific improvement in scene gist extraction?

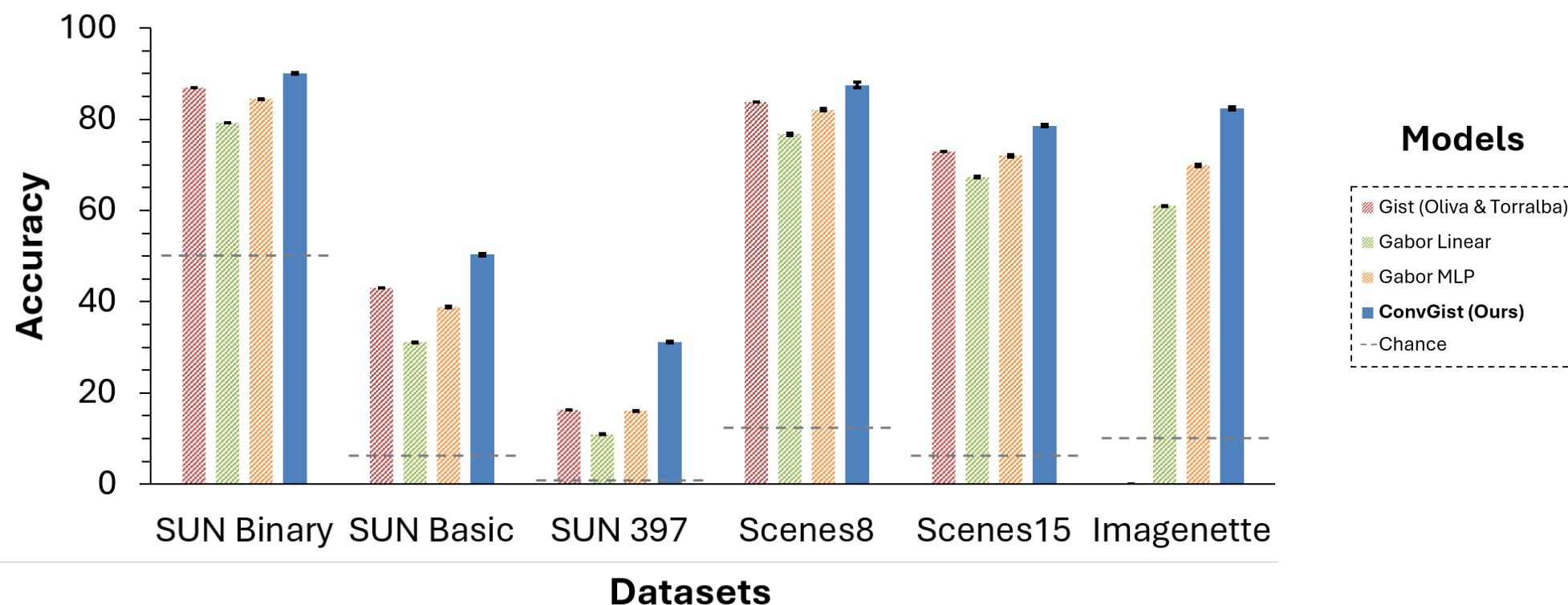
We propose ConvGist, a convolutional model of task-specific gist

- **Early proposal¹:** Global feature extraction by spectral analysis using Gabor filters
- **Extension:** We combine Gabor filterbank with a learnable convolutional cascade
 - Fixed Gabor filterbank extracts low-level representation correlated with V1 responses
 - Learnable filtering cascade refines them for target domain

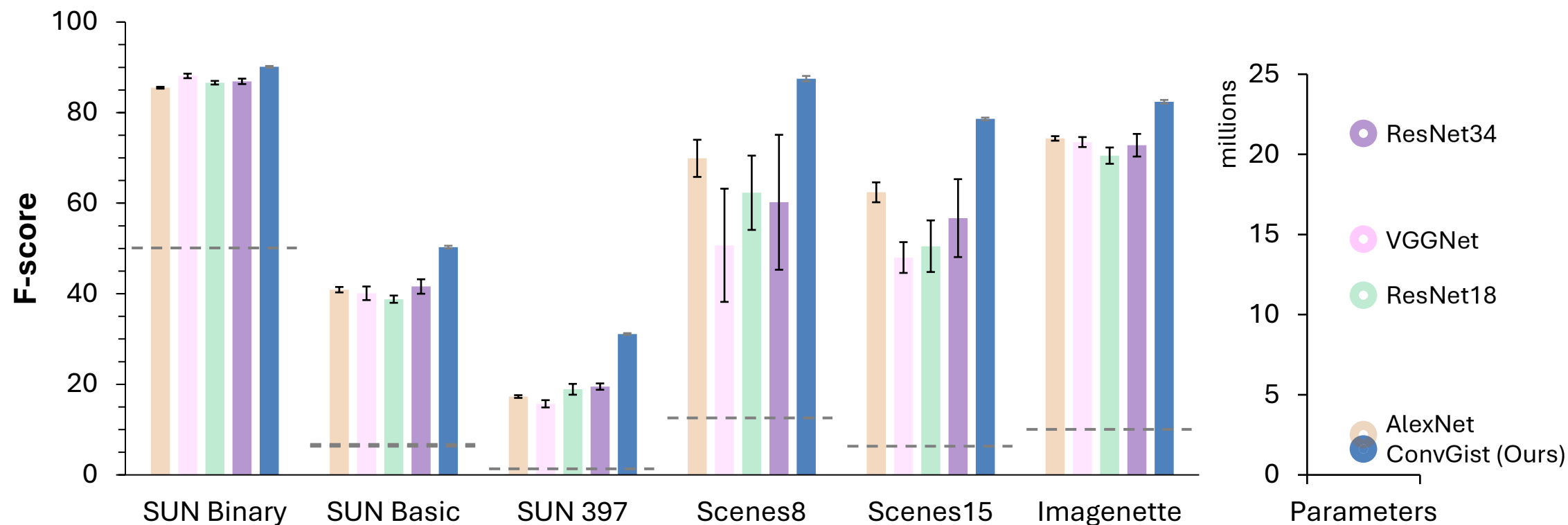


ConvGist outperforms static gist representations on tested datasets

- Comparison vs global statistical feature extraction without learnable feature refinement
- Greater improvement on datasets that require fine-grained information

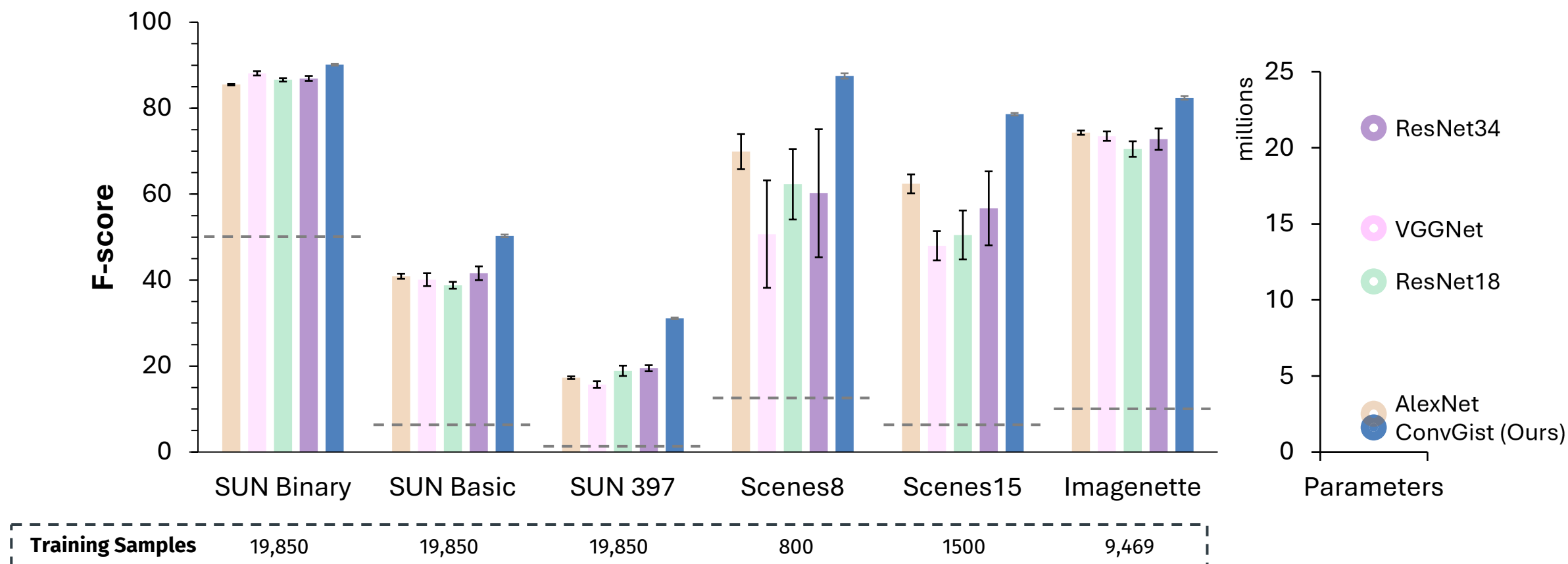


ConvGist outperforms much larger CNNs on tested datasets



ConvGist outperforms much larger CNNs on tested datasets

- **Hypothesis:** Gabor filterbank acts as an inductive bias, enabling data-efficient training





Conclusion

We combine a **fixed Gabor filterbank** with a **learnable convolutional cascade** to **model task-specific** improvement in **scene gist** extraction.

ConvGist model **outperforms** static scene **gist models** and **much larger CNNs**

Gabor filterbank may be an **effective inductive bias** for data-efficient training

Future Work

Systematic evaluation of component choices and **comparison with** more **recent** scene gist and scene classification **models**

Incorporation of more biologically-inspired **components**, e.g. normalisation

Comparison of model behavior **to human gist perception**



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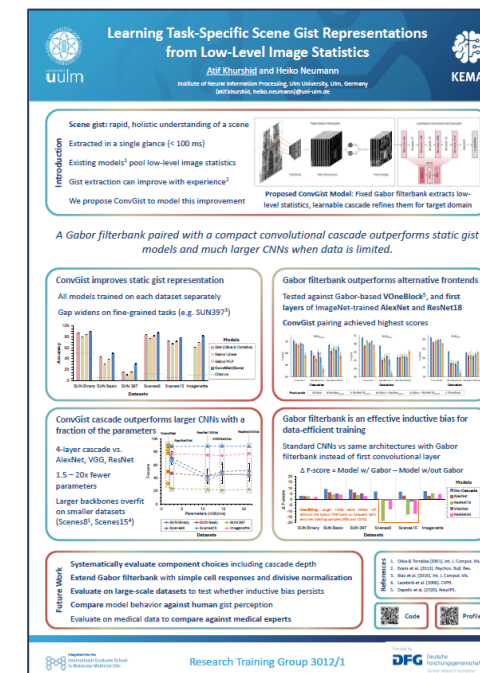
Thank you for your attention.

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Code



Poster

Knowledge Infusion and Extraction for Explainable Medical AI

DFG Research Training Group 3012/1