# Channel Importance Matters in Few-Shot Image Classification

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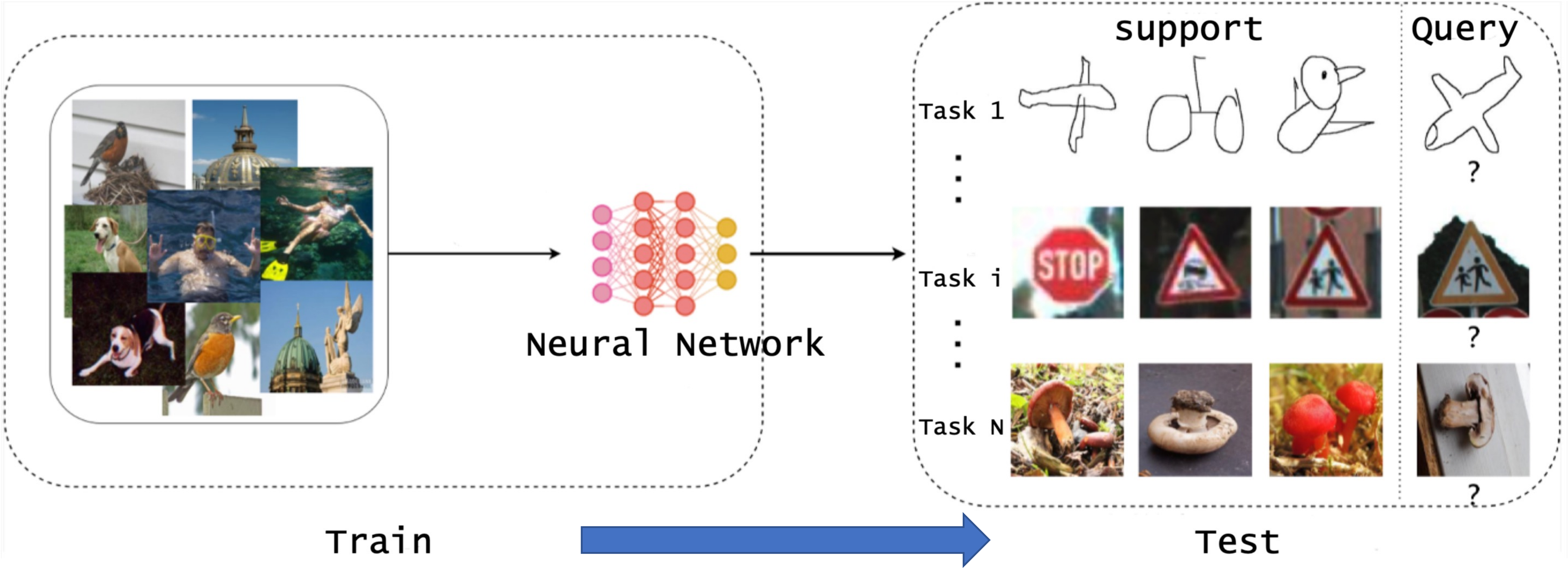
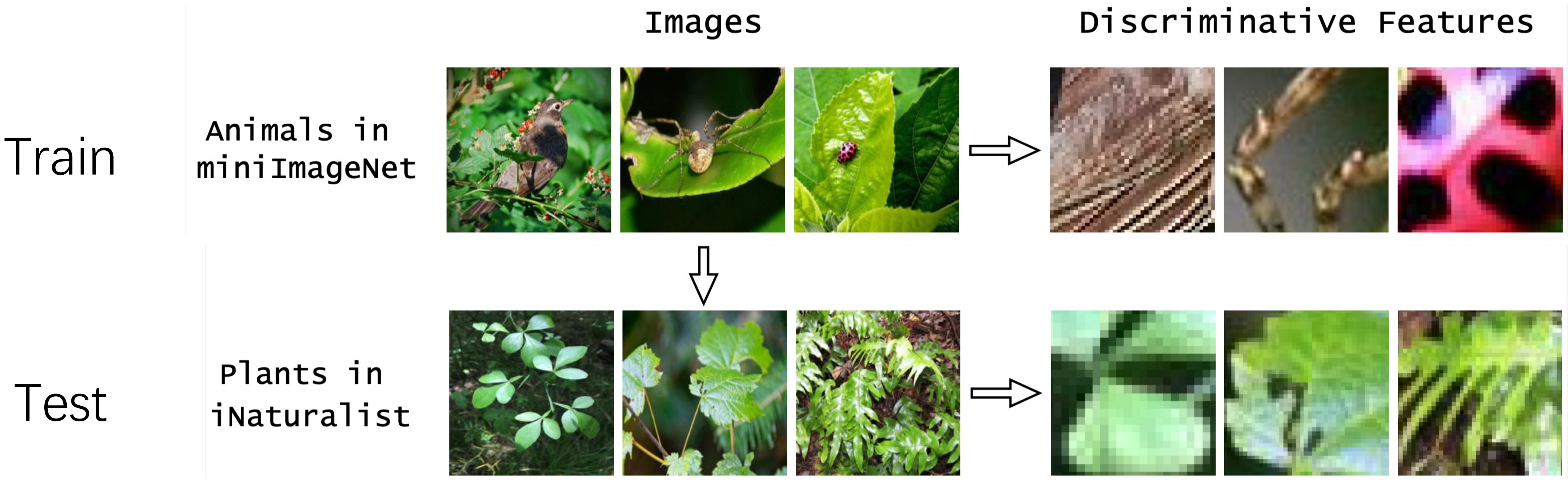
# Few-shot image classification

**Goal:** train a visual model that can quick *learn* new visual concept from a few examples.




Task distribution shift

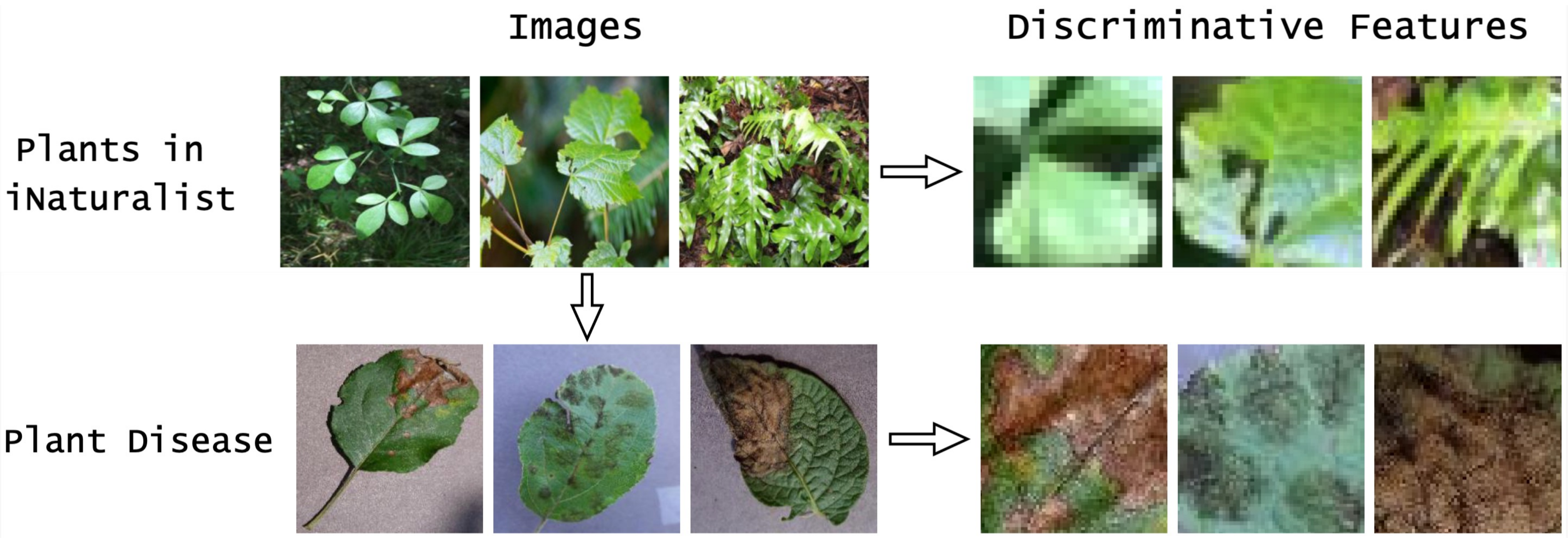
# Task distribution shift



# Task distribution shift

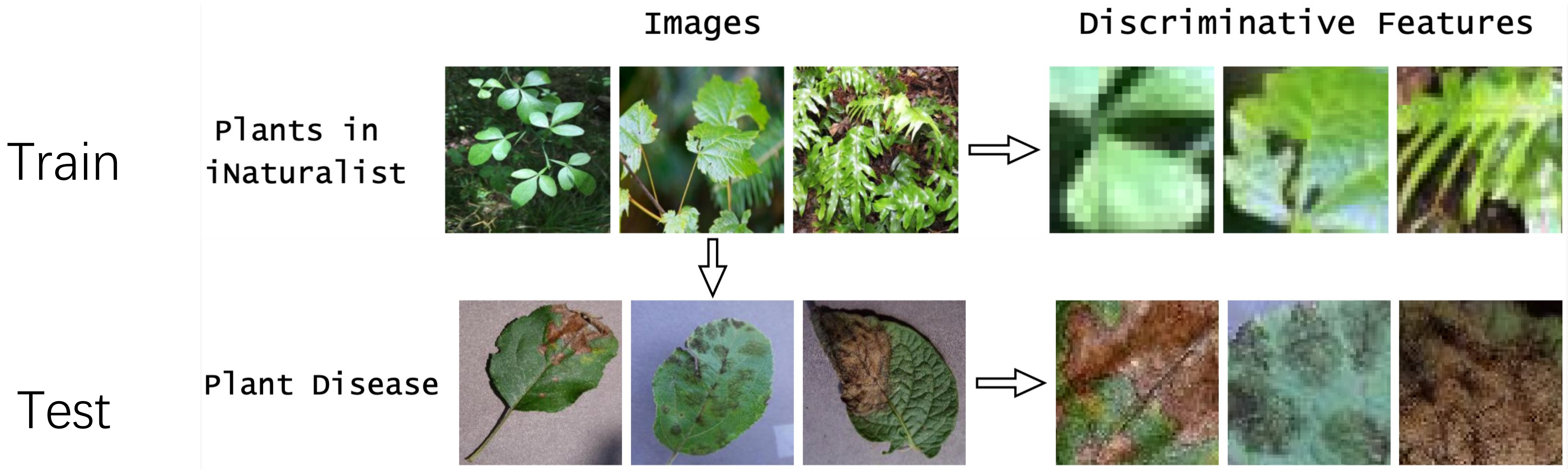
Train

Test

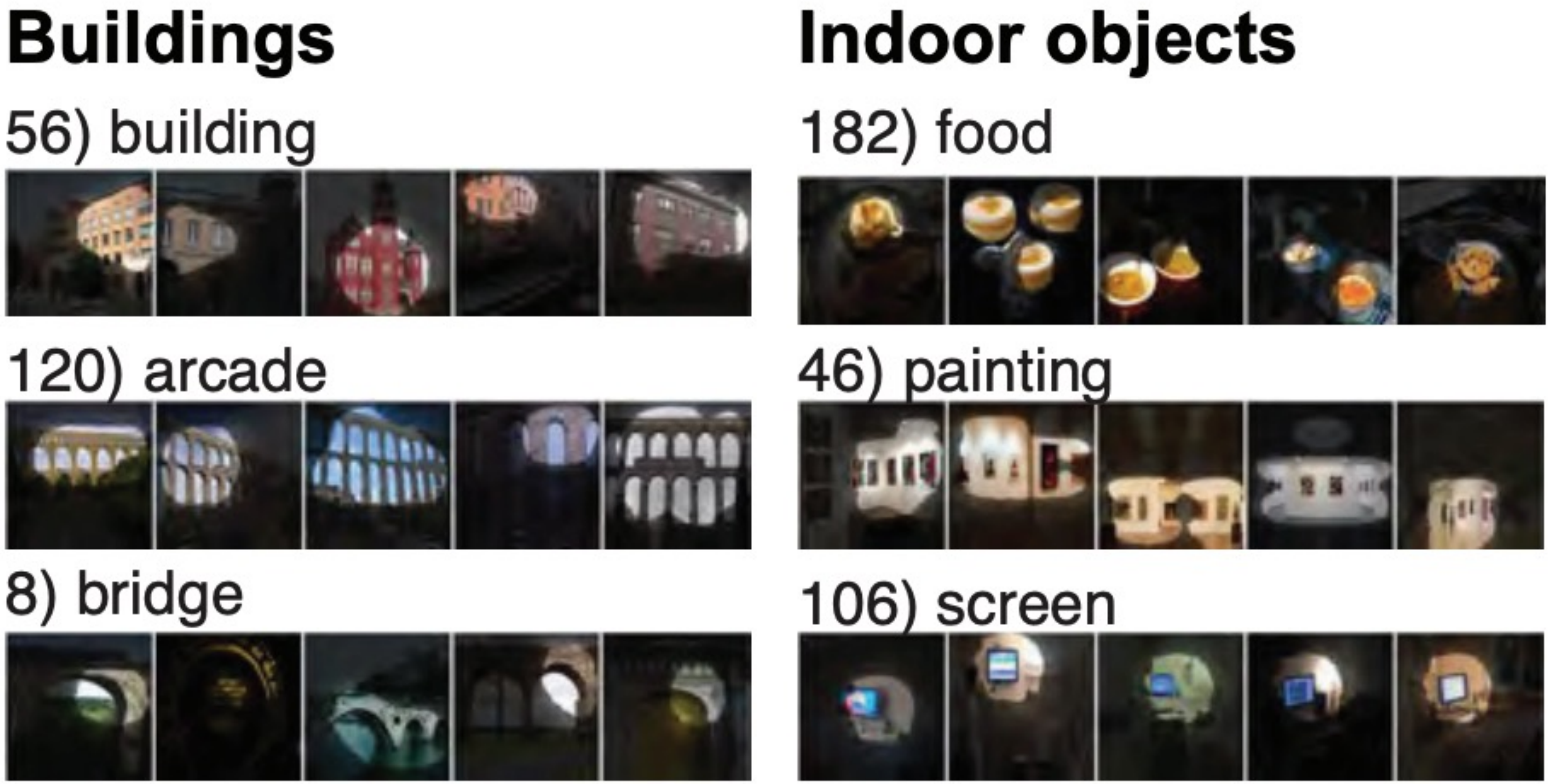


# Task distribution shift

**How does image representation encode discriminative features?**
**Can image representation change focus when facing task distribution shift?**

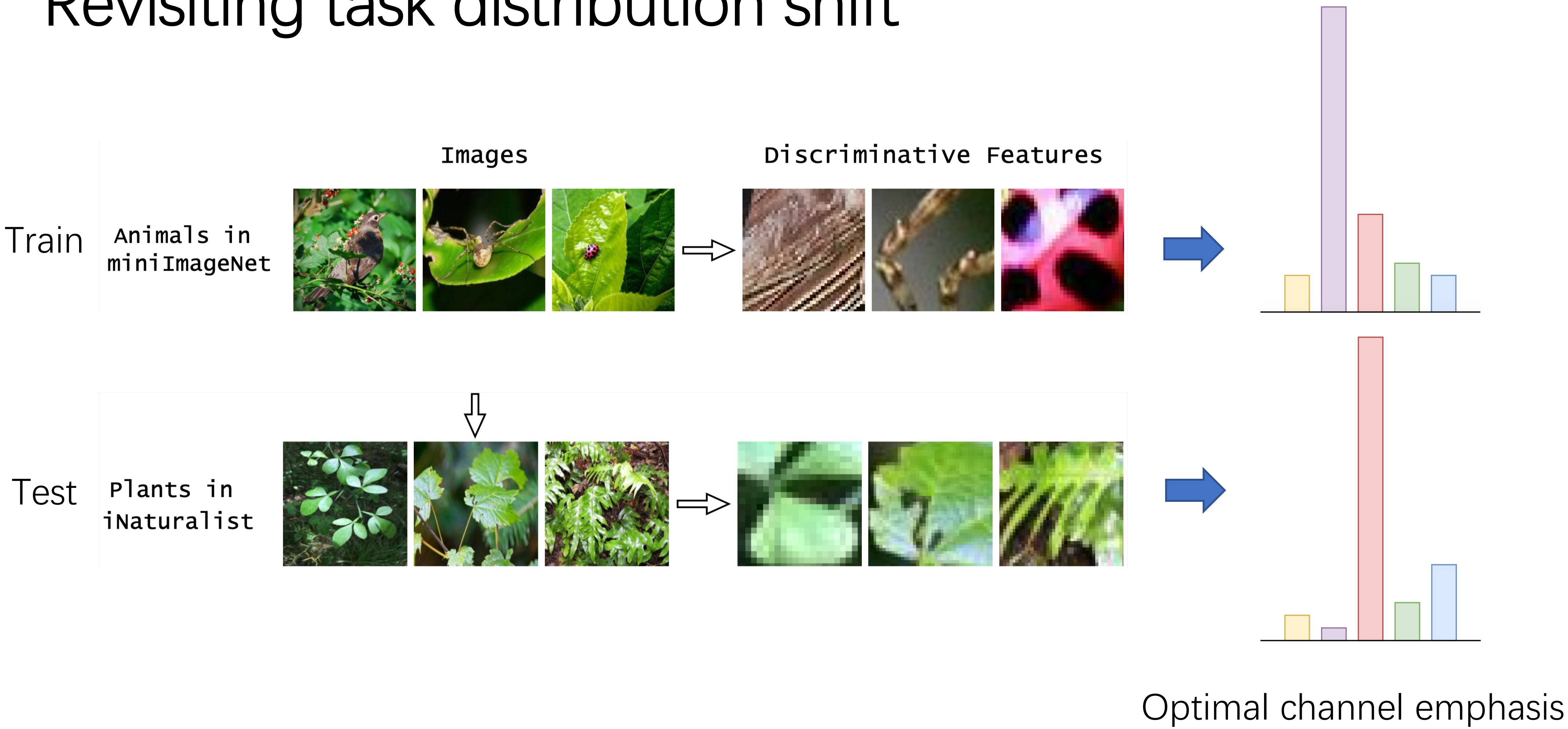


# Different channels of CNNs detect different features




**Object Detectors Emerge in Deep Scene CNNs. ICLR 2015**

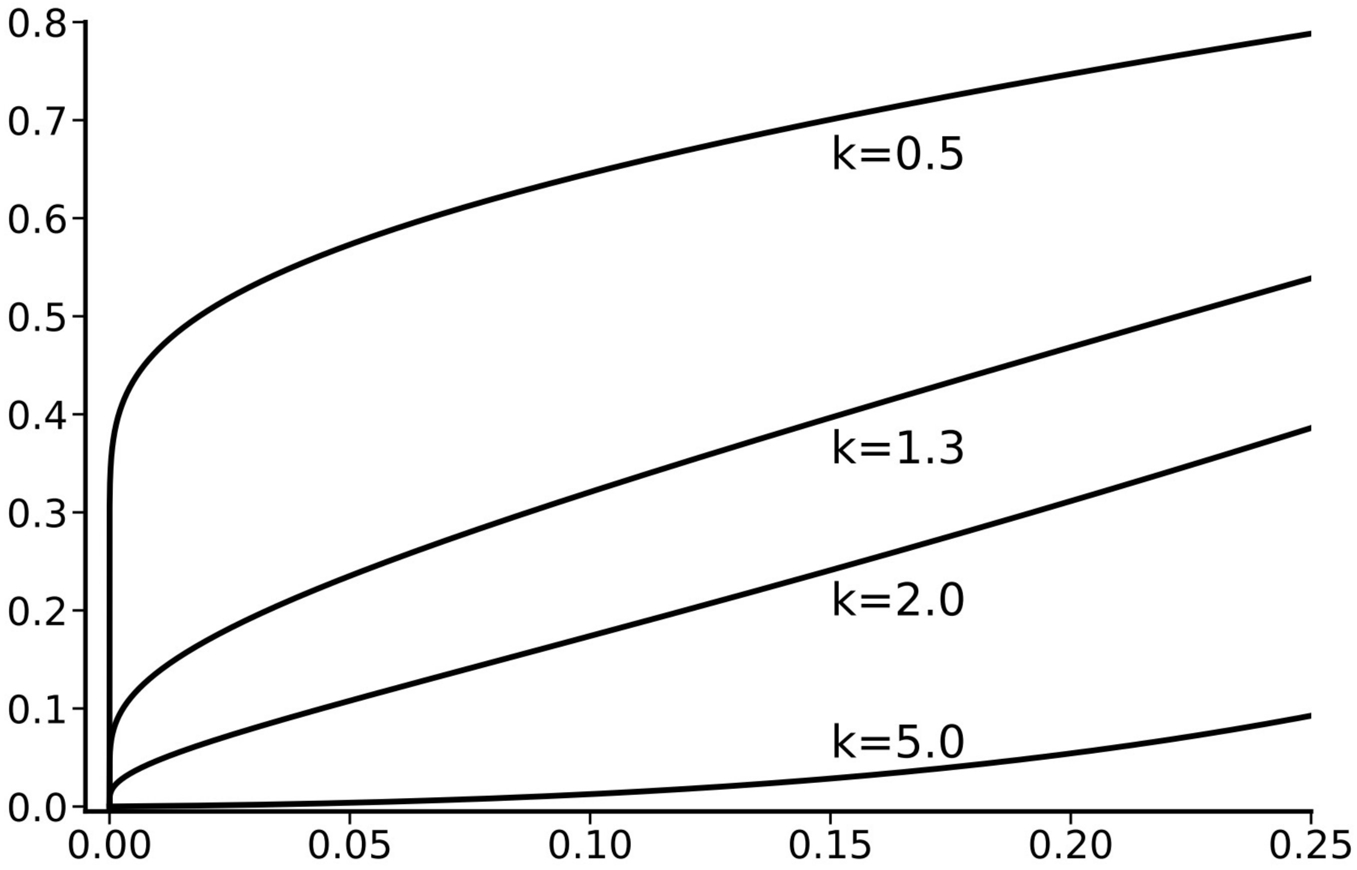
# Revisiting task distribution shift




Do image represenations of CNNs accurately capture such changes in channel emphasis?

# A simple transformation function

$$\phi_k(\lambda) = \begin{cases} \frac{1}{ln^k(\frac{1}{\lambda}+1)}, & \lambda > 0 \\ 0, & \lambda = 0 \end{cases}$$



# A simple channel-wise transformation function

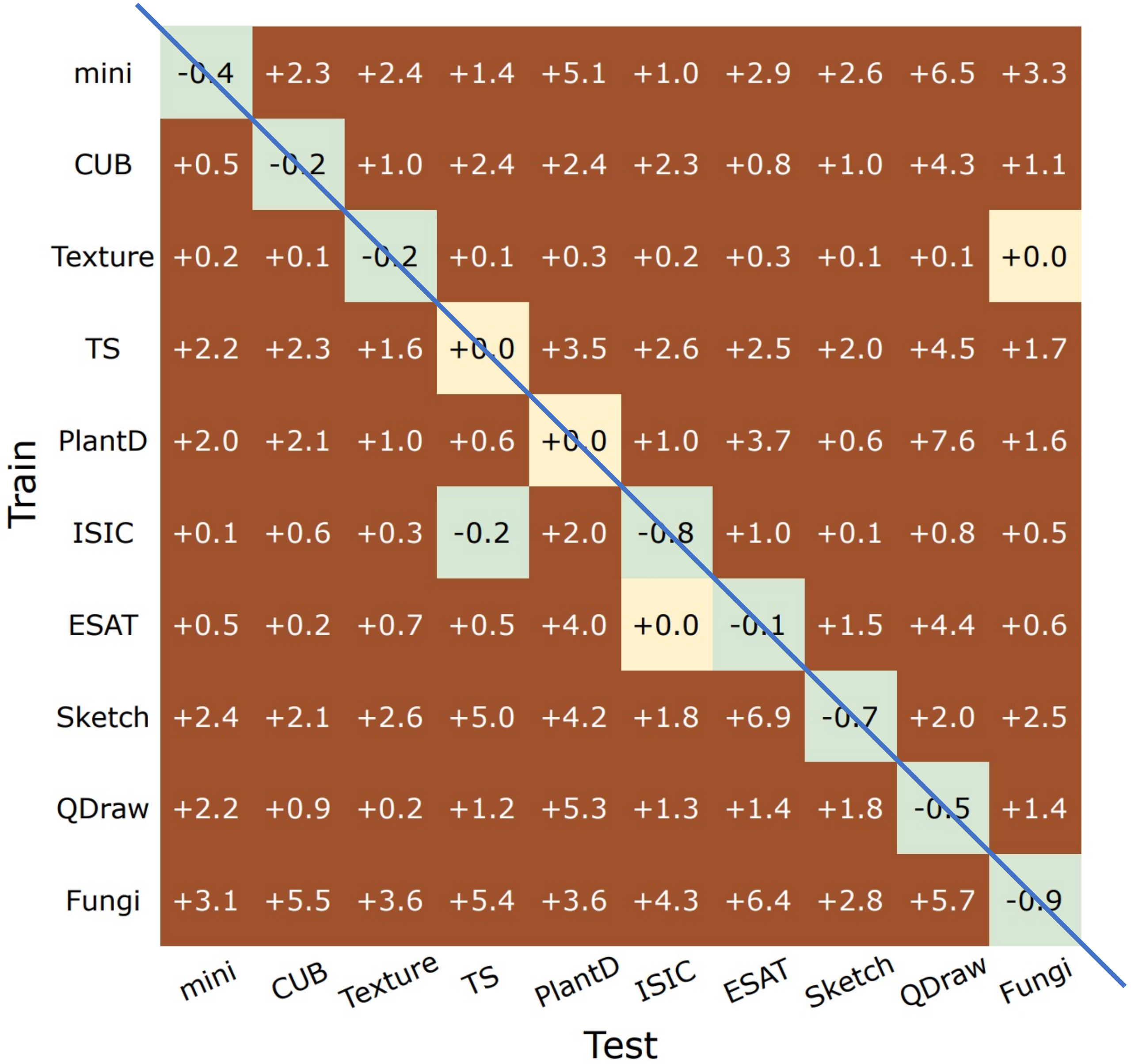
Transformed representation $\boldsymbol{\phi}(\mathbf{z}) = (\phi(z_1), \phi(z_2), \ldots, \phi(z_d))$

Representation $\mathbf{z} = f_\theta(\mathbf{x}) = (z_1, z_2, \ldots, z_d)$

Image $\mathbf{x}$

For Testing only!

# A simple channel-wise transformation function




**Channel bias problem**: When facing novel task with a shift in distribution, CNNs assign wrong channel emphasis.

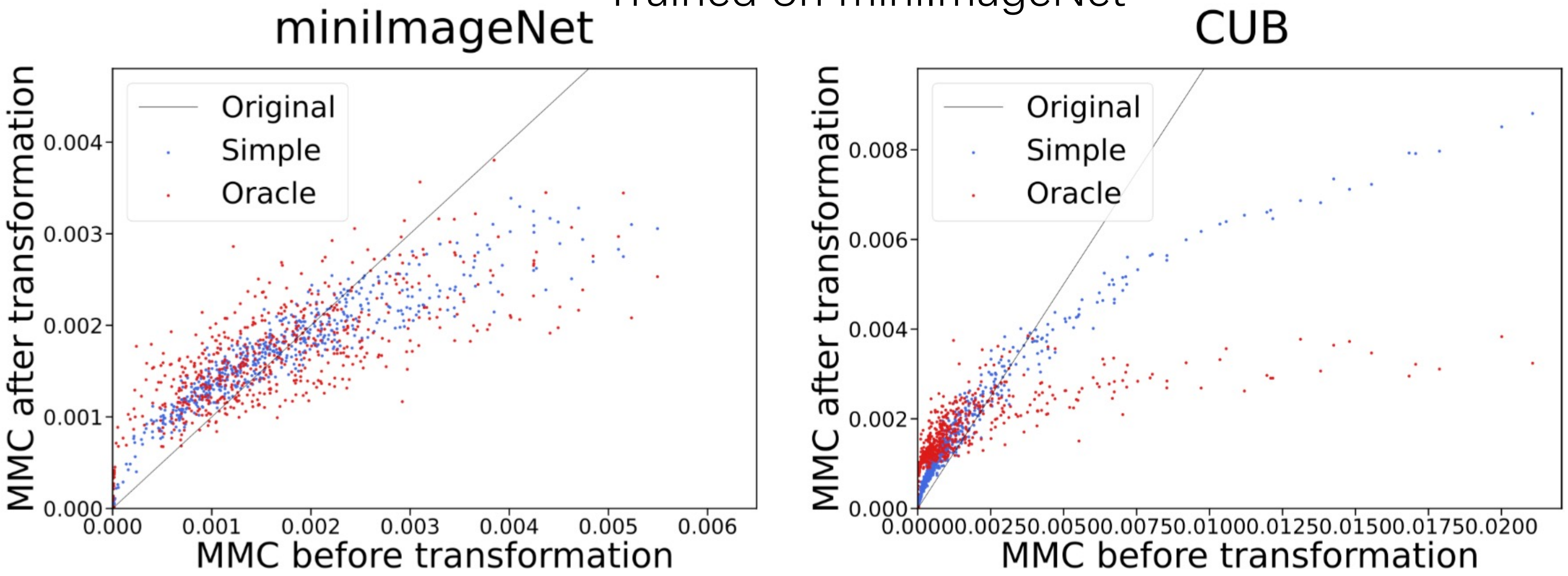
# Deriving the optimal channel emphasis of any binary task

Two classes of image representations, each with mean and variances $\boldsymbol{\mu_1}, \boldsymbol{\sigma_1}$ and $\boldsymbol{\mu_2}, \boldsymbol{\sigma_2}$, respectively. Then the optimal emphasis of the $c$-th channel $\omega_c$ should satisfy

$$\omega_c \propto \frac{|\mu_1^c - \mu_2^c|}{\sigma_1^c + \sigma_2^c}$$

# Analysis of channel emphasis

Trained on miniImageNet

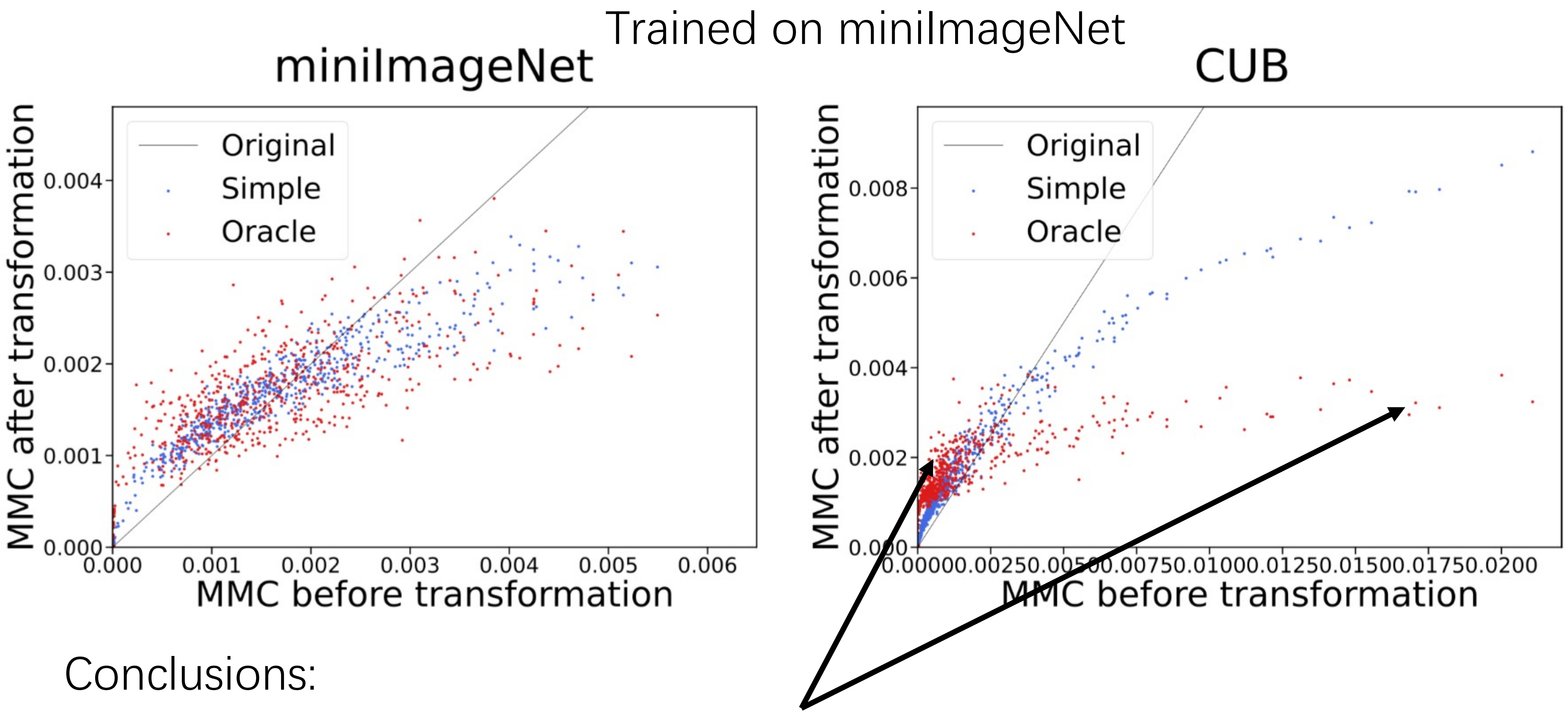



**Original**：original channel emphasis

**Simple**：channel emphasis rectified by the simple transformation

**Oracle**： optimal channel emphasis

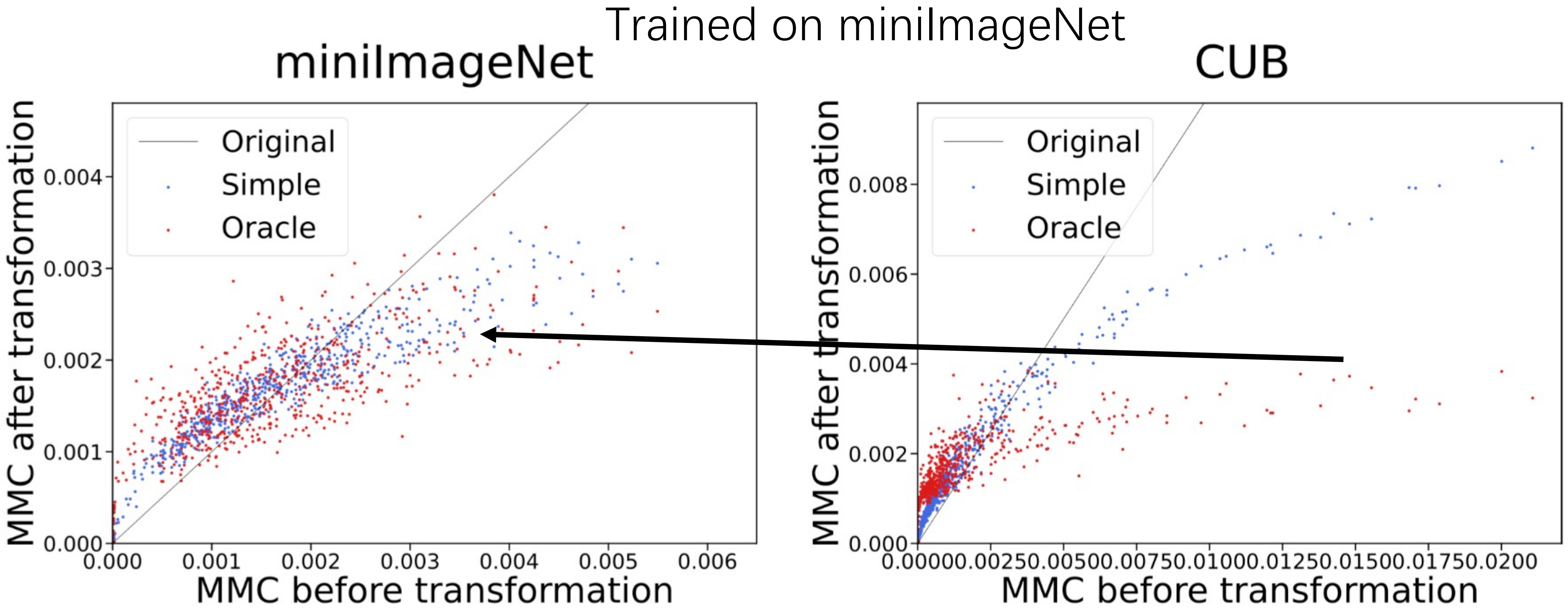
# Analysis of channel emphasis




Conclusions:

1. Neural networks are overconfident in previously learned channel emphasis.

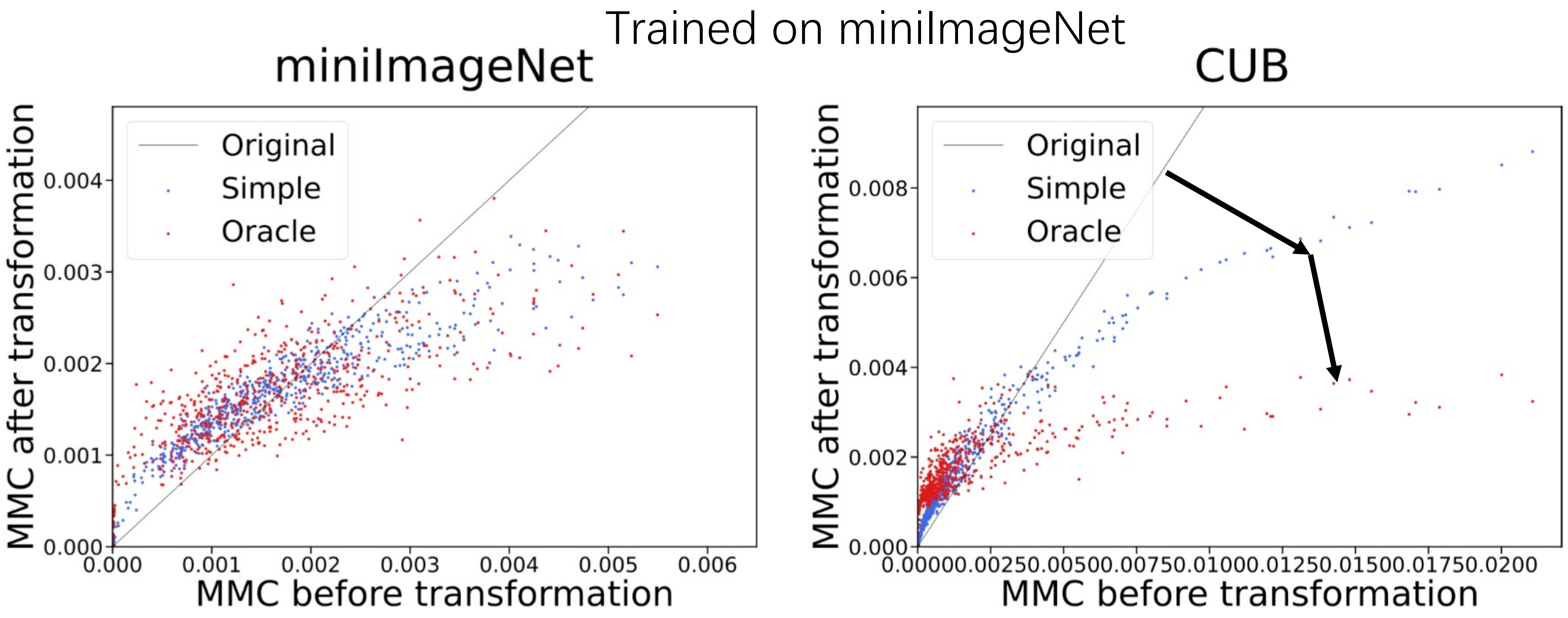
# Analysis of channel emphasis




Conclusions:

2. The channel bias problem diminishes as task distribution shift lessens.

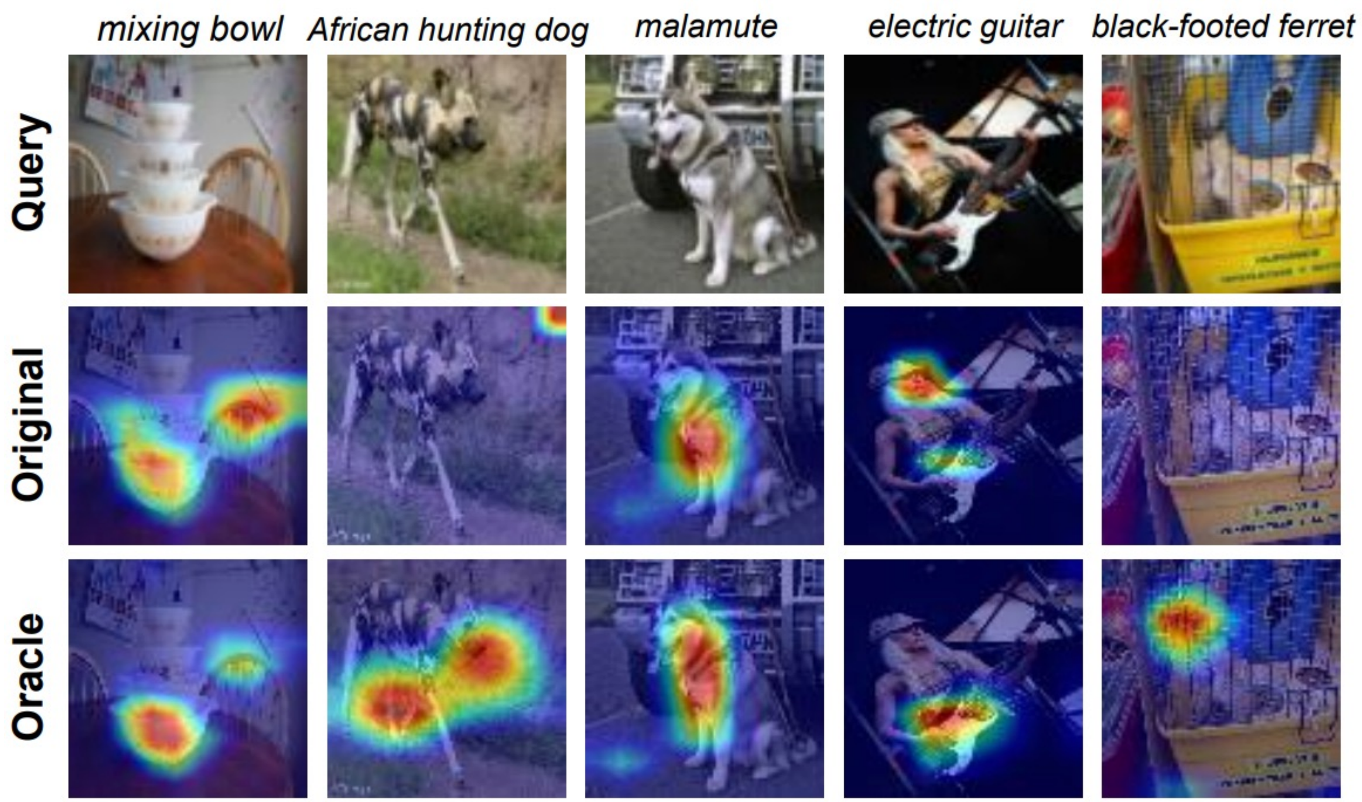
# Analysis of channel emphasis




Conclusions:

3. The simple transformation pushes channel emphasis towards the optimal ones.

# Analysis of channel emphasis




Conclusions:

4. The channel bias problem distracts the neural network from new objects.

Thank you for listening!