Bias and Generalization in Deep Generative Models

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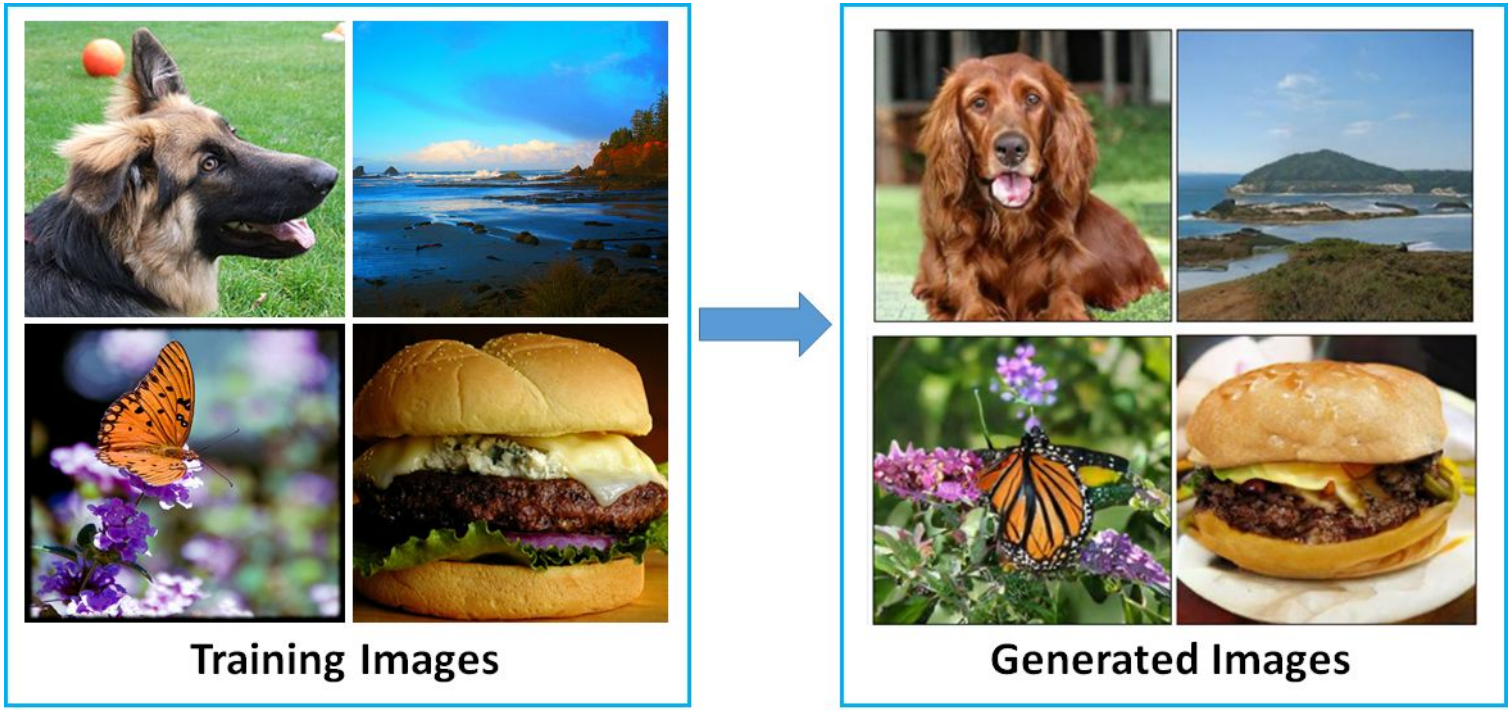
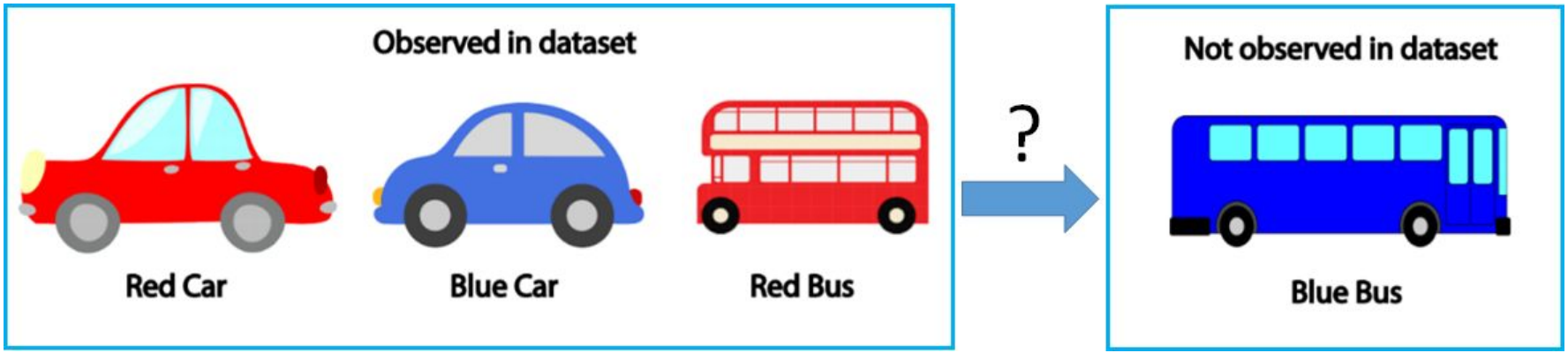
*equal contribution

Success in Generative Modeling of Images



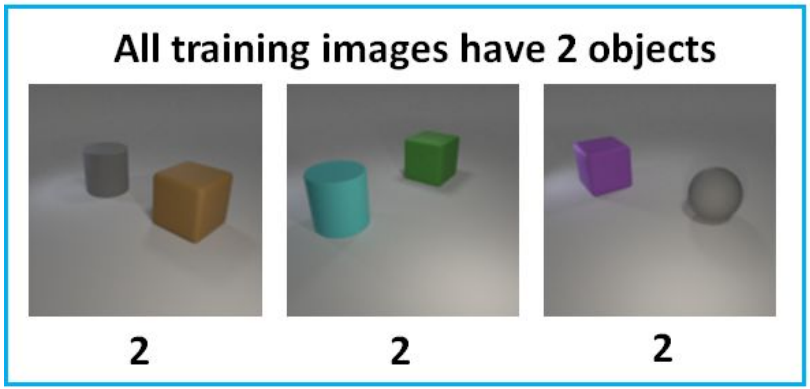
Brock A, et al. "Large scale gan training for high fidelity natural image synthesis."

Goal: Understanding Generalization



How do generative models generalize?

Generalization Example: Object Count



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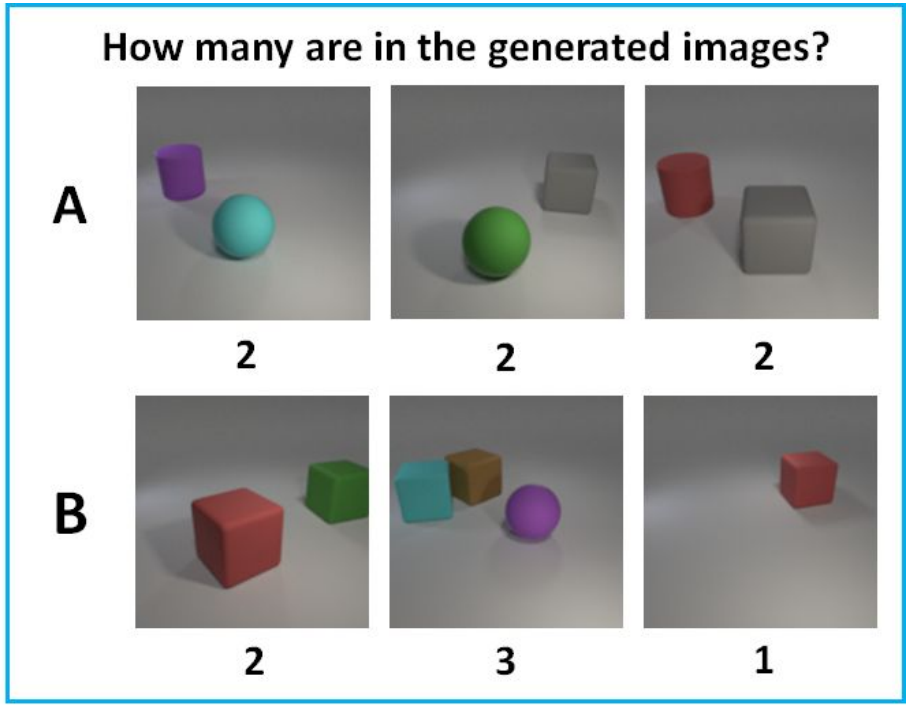
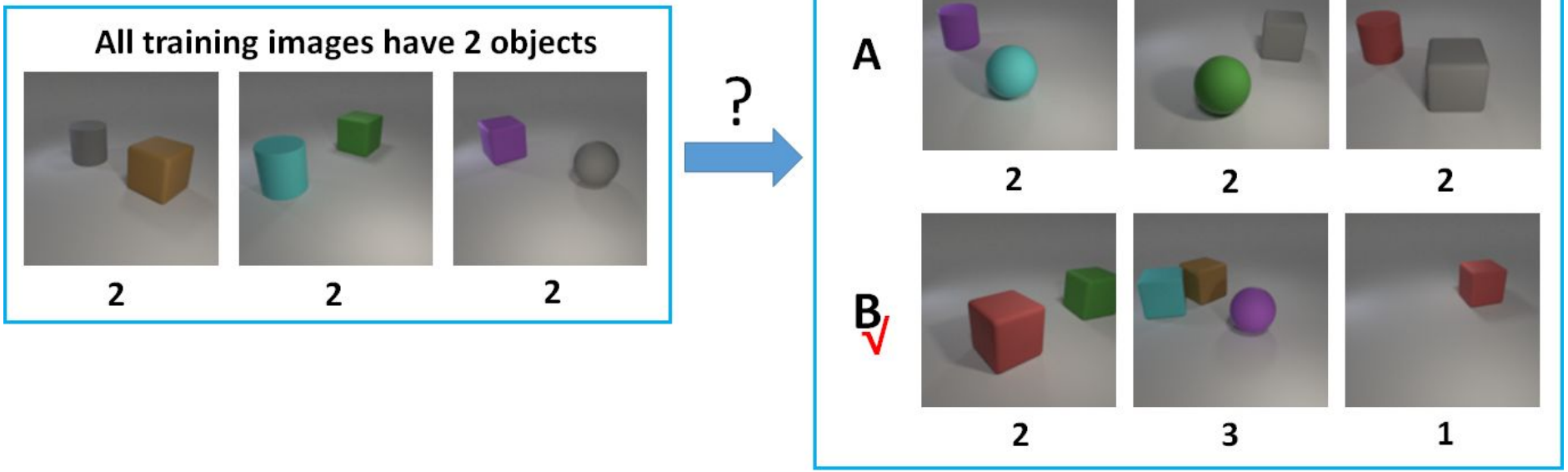


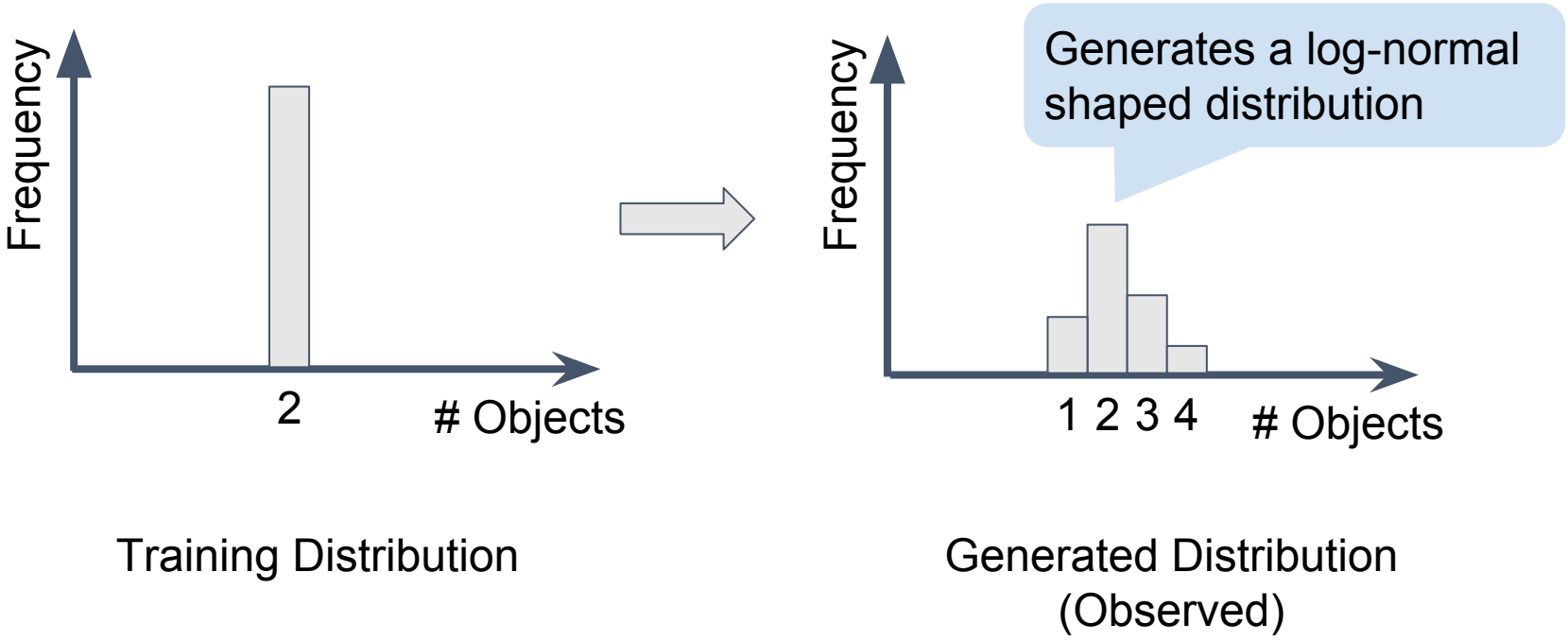
Empirical Study of Generalization: Method

- Design datasets
- Train generative models (VAE, GAN, PixelCNN)
- Observe generalization behavior
- Find common patterns

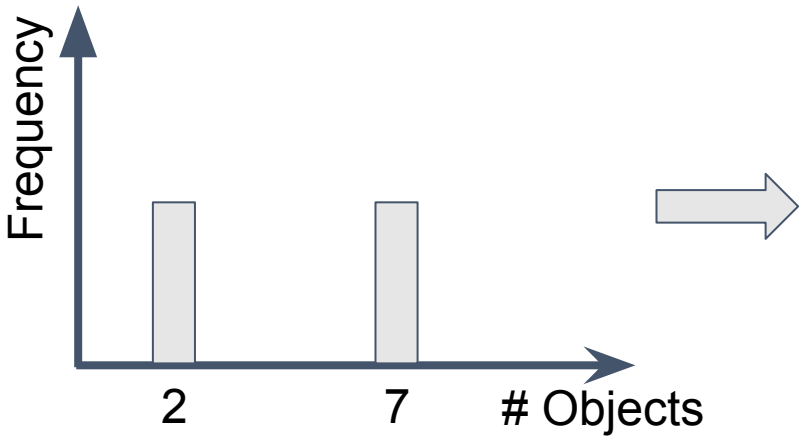
Generalization Example: Object Count



Generalization in Feature Space: Numerosity



Multiple Numerosities



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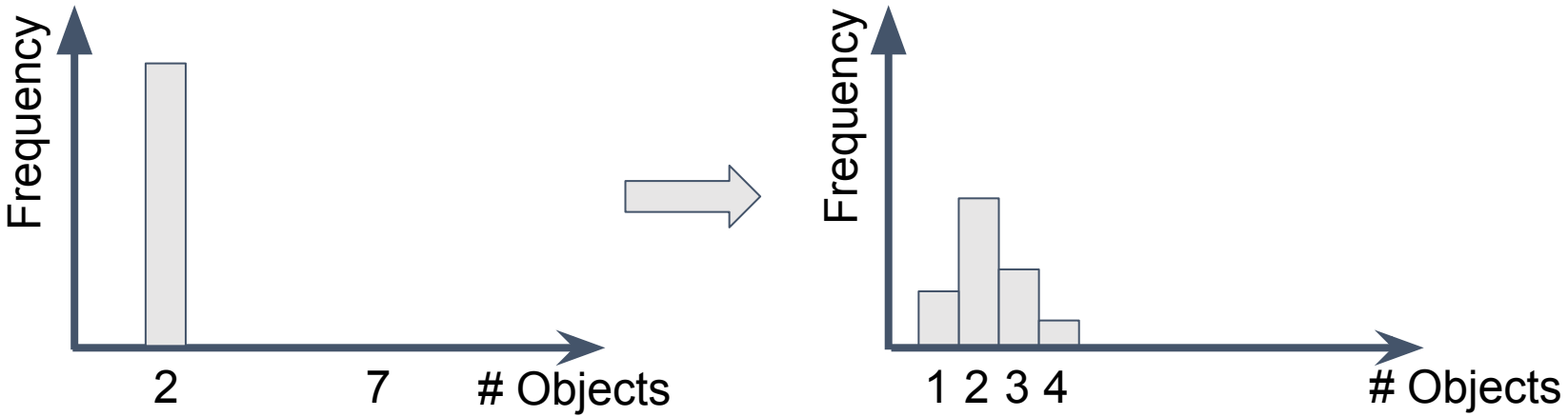
Training Distribution

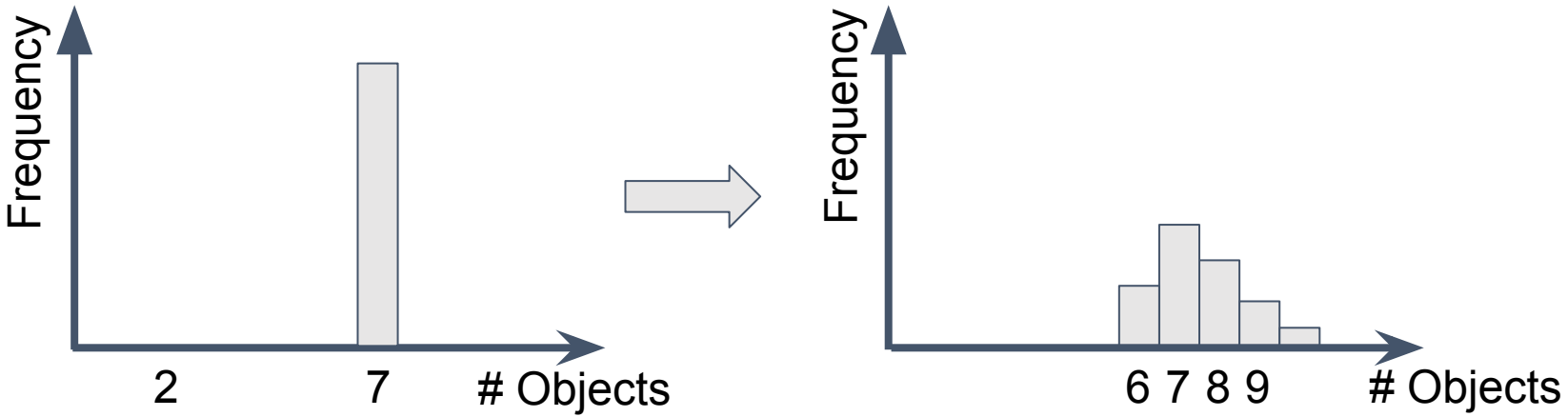
Multiple Numerosities: Only 2



Training Distribution

Generated Distribution

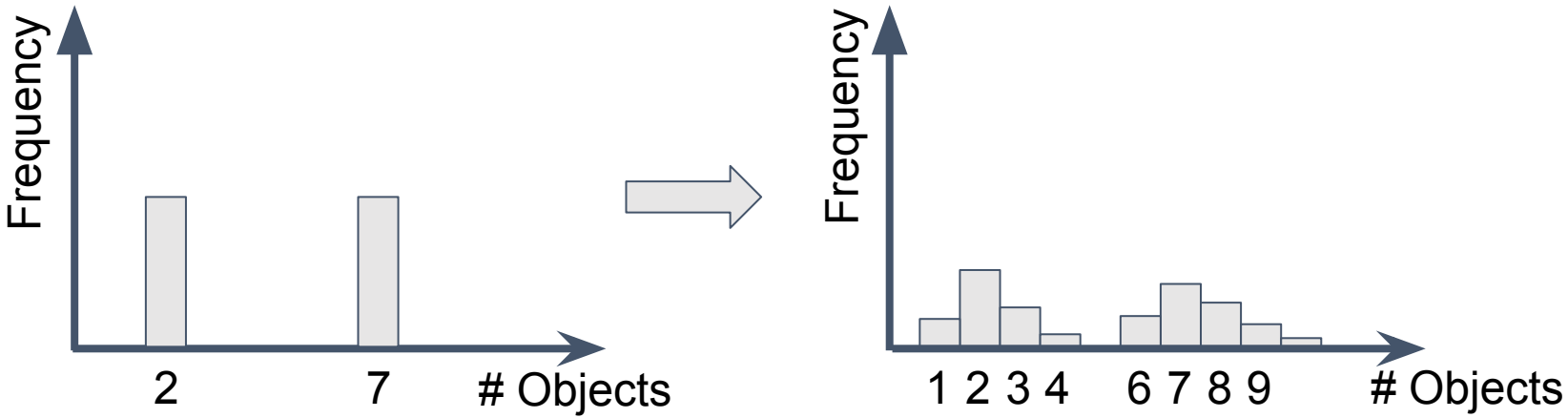
Multiple Numerosities: Only 7



Training Distribution

Generated Distribution

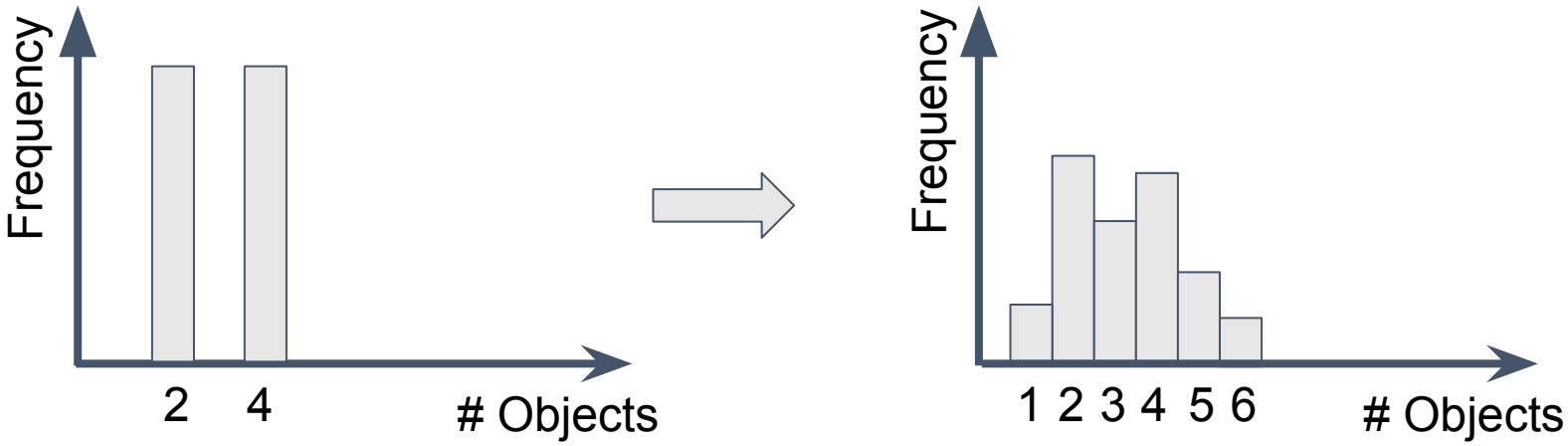
Multiple Numerosities: Additive Hypothesis



Training Distribution

Generated Distribution
(**Observed**)

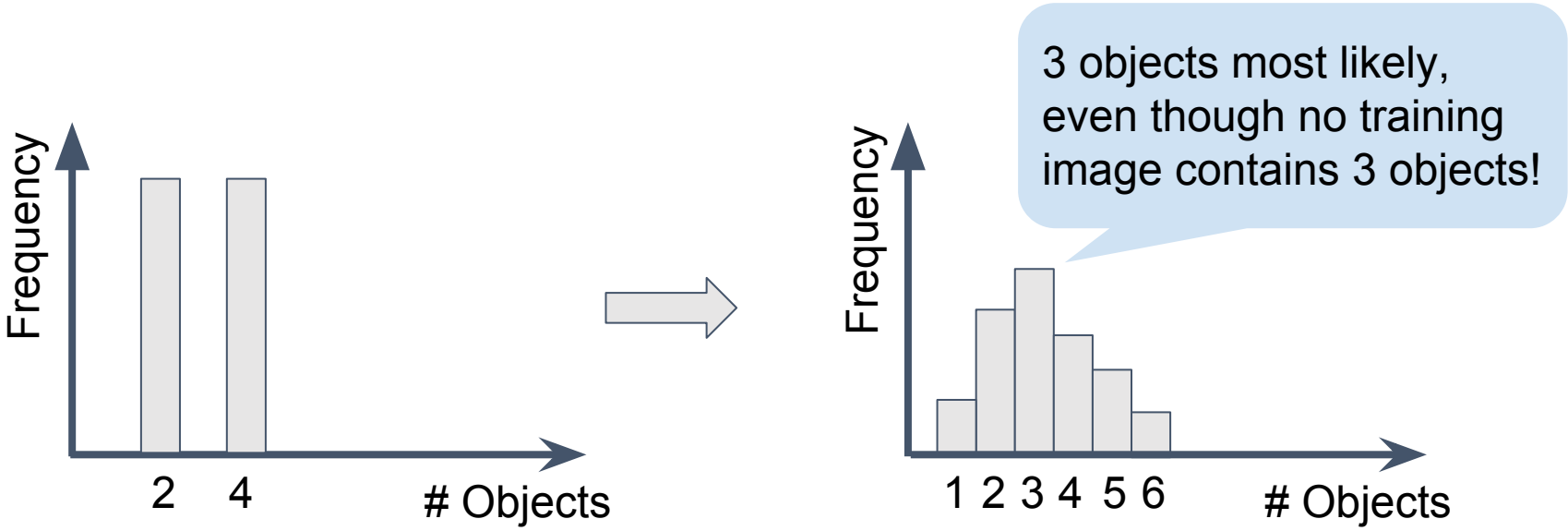
Additive Hypothesis with 2 and 4 Objects



Training Distribution

Generated Distribution
(**Hypothesized**)

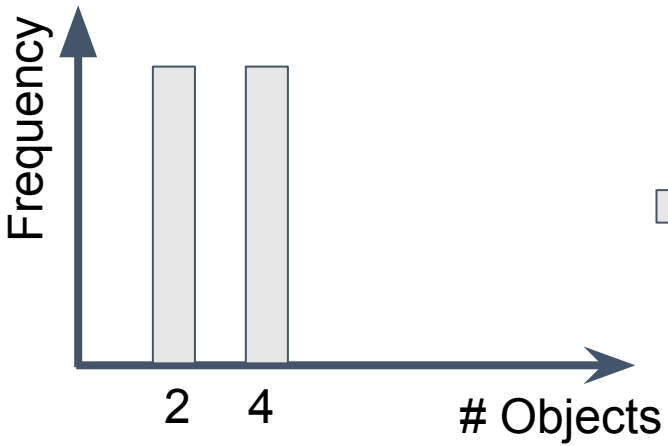
Actual Result: Prototype Enhancement



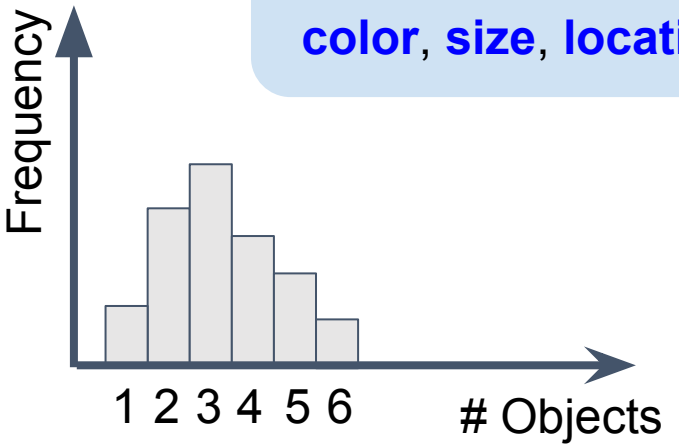
Training Distribution

Generated Distribution
(**Observed**)

Prototype Enhancement



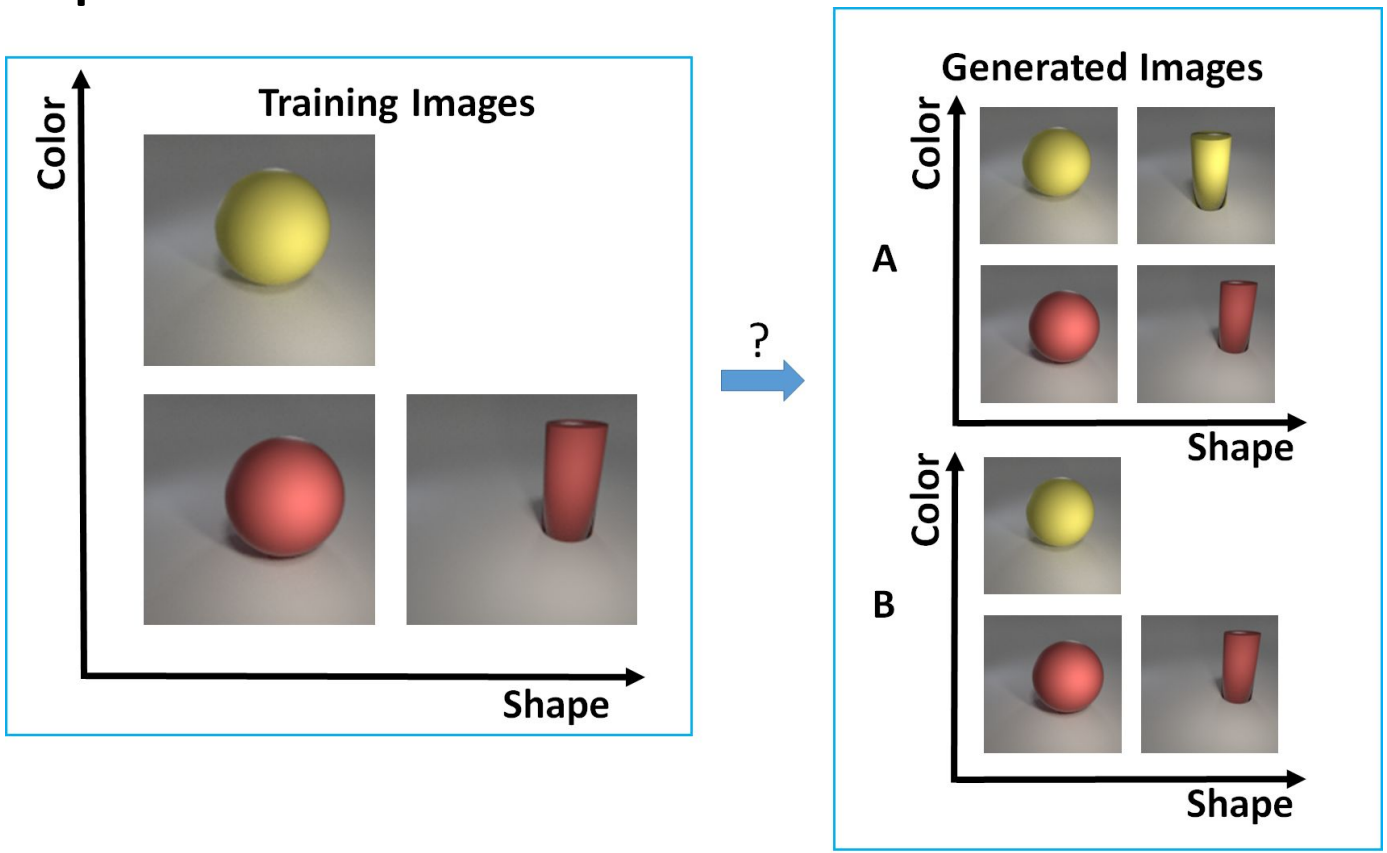
Training Distribution



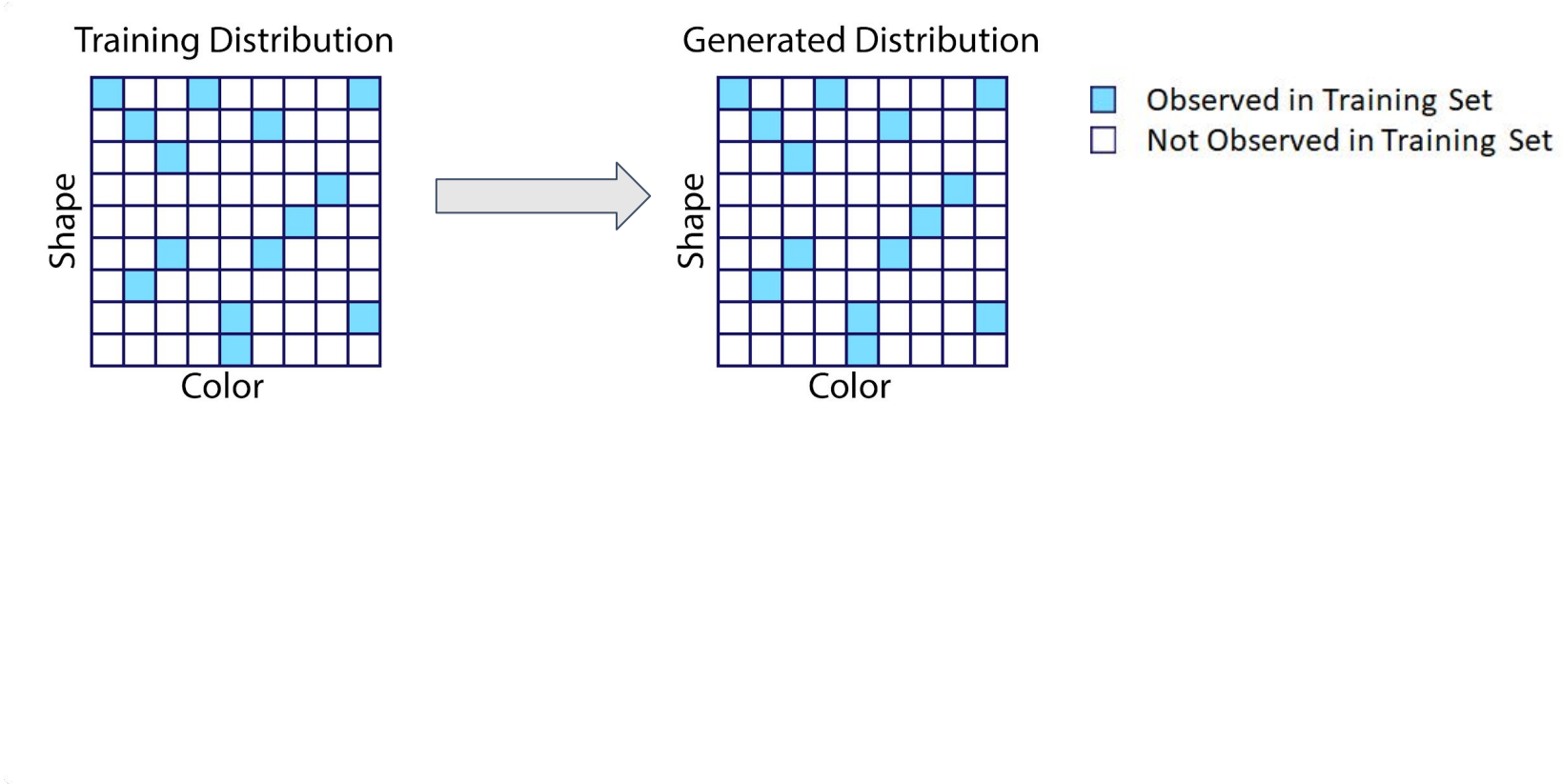
Generated Distribution
(**Observed**)

Similar pattern for other features: **color**, **size**, **location**

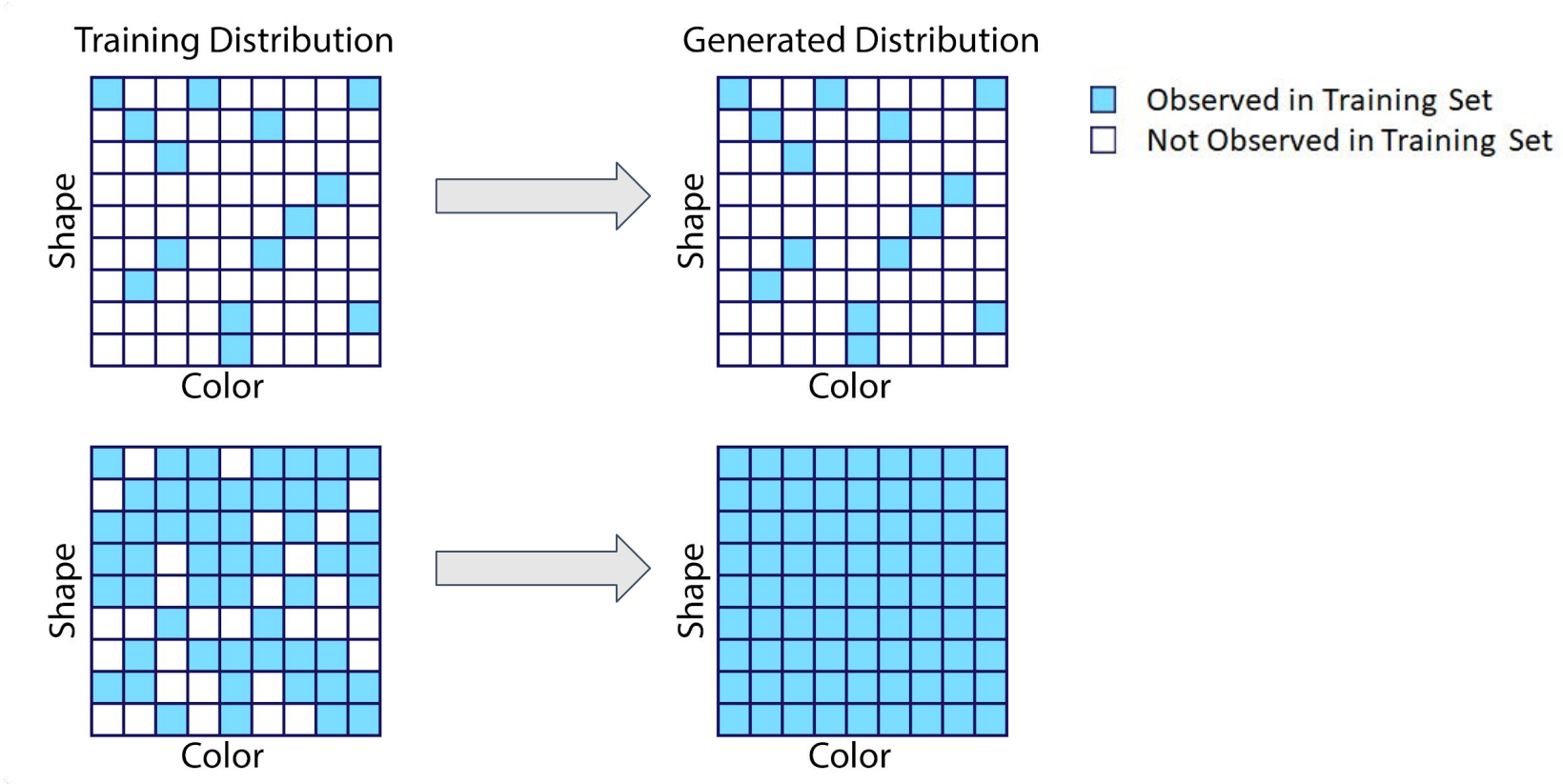
Multiple Features



Memorization vs. Generalization



Memorization vs. Generalization



Different Setups, Similar Results

- Different features (shape, color, size, numerosity, etc.)
- Different models: (VAE, GAN, PixelCNN, etc.)
- Different architectures (fully connected, convolutional, etc.)
- Different hyper-parameters (network size, learning rate, etc.)

Conclusion

- New methodology: design datasets to probe generative models
- Observed common patterns across different setups

Welcome to our poster session for further discussions!

Tuesday 5-7pm @ Room 210 & 230 AB #6

Code available at github.com/ermongroup/BiasAndGeneralization