# A Simple Framework for Contrastive Learning of Visual Representations

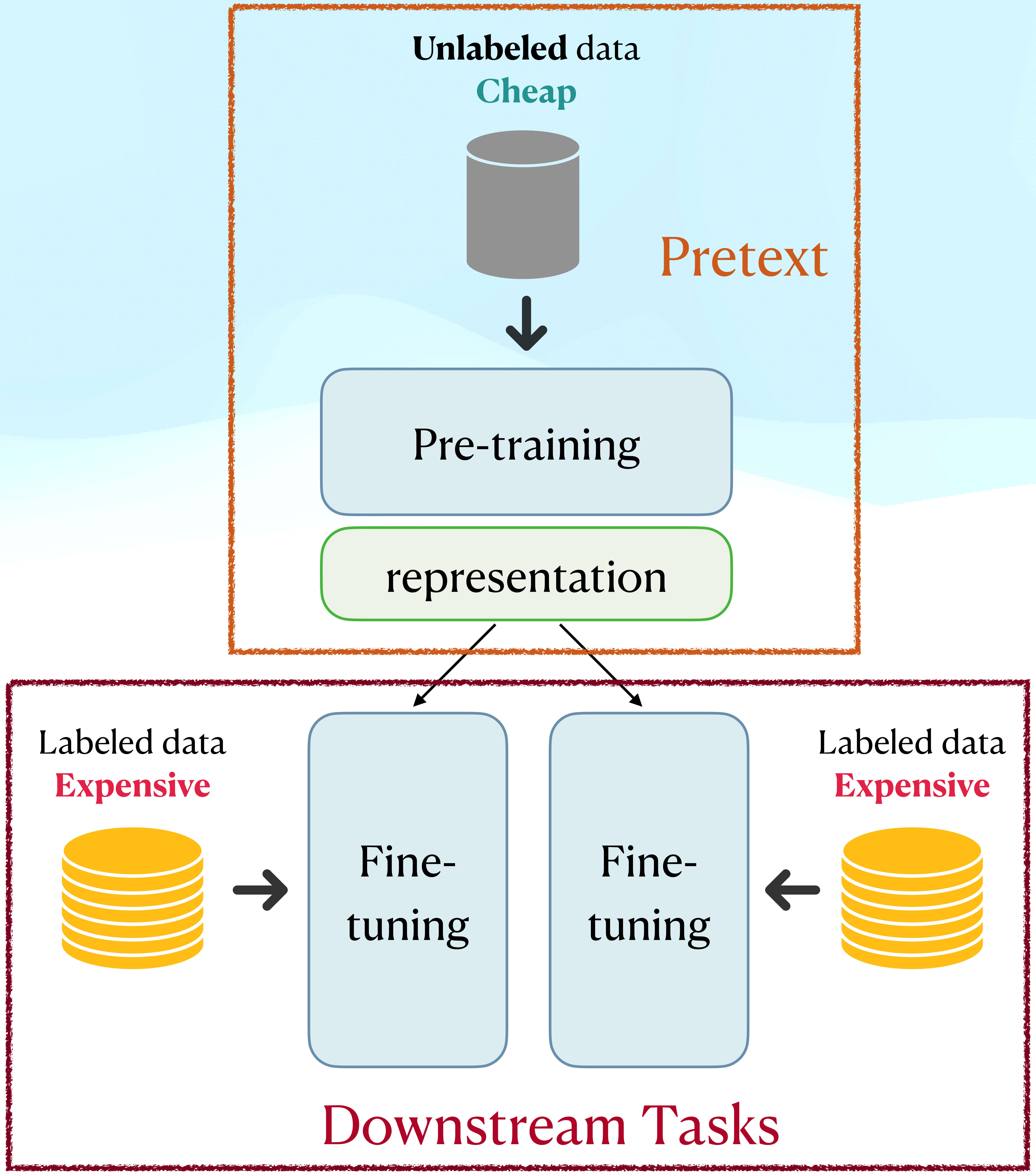
## SimCLR review

YU MO, 2022/06/27

# Background

## Self-supervised Learning

- **“Unsupervised pre-training, Supervised fine-tuning”**
- **Pretext** is task-agnostic, we train the model (Encoder) with a **large** amount of unlabeled data
- **Downstream task** is task-specific, we train the model with a **few** amount of labeled data (1% to 10%)

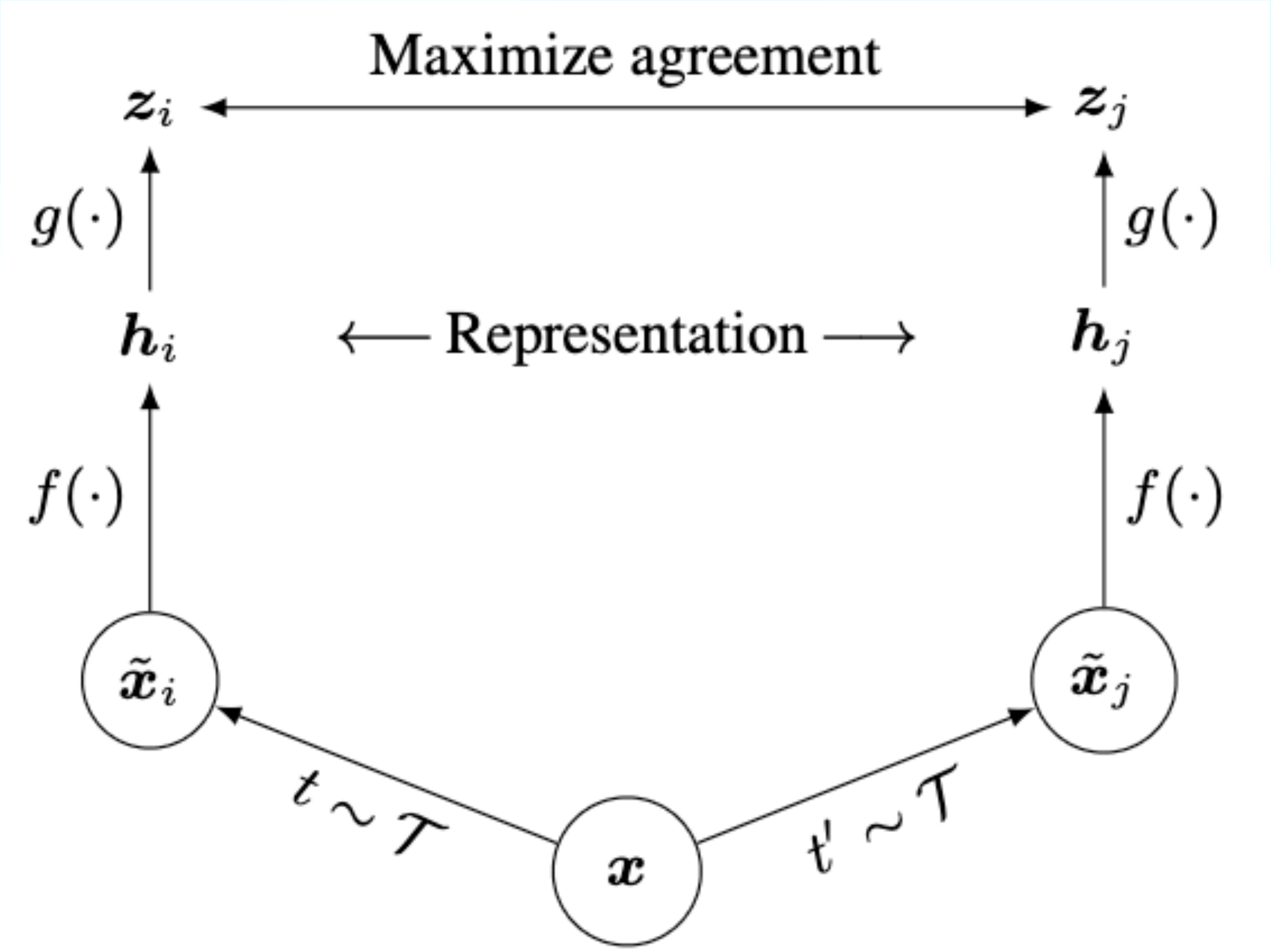


# Framework

## Paper abstract

### Findings/Contributions

- Composition of data augmentations is important
- Functionality of projection head (nonlinear transformation)
- Larger batch size and longer training steps benefits SSL more than supervised model.

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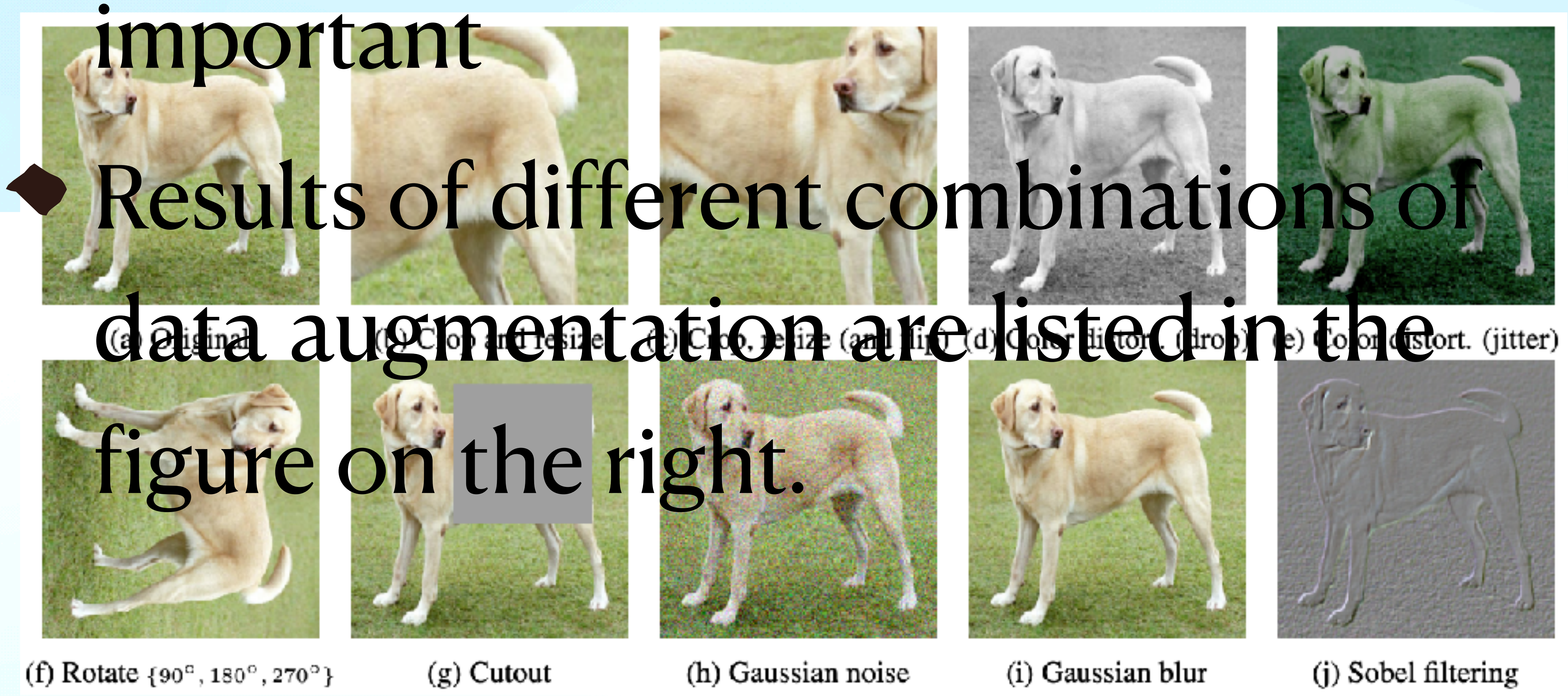
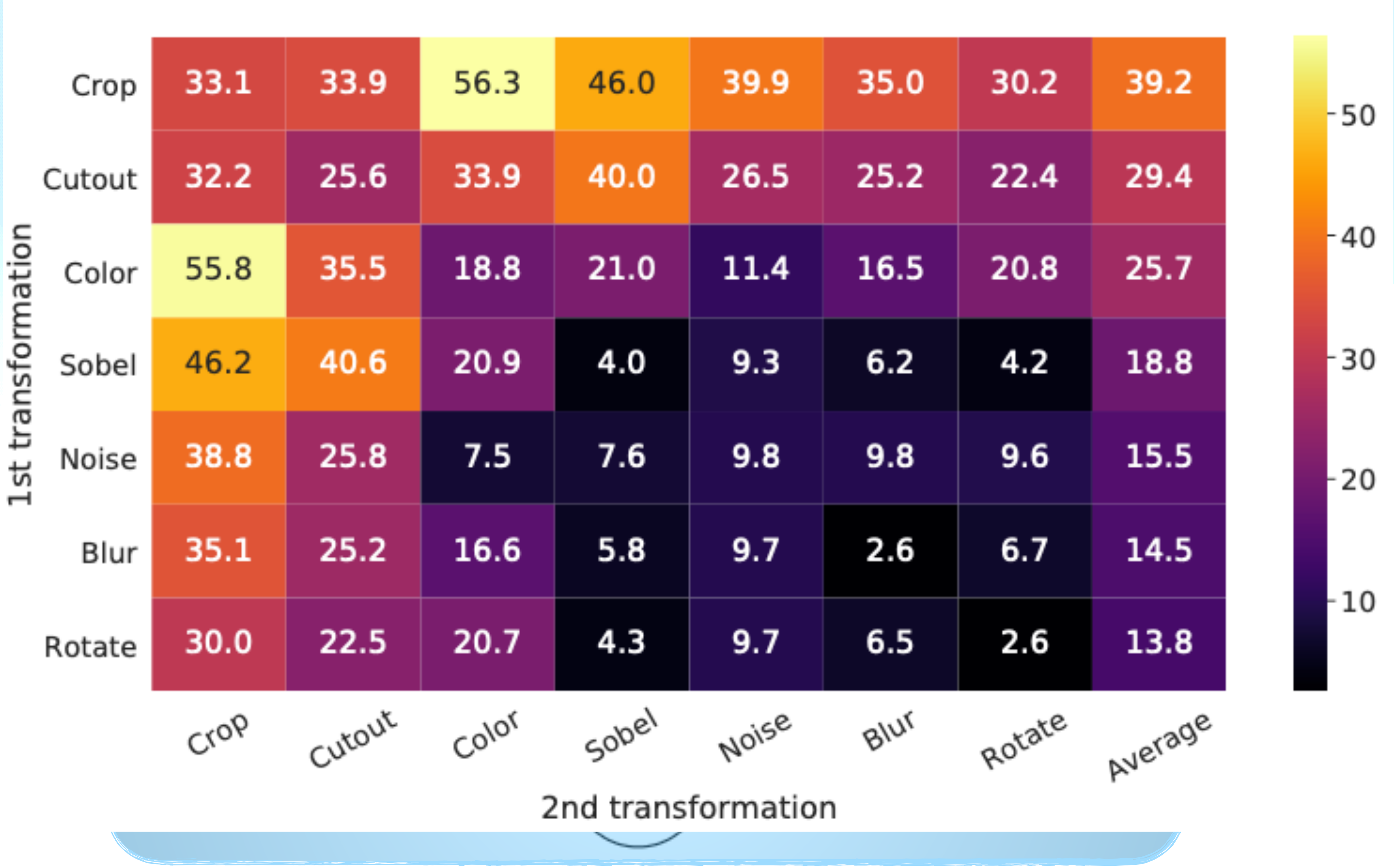
# Data Augmentations

## Finding 1

- Composition of data augmentations is important
- Results of different combinations of data augmentation are listed in the figure on the right.

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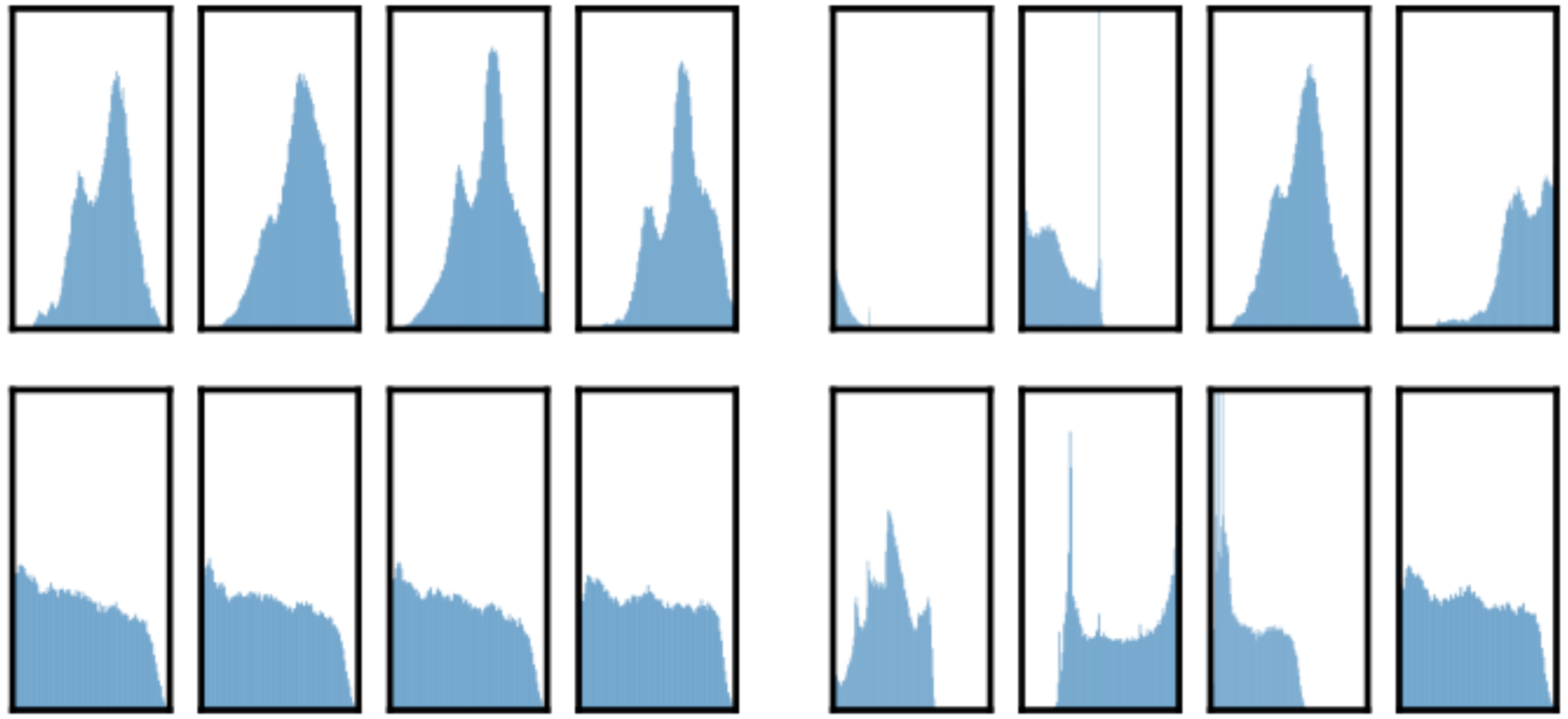
# Data Augmentations

## Finding 1

- Color distortion suffice to distinguish the image with similar color distributions after random cropping.
- SSL need stronger data augmentations



(a) Without color distortion. (b) With color distortion.

**Color distortion**

| Methods | 1/8 | 1/4 | 1/2 | 1 | 1 (+Blur) | AutoAug |
|---|---|---|---|---|---|---|
| | Color distortion strength | | | | | |
| SimCLR | 59.6 | 61.0 | 62.6 | 63.2 | 64.5 | 61.1 |
| Supervised | 77.0 | 76.7 | 76.5 | 75.7 | 75.4 | 77.1 |

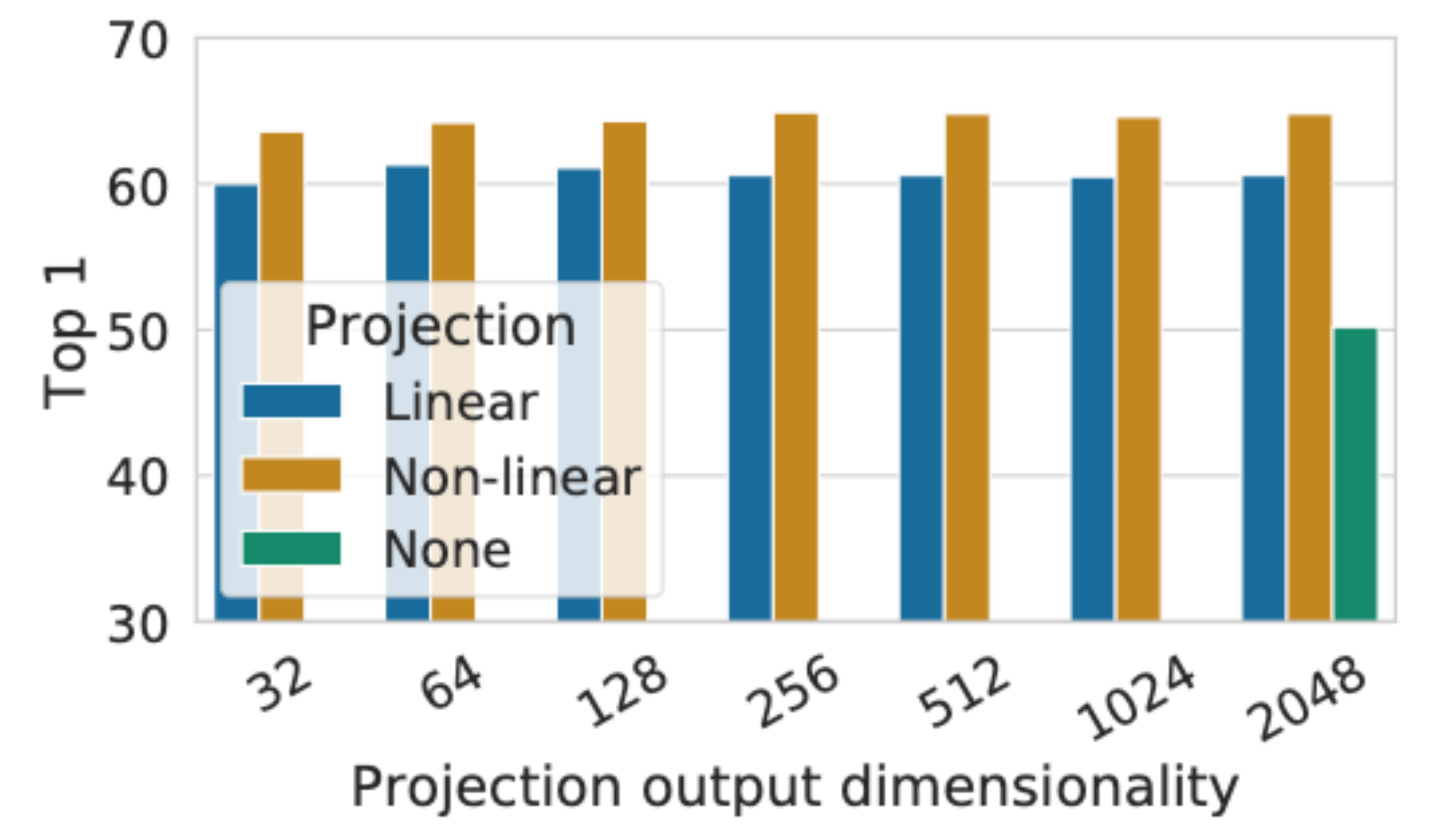
**Different level of color distortion**

# Projection Head

## Finding 2

A nonlinear projection head improves the representation quality of the layer before it.

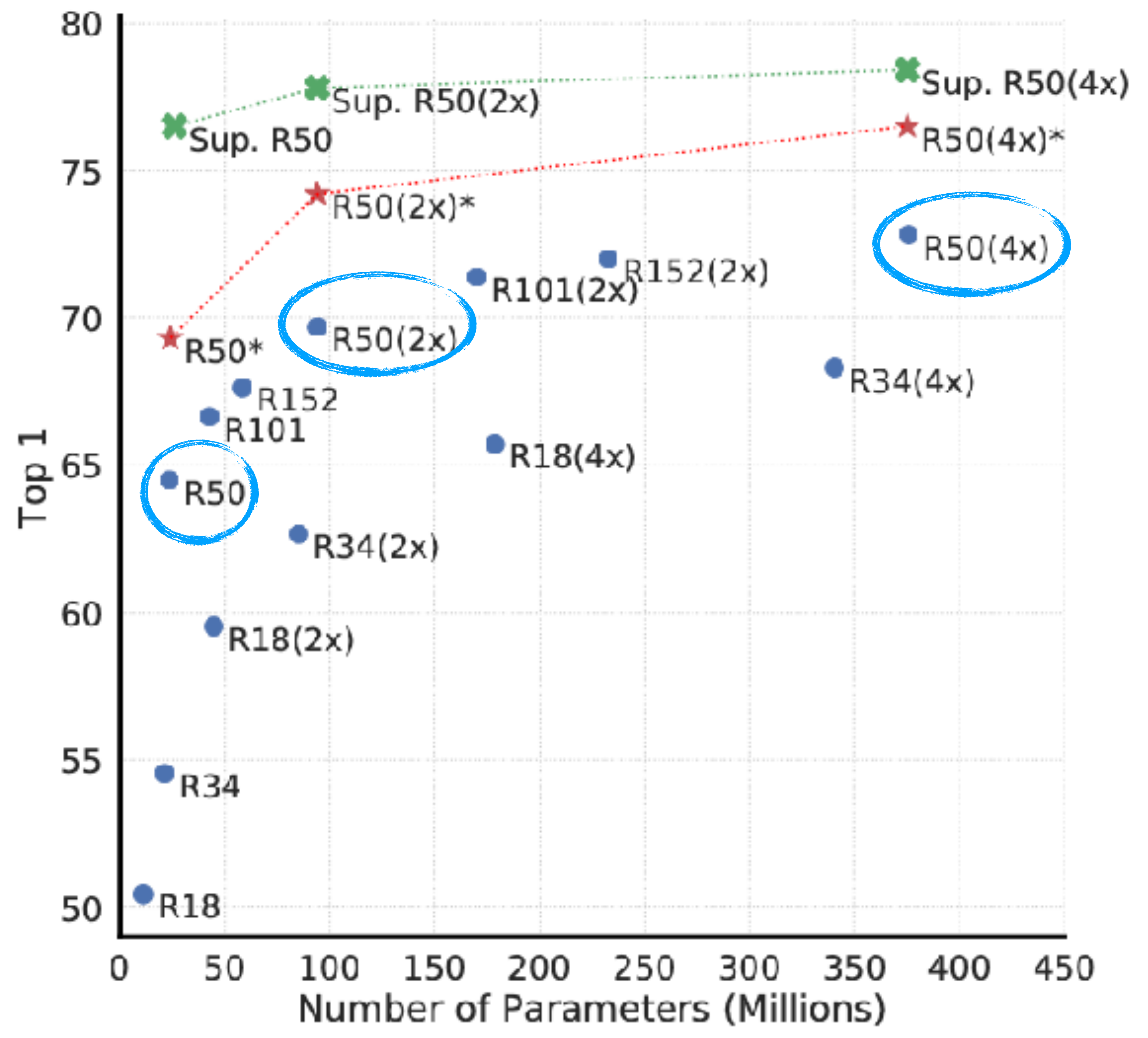
- Default setting is MLP and nonlinear ReLU.
- More information is contained before projection than after, e.g, the augmentation operation.

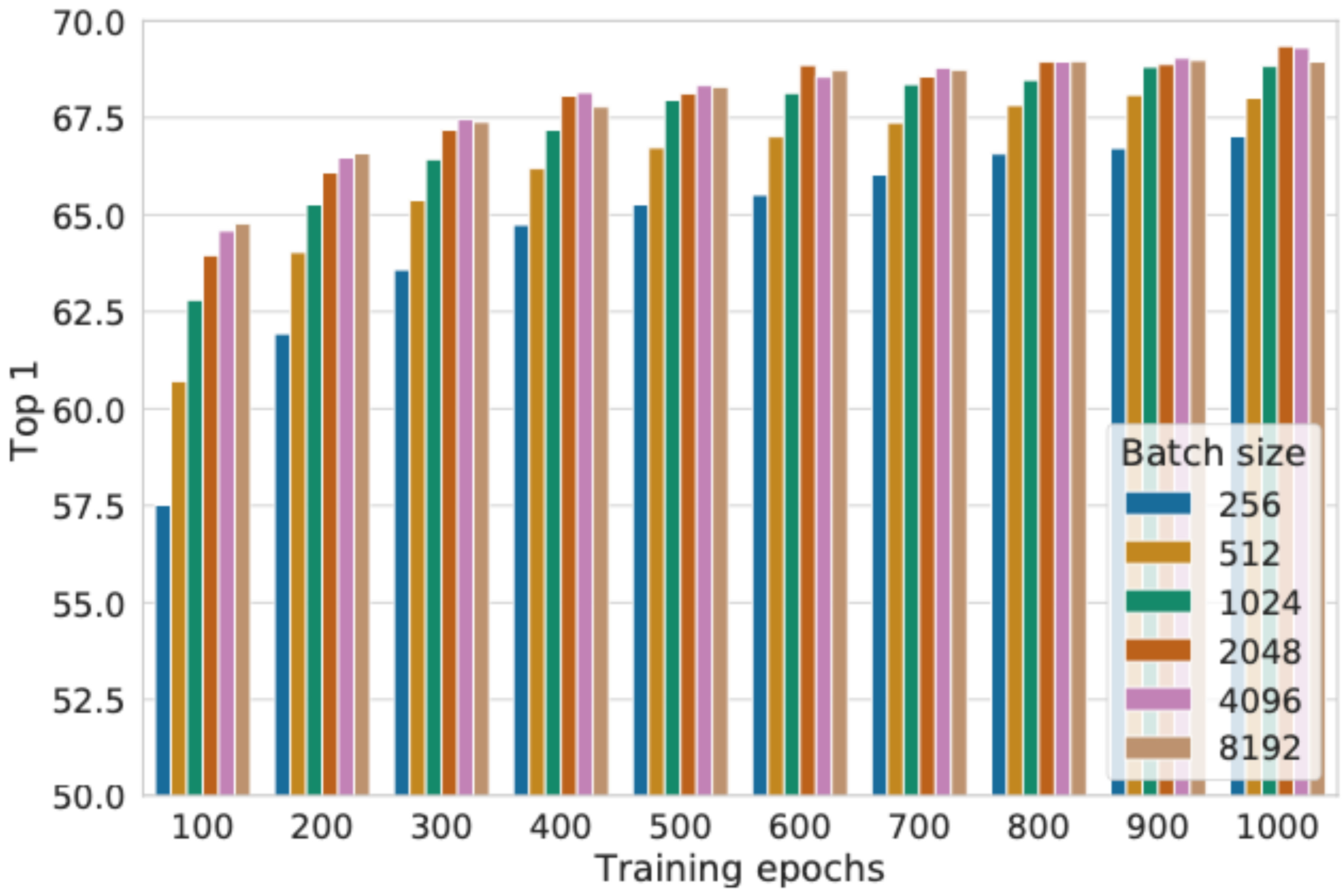



| What to predict? | Random guess | Representation $h$ | $g(h)$ |
|---|---|---|---|
| Color vs grayscale | 80 | 99.3 | 97.4 |
| Rotation | 25 | 67.6 | 25.6 |
| Orig. vs corrupted | 50 | 99.5 | 59.6 |
| Orig. vs Sobel filtered | 50 | 96.6 | 56.3 |

# Intensive Training

## Finding 3




- Contrastive learning benefits more from larger batch size and longer training.