Benchmarking Robustness of Adaptation Methods on Pre-trained Vision-Language Models

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Project Page

1. Introduction

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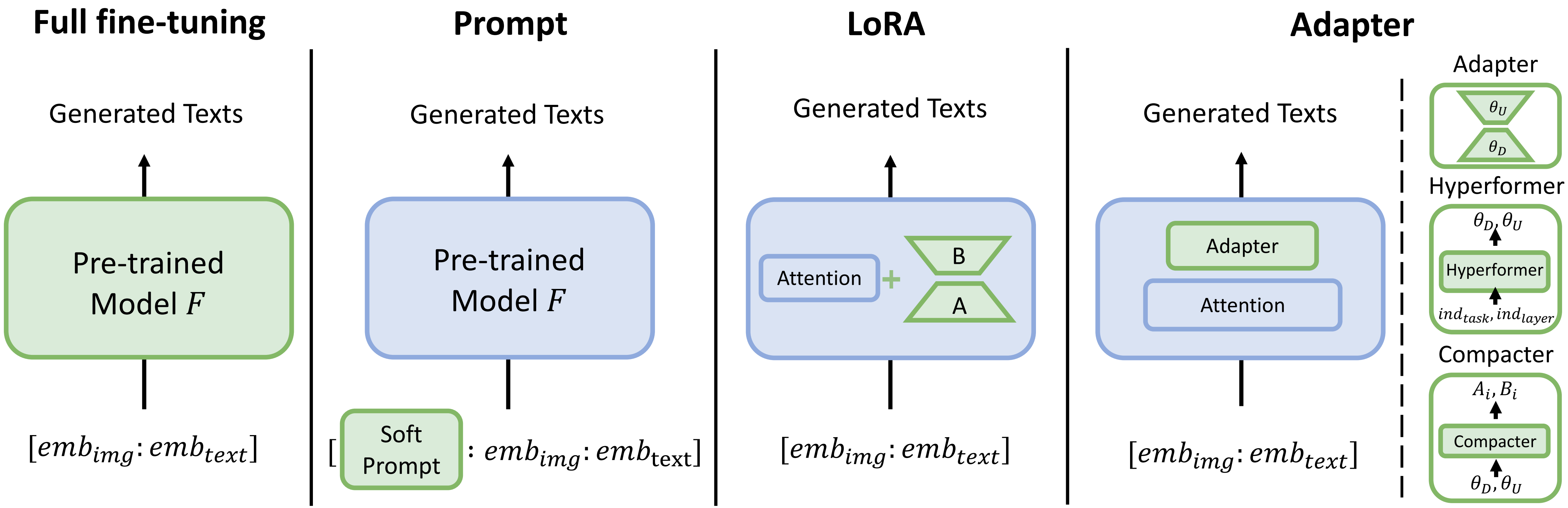

Figure 1. Various adaptation methods have been proposed to enhance the performance of pre-trained vision-language models in specific domains.

1. Introduction

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Test samples in real-world applications often
differ from the data used during pre-training and adaptation.
Model robustness is essential.

VQA during adaptation

What is this animal?

Source: https://www.pinterest.com/

VQA on test sample

What is this animal?

Source: https://www.pinterest.com/

1. Introduction

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Figure 2. Multimodal adaptation methods are sensitive to image and text corruptions.

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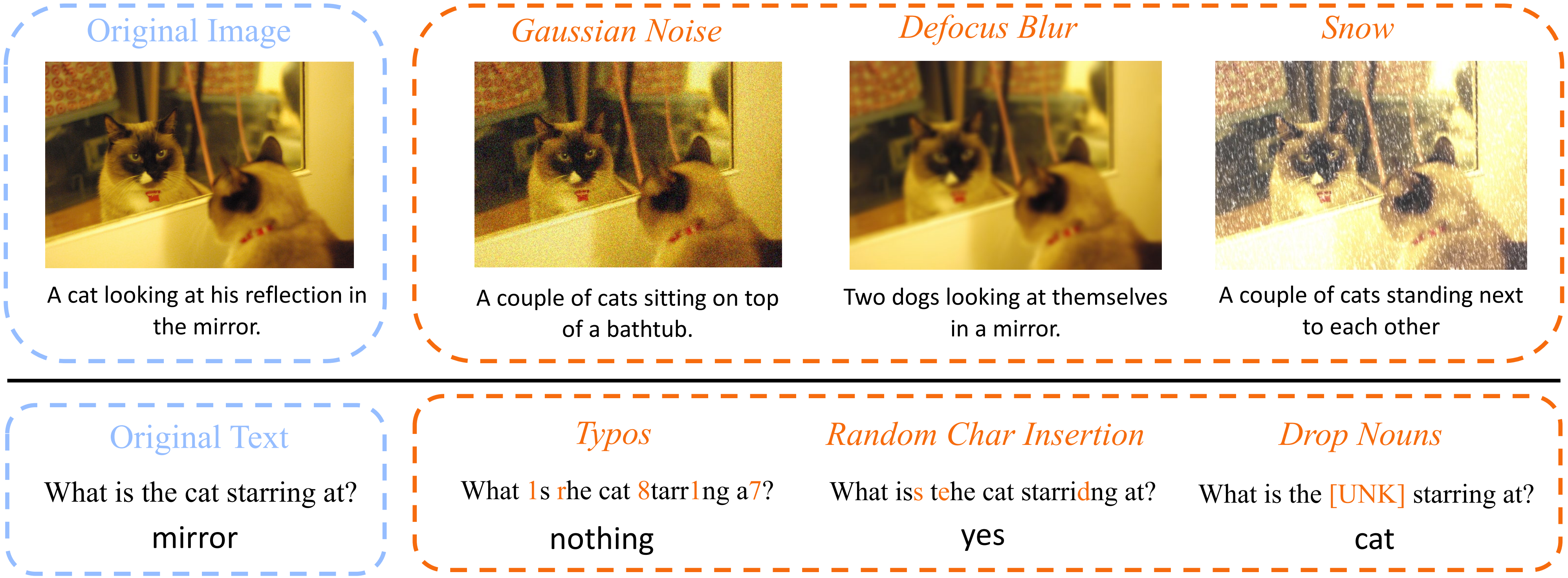

Figure 2. Multimodal adaptation methods are sensitive to image and text corruptions.

We want to know

- Which adaptation performs better on which tasks, w.r.t robustness and performance.
- Whether these methods are robust against multimodal corruptions.
- Whether more examples or more trainable parameters assure better robustness

Some examples of image and text corruption

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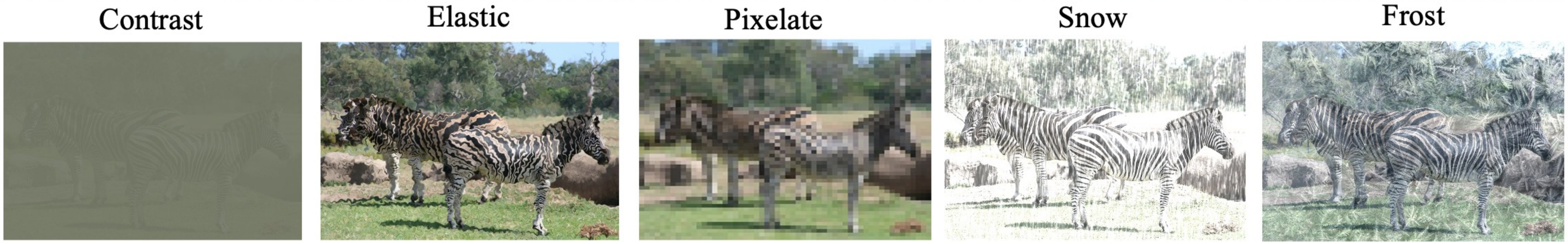

Some examples of image and text corruption

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Contrast | Elastic | Pixelate | Snow | Frost

Original Text

What is the cat starring at?

Typos

What 1s rhe cat 8tarr1ng a7?

Random Char Insertion

What iss tehe cat starriding at?

Drop Nouns

What is the [UNK] starring at?

2. Corruption Methods

Project Page

Some examples of image and text corruption

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Original Image | Severity 1 | Zoom Blur | Severity 5

2. Corruption Methods

Project Page

96 different levels of image corruption

87 different levels of text corruption

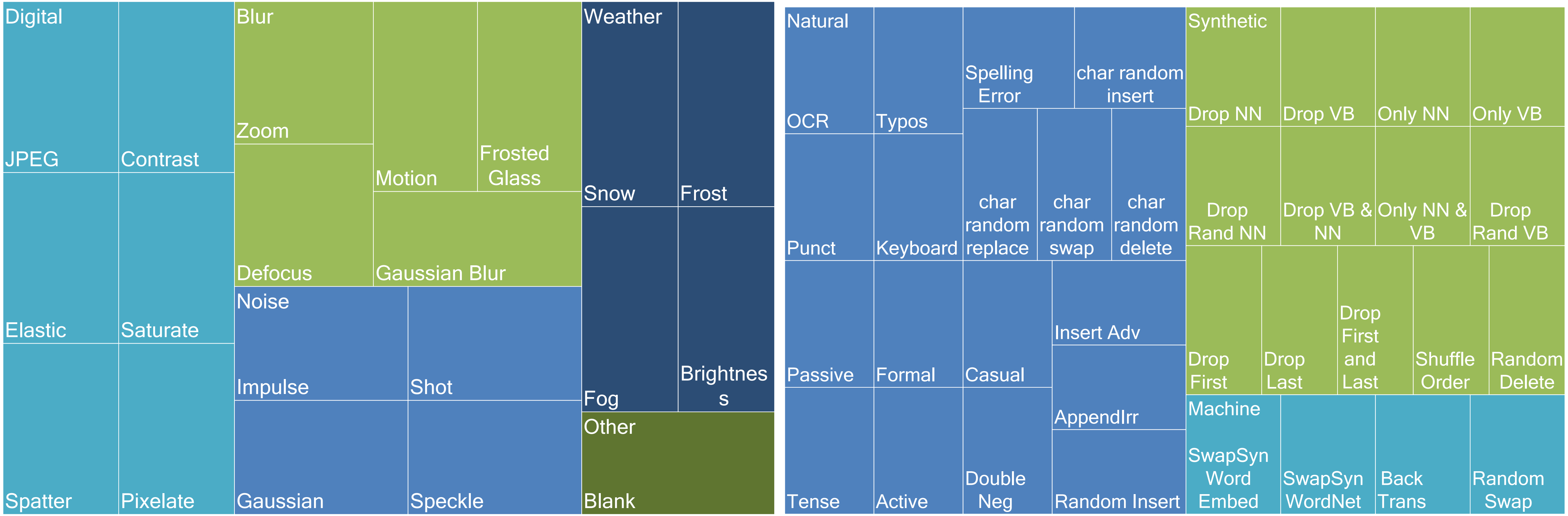

Figure 3. Corruption methods used in this study.

3. Benchmark

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	VQAv2		GQA		NLVR^2		MSCOCO Caption	
The Number of	Images	QA pairs	Images	QA pairs	Images	QA pairs	Images	Captions
Training set	113.2K	605.1K	72.1K	943.0K	103.2K	86.4K	113.2K	566.8K
Validation set	5.0K	26.7K	10.2K	132.1K	8.1K	7.0K	5.0K	5.0K
Test set	5.0K	26.3K	398	12.6K	8.1K	7.0K	5.0K	5.0K

Table 1. Dataset Statistics

https://adarobustness.github.io

We have built

11 widely used adaptation methods
20 different image corruption methods
96 different levels of image corruption
35 different text corruption methods
87 different levels of text corruption
7 out-of-distribution benchmark datasets

Relative Robustness: $RR = 1 - \frac{\Delta P}{P_I}, \Delta \mathrm{P} = (\mathrm{P_I} - \mathrm{P_o})$

P_I: performance on in-distribution dataset

P_O: performance on out-of-distribution dataset

Equation 1. Evaluation Protocol

4. Results and Analysis

Project Page

Adaptation method *Image Corruptions*	Updated Params	VQAv2 Acc (%)	VQAv2 RR (%)	GQA Acc (%)	GQA RR (%)	$NLVR^2$ Acc (%)	$NLVR^2$ RR (%)	MSCOCO Caption CIDEr	MSCOCO Caption RR (%)
Full Fine-tuning	100%	66.75	84.86$\pm$5.17	55.04	89.20$\pm$0.04	73.01	90.34$\pm$0.04	115.03	68.40$\pm$0.14
Single Adapter	4.18%	65.35	**85.76**$\pm$5.32	54.14	82.49$\pm$0.04	73.89	90.04$\pm$0.05	115.04	68.68$\pm$0.14

Adaptation method *Text Corruptions*	Updated Params	VQAv2 Acc (%)	VQAv2 RR (%)	GQA Acc (%)	GQA RR (%)	$NLVR^2$ Acc (%)	$NLVR^2$ RR (%)
Full Fine-tuning	100%	66.75	73.65$\pm$22.38	55.04	66.92$\pm$24.14	73.01	87.06$\pm$11.00
Single Adapter	4.18%	65.35	**77.64**$\pm$21.09	54.14	67.47$\pm$20.03	73.89	88.49$\pm$10.87

A higher sensitivity towards ***text corruptions, especially to character-level corruptions***

4. Results and Analysis

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Adaptation method *Image Corruptions*	Updated Params	**VQAv2** Acc (%)	RR (%)	**GQA** Acc (%)	RR (%)	**NLVR^2** Acc (%)	RR (%)	**MSCOCO Caption** CIDEr	RR (%)
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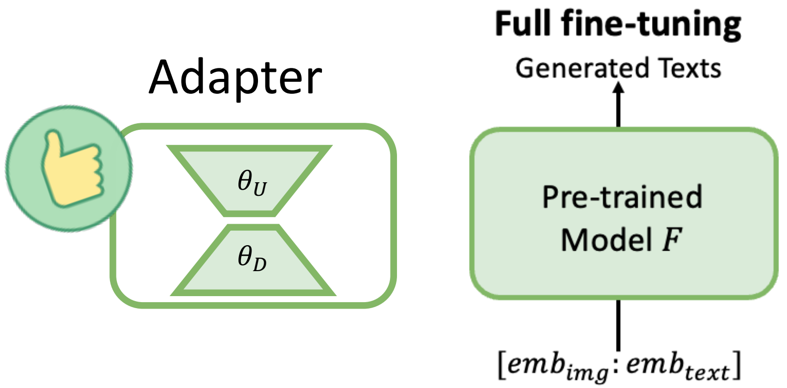
Single Adapter	4.18%	65.35	**77.64**±21.09	54.14	67.47±20.03	73.89	88.49±10.87



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***Language information** plays a more significant role than visual information*

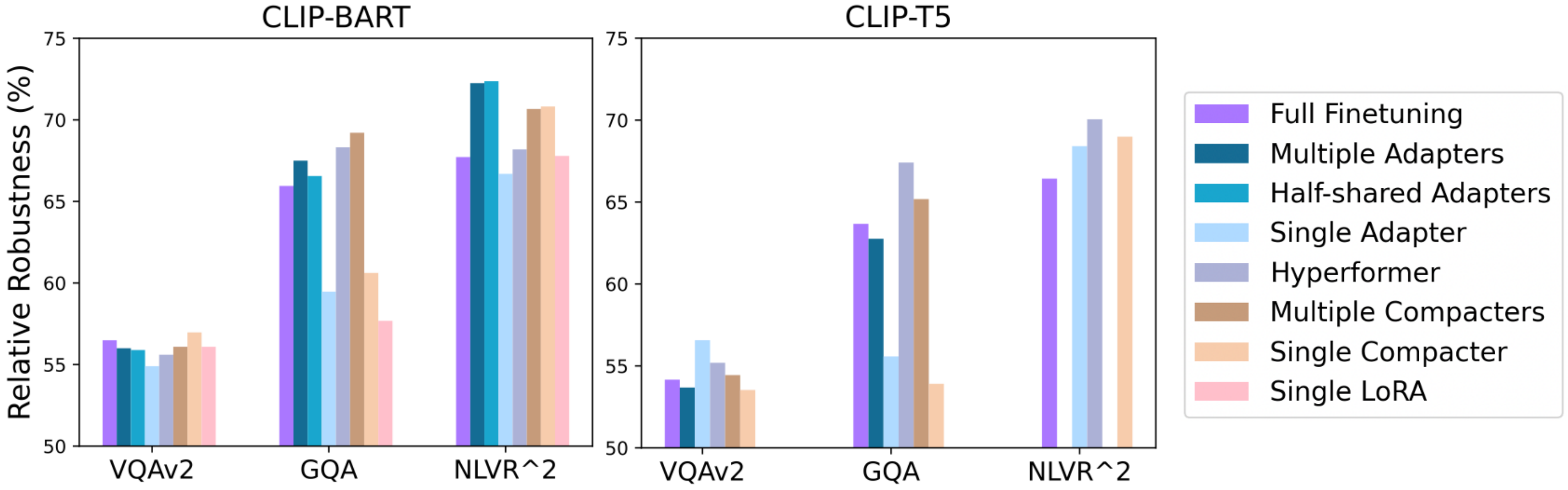

Figure 4. RR against blank-image corruption.

4. Results and Analysis

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More adaptation data ***does not consistently enhance*** *robustness.*

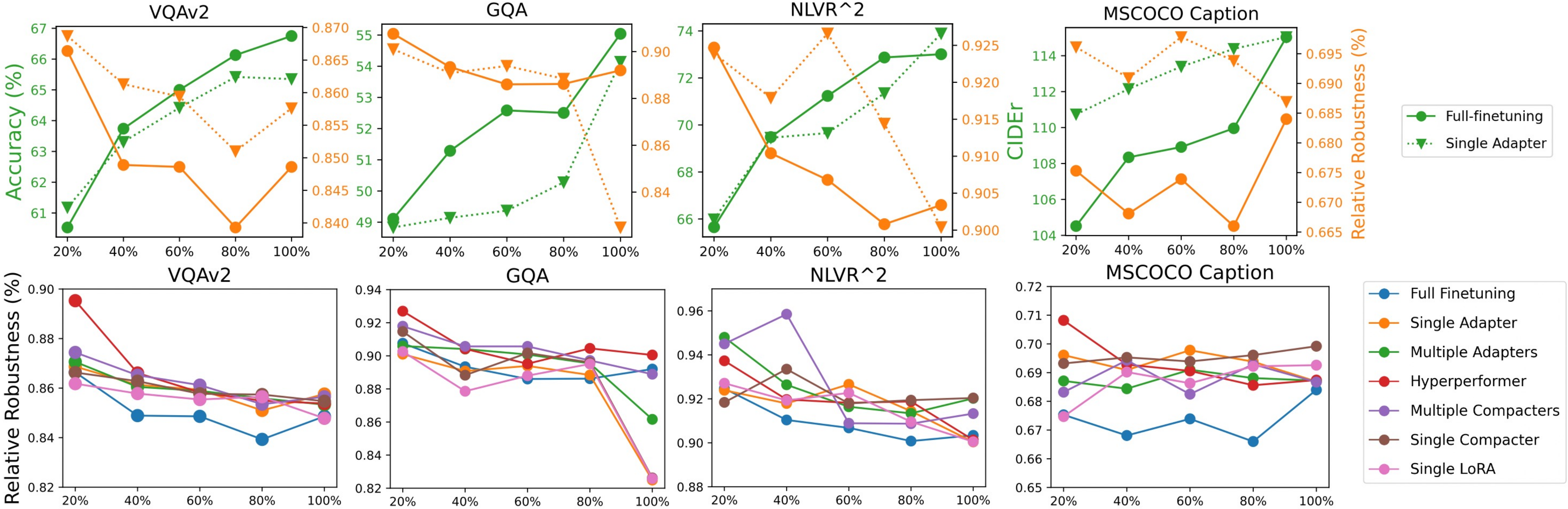

Figure 5. RR given different size of adaptation dataset.

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More parameters ***do not ensure enhanced robustness*** *and some even* ***reduce*** *it*

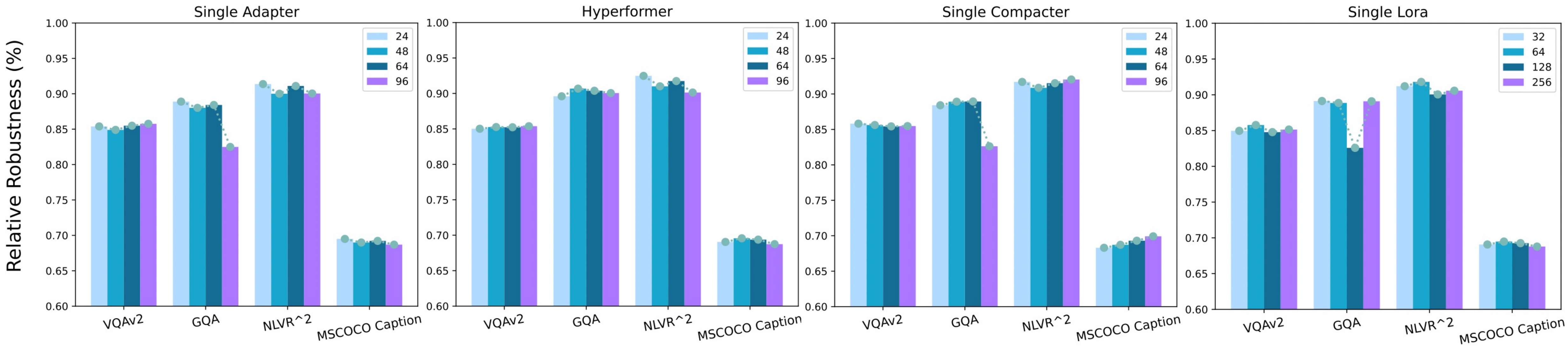

Figure 6. RR given different size of adaptation modules.

4. Results and Analysis

Project Page

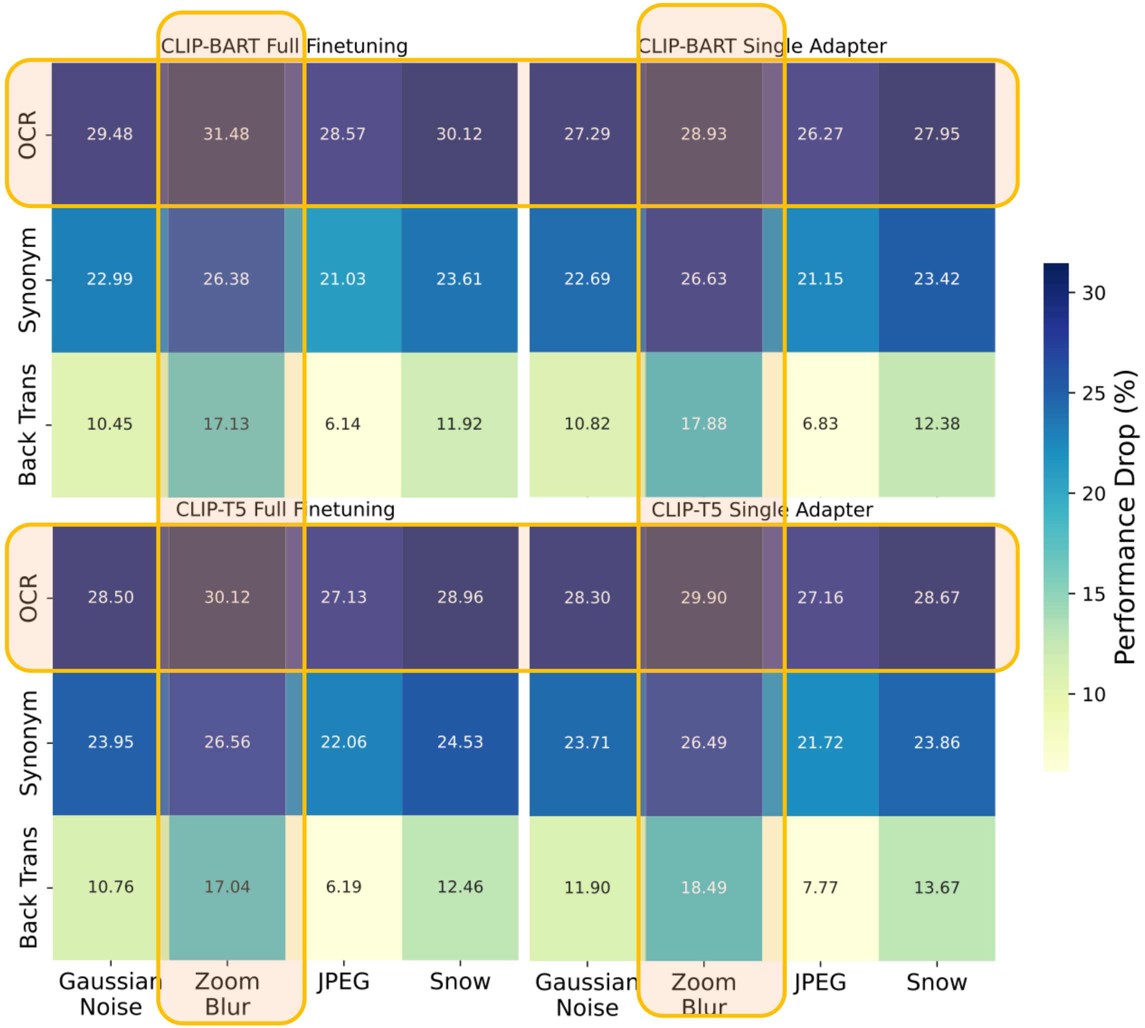

Figure 7. RR given both visual and text corruptions.

Combining corruptions from two modalities can lead to a greater drop in robustness

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Robustness against natural dataset distribution shift follows the similar conclusions.

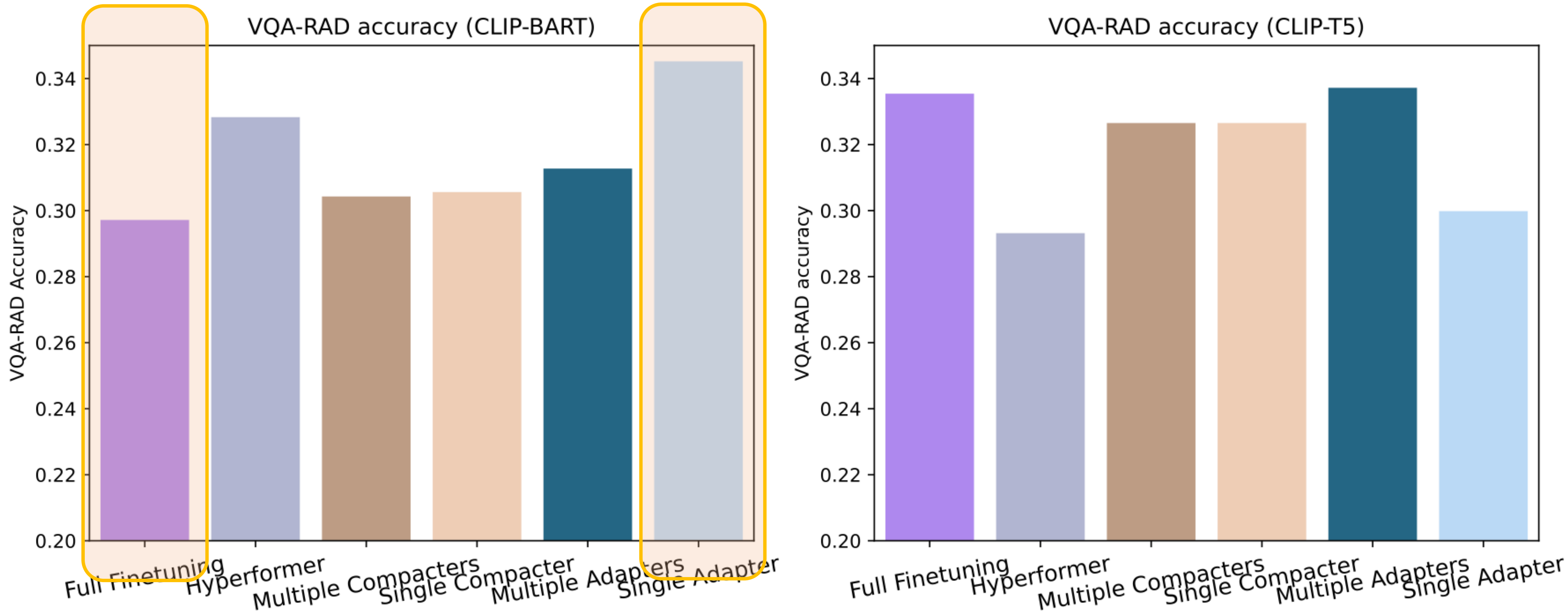

Figure 8. Performance on natural distribution shift dataset (VQA-RAD).

5. Conclusion

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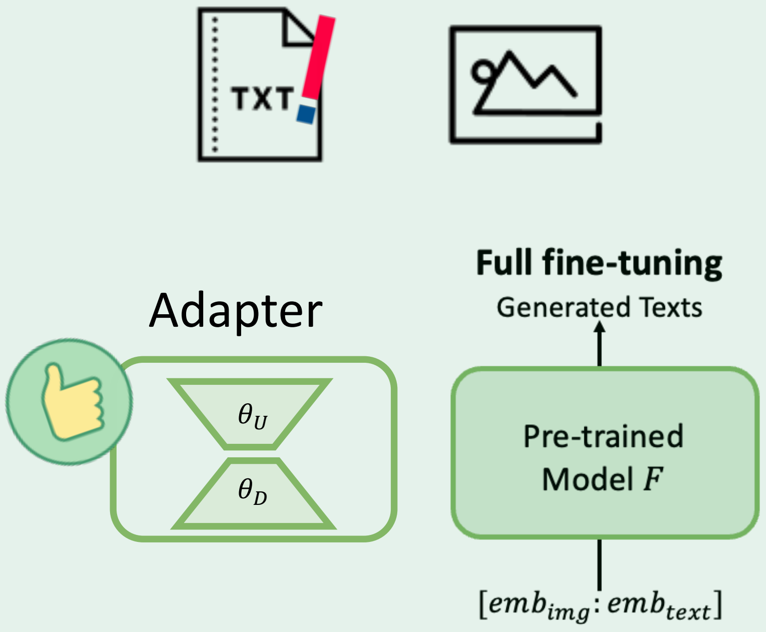
We find out



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Check our paper for more !

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Thank you!

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chenshuo.cs@outlook.com