A Little Robustness Goes a Long Way: Leveraging Robust Features for Targeted Transfer Attacks

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- Robust neural networks can increase targeted adversarial transferability

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- Image representations are often highly transferable when generated with robust neural networks

- Why are adversarial examples optimized to fool robust neural networks so transferable?

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- Why do non-robust networks not have this property?

- Non-robust neural networks have low *representation transferability*

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- Robust neural networks have high *representation transferability*

- *Robust* neural networks: adversarial training

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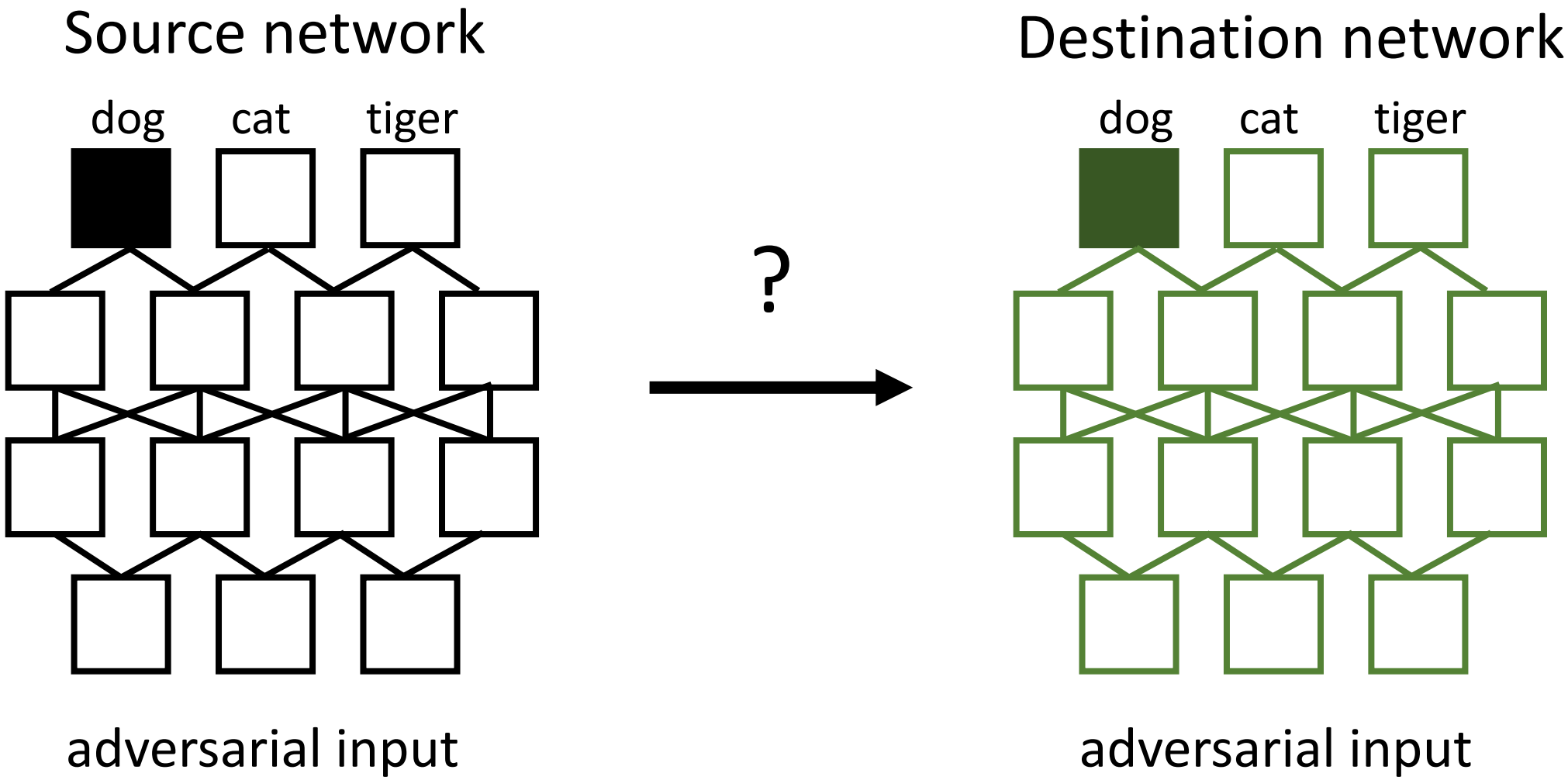
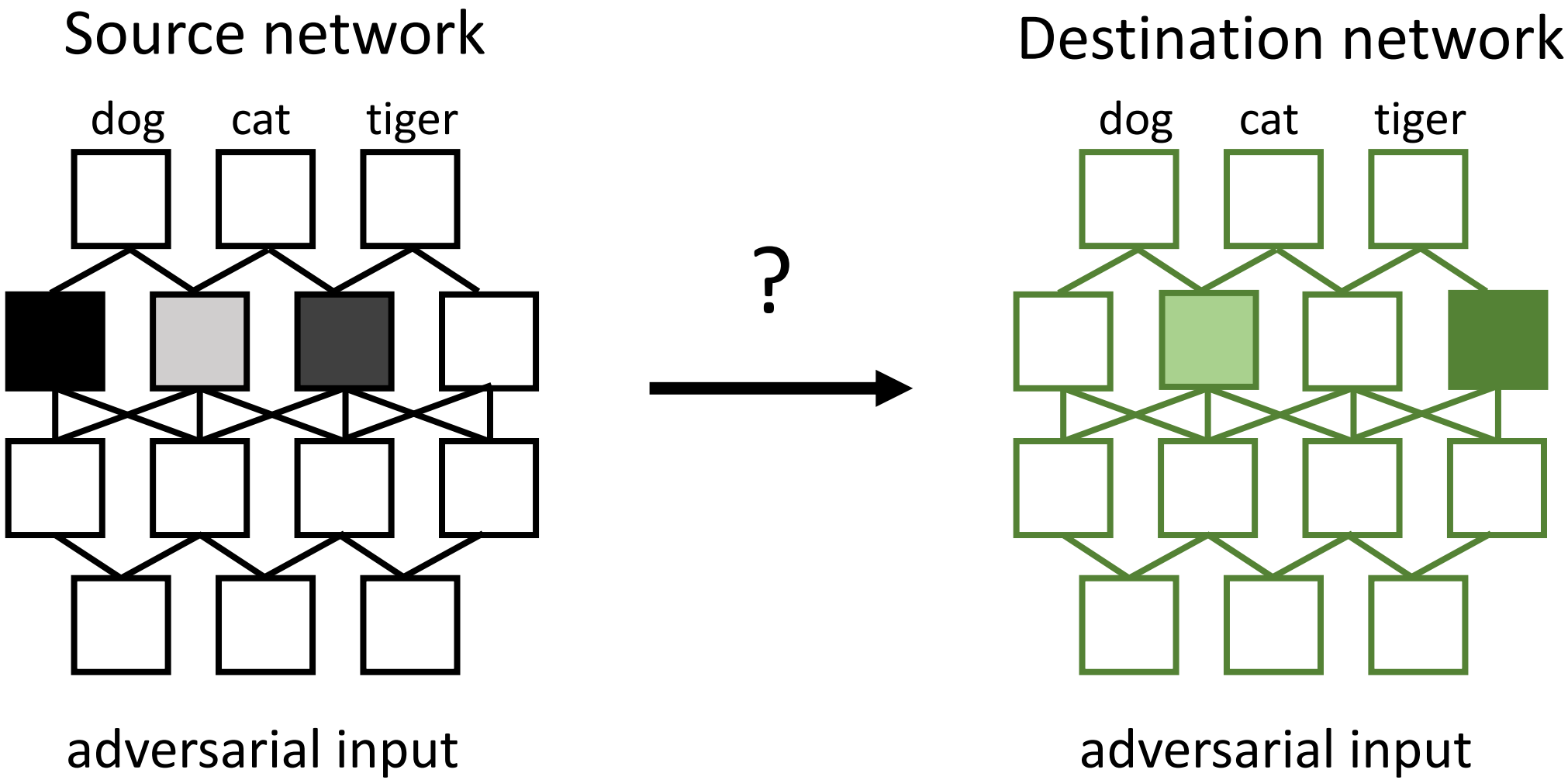
- Train on adversarial examples limited in L2 norm by ε (*robustness parameter)*

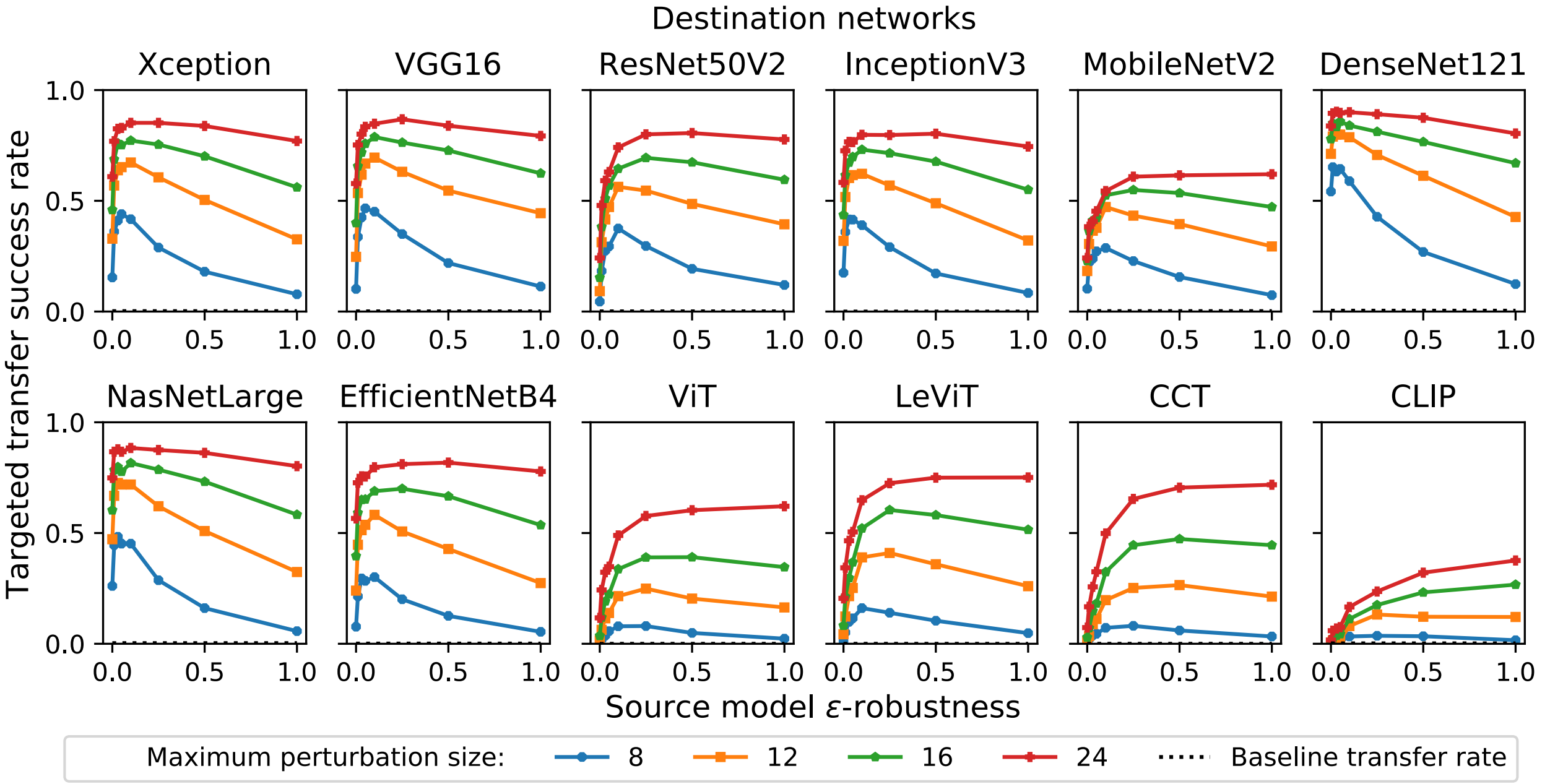
Class-targeted (standard) transferability

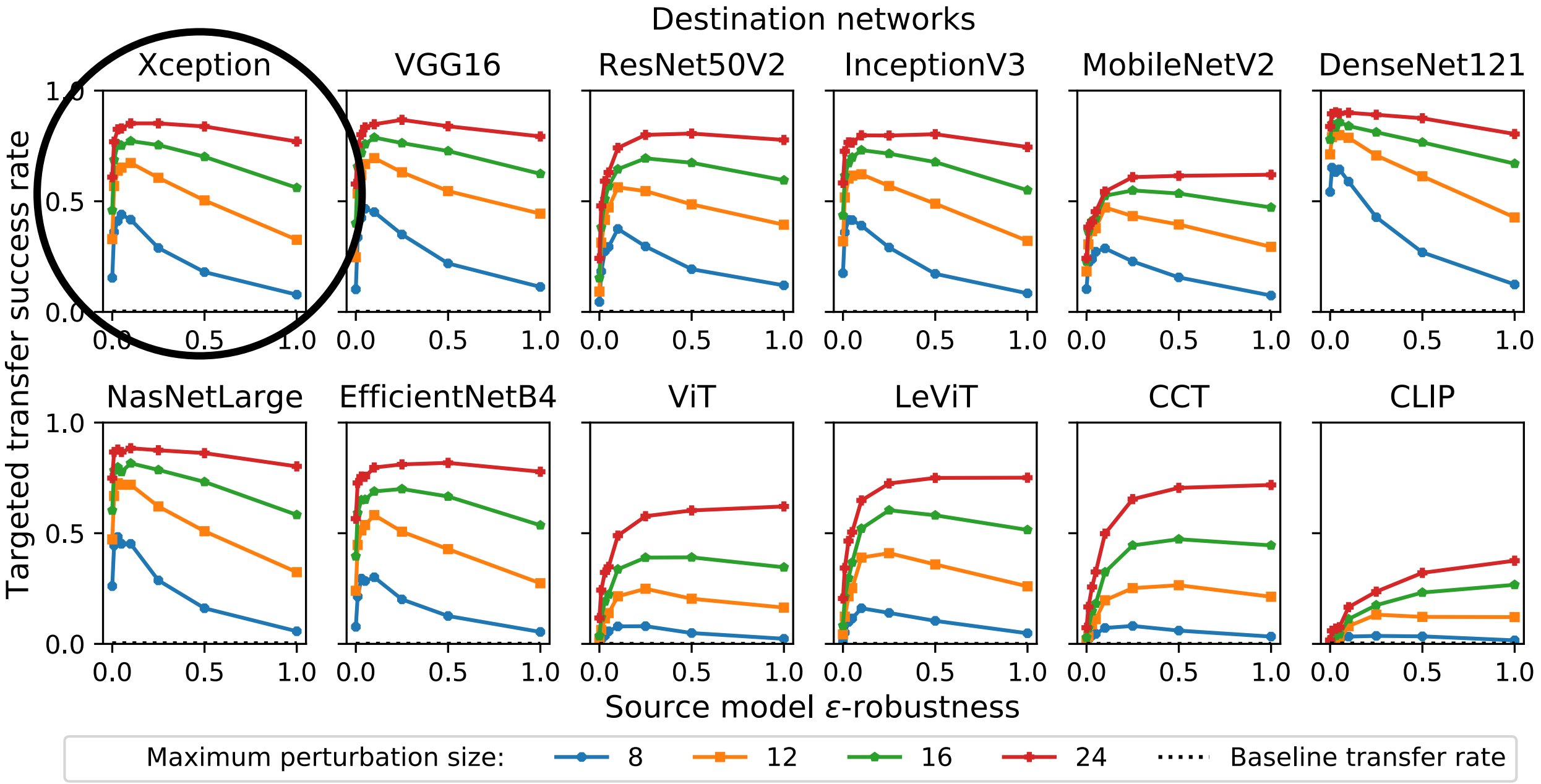


Representation-targeted transferability



- Transferability in this talk is *targeted*
- See paper for experiments on *untargeted* adversarial examples


Destination networks
Xception
VGG16
ResNet50V2
InceptionV3
MobileNetV2
DenseNet121
NasNetLarge
EfficientNetB4
ViT
LeViT
CCT
CLIP
Targeted transfer success rate
Source model ε-robustness
0.0
0.5
1.0
Maximum perturbation size:
8
12
16
24
Baseline transfer rate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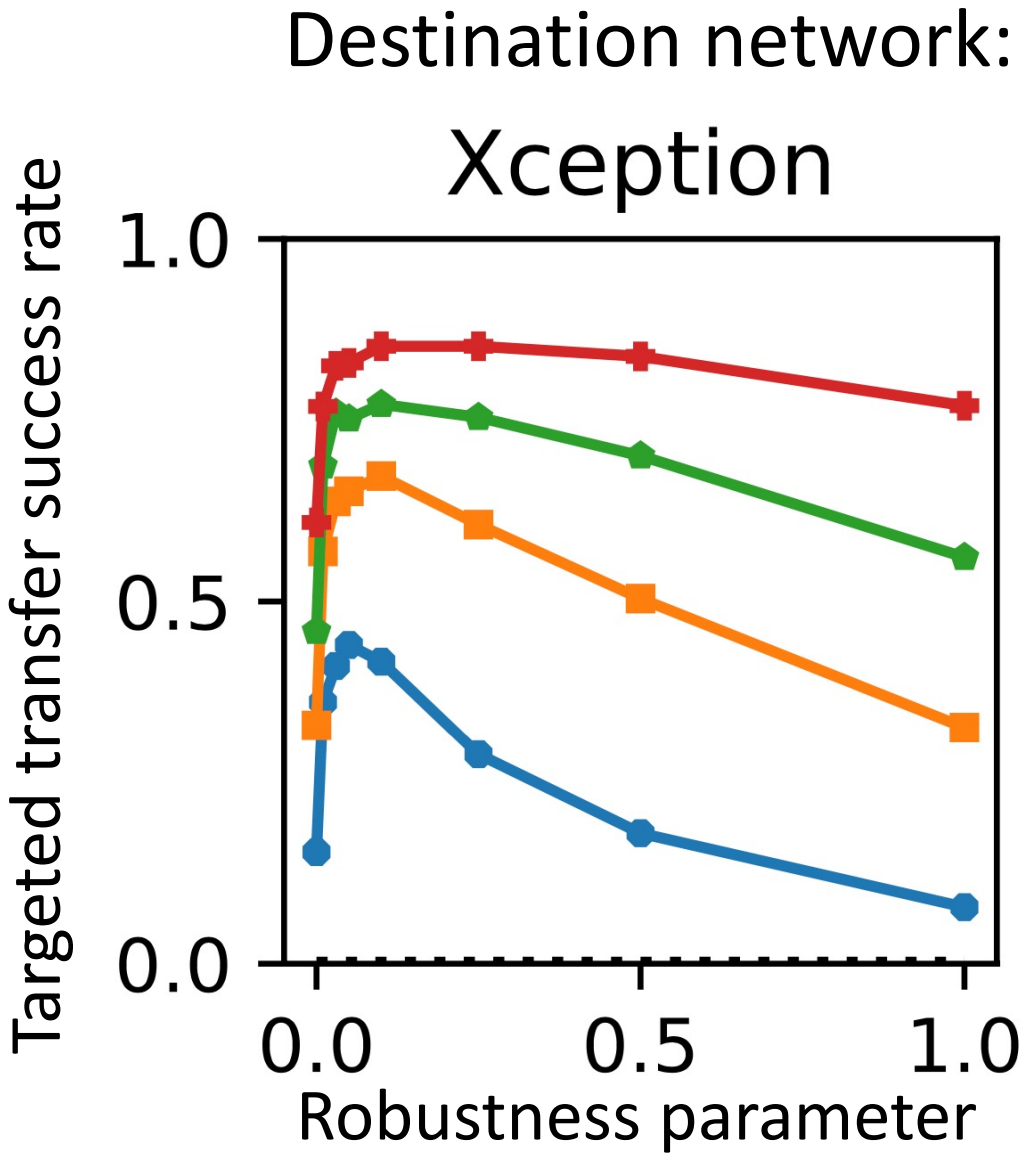
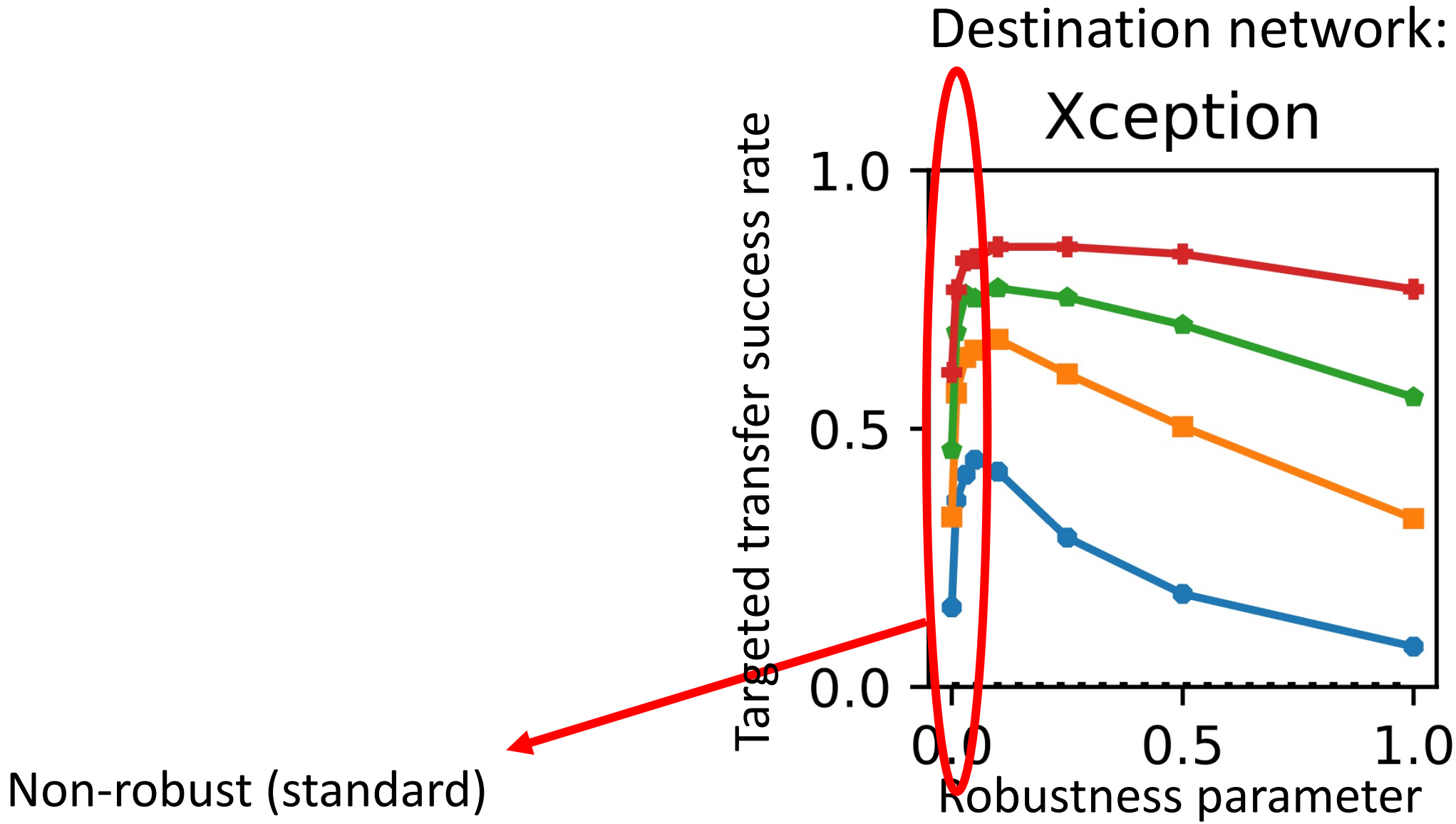

Destination network:
Xception
Targeted transfer success rate
1.0
0.5
0.0
0.0
0.5
1.0
Robustness parameter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Targeted transfer success rate
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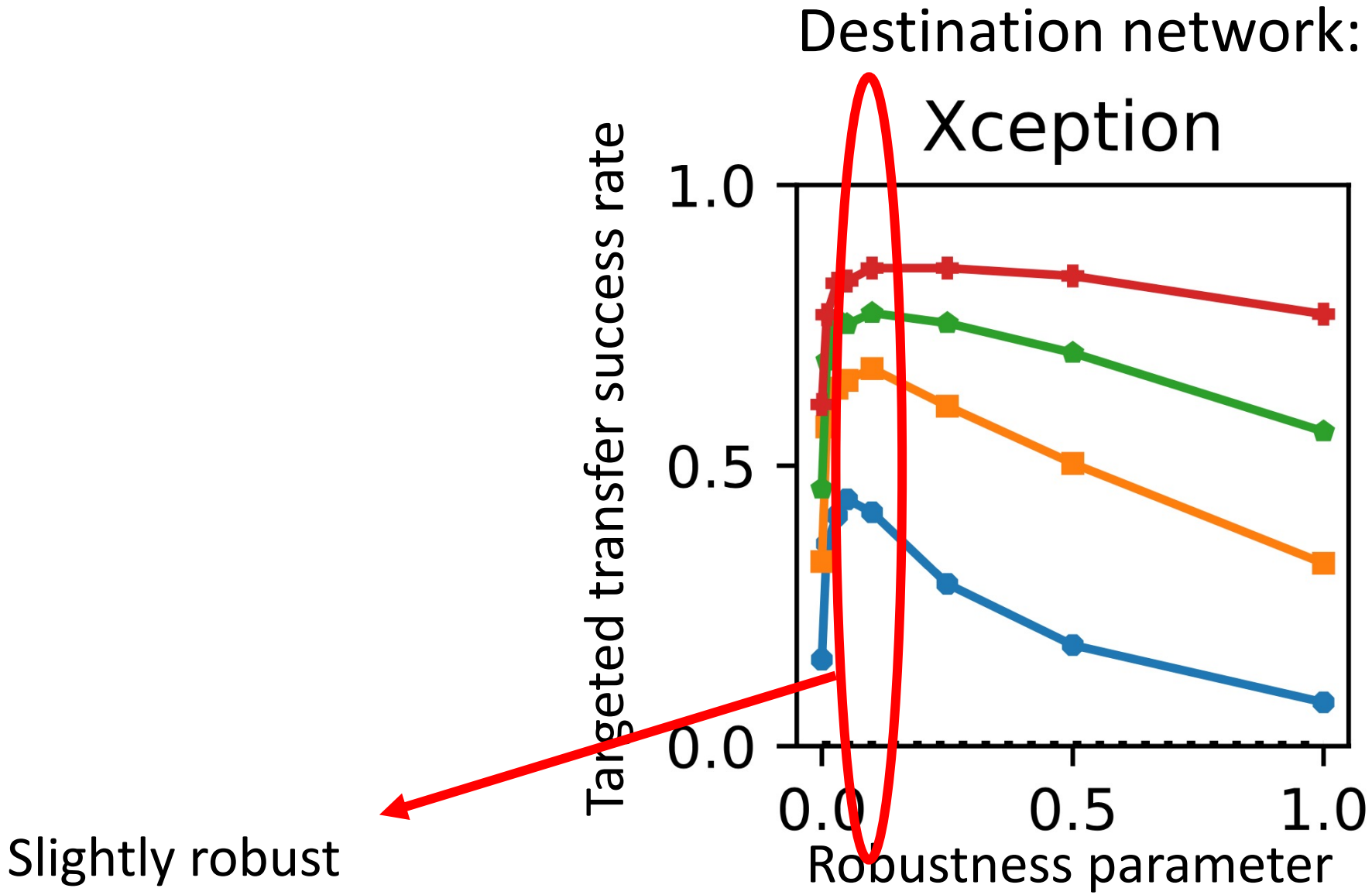
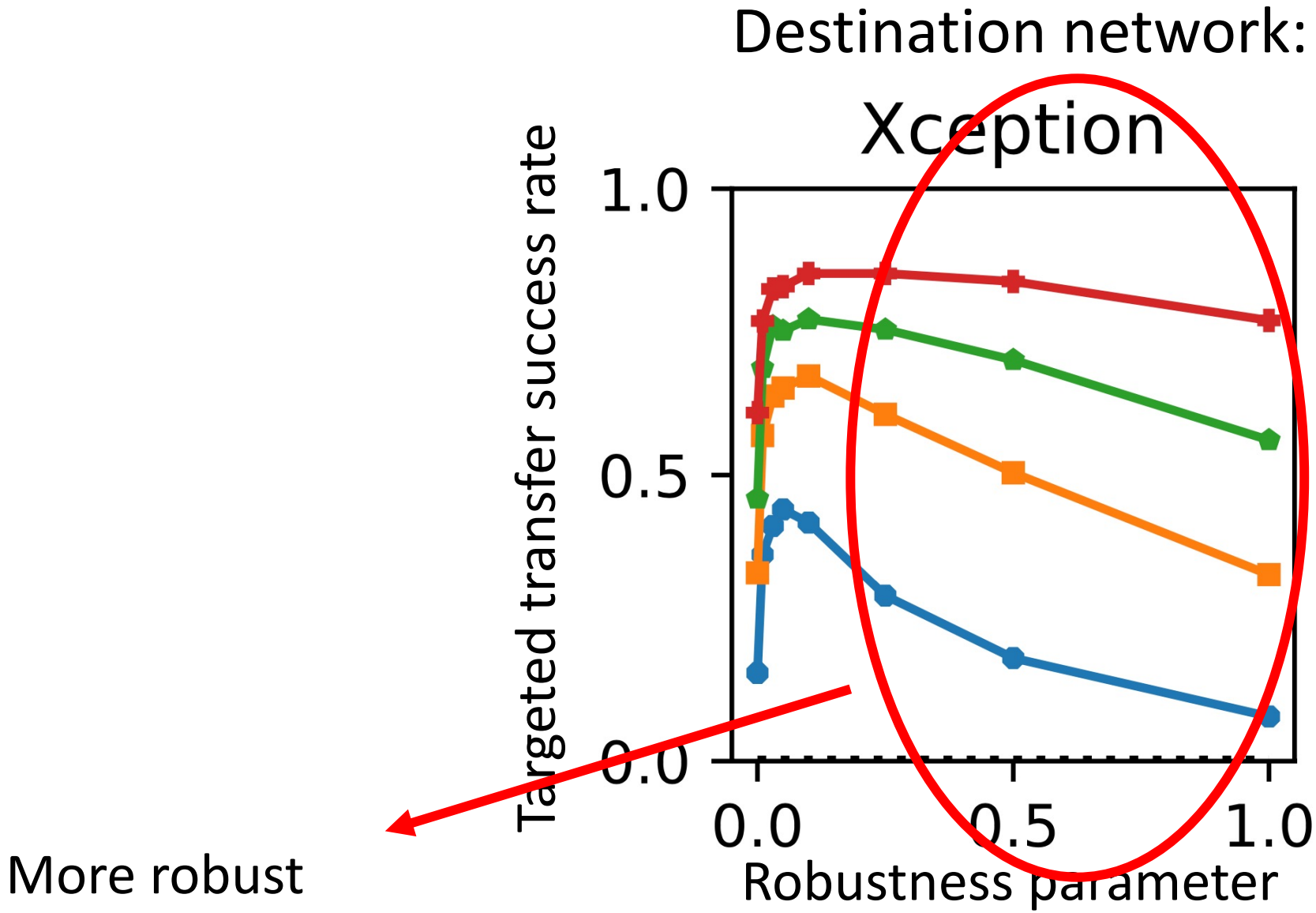
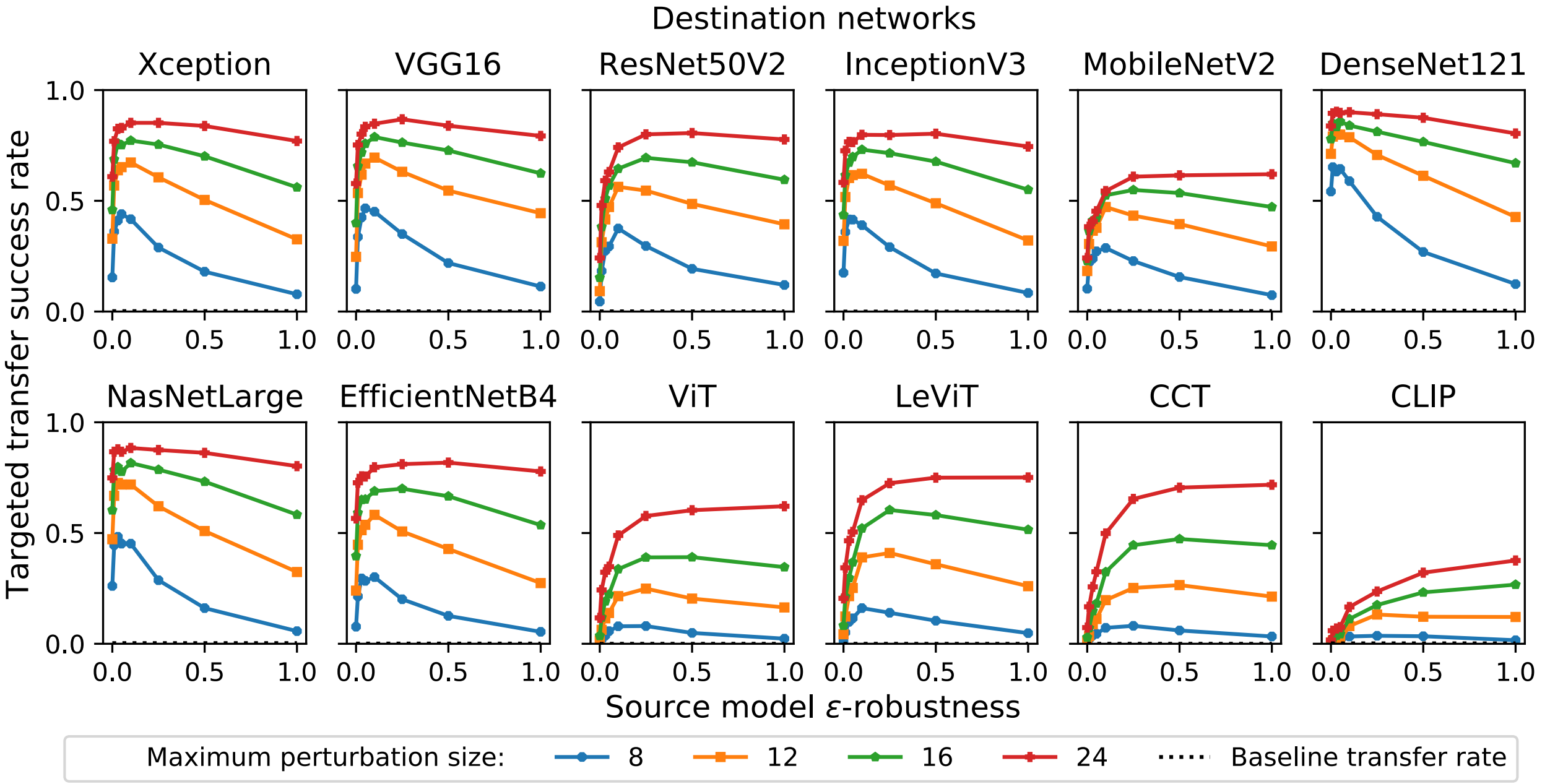
0.5
0.0
0.0
0.5
1.0
Robustness parameter
Non-robust (standard)


Destination network:
Xception
Targeted transfer success rate
1.0
0.5
0.0
0.0
0.5
1.0
Robustness parameter
Slightly robust


Destination network:
Xception
Targeted transfer success rate
1.0
0.5
0.0
0.0
0.5
1.0
Robustness parameter
More robust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LeViT
CCT
CLIP
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0.0
0.5
1.0
Maximum perturbation size:
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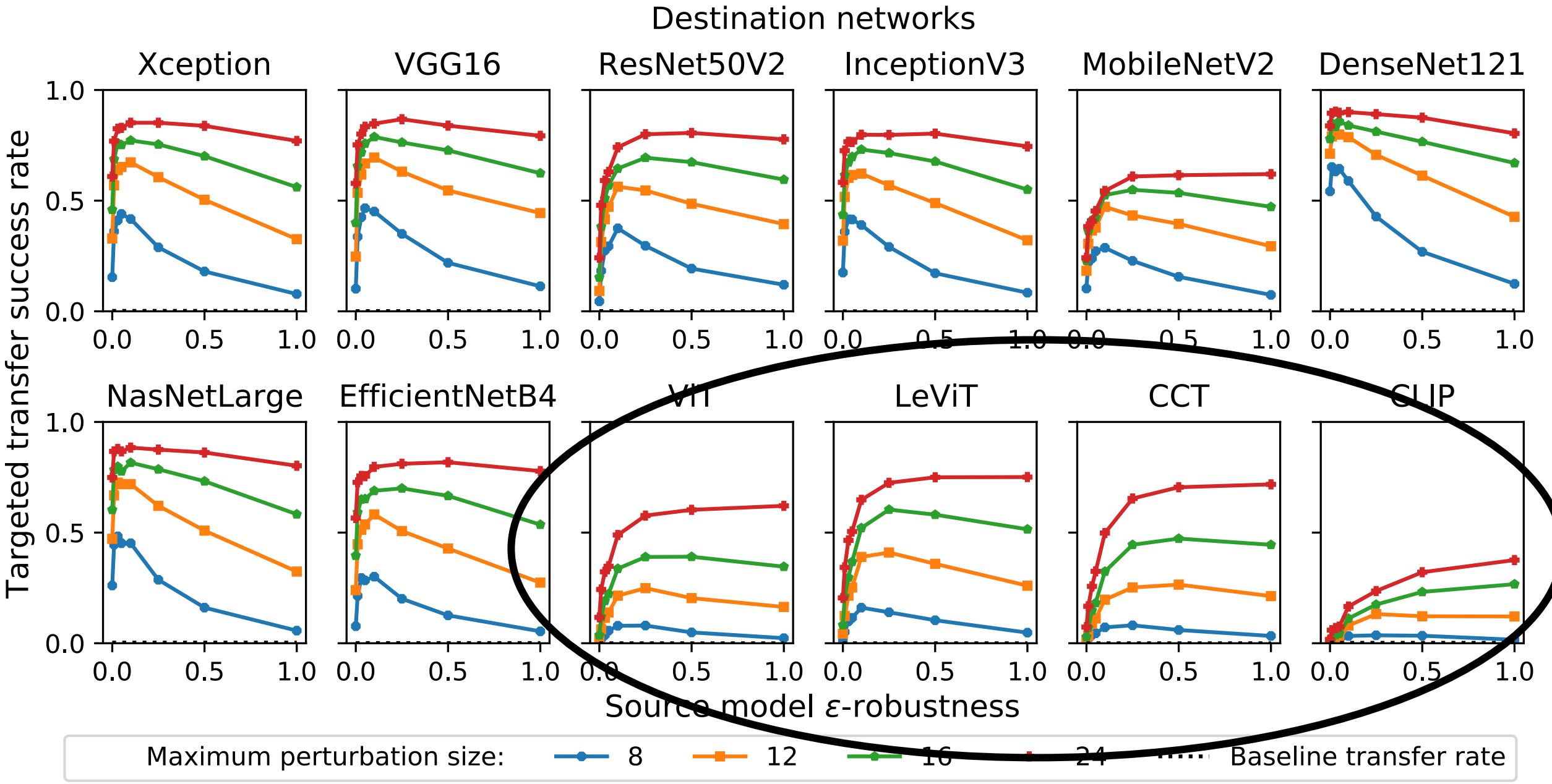
12
16
24
Baseline transfer rate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0.5
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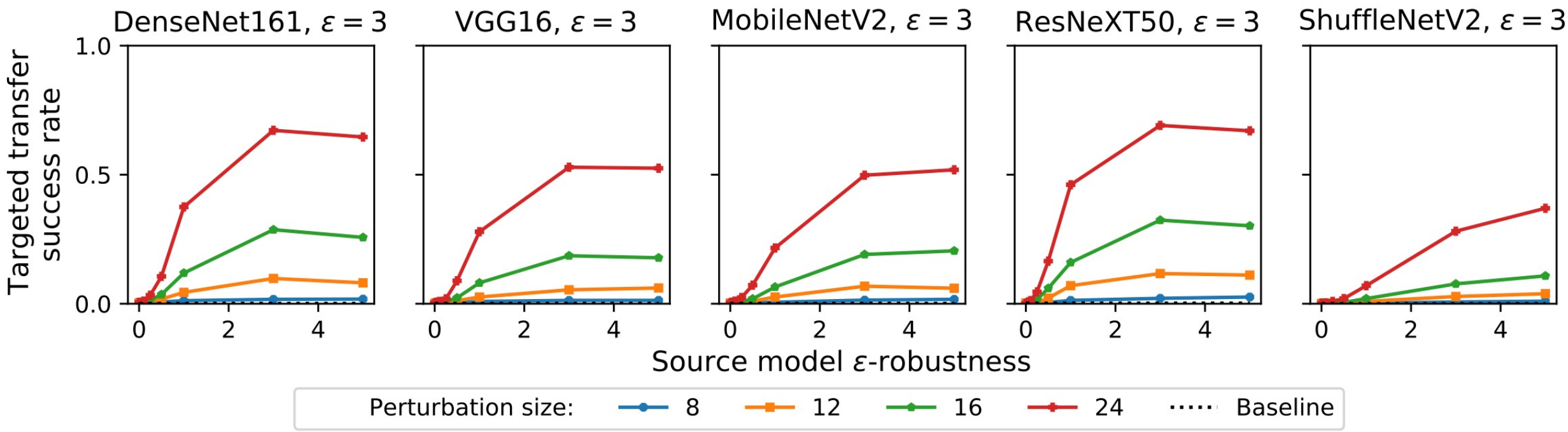
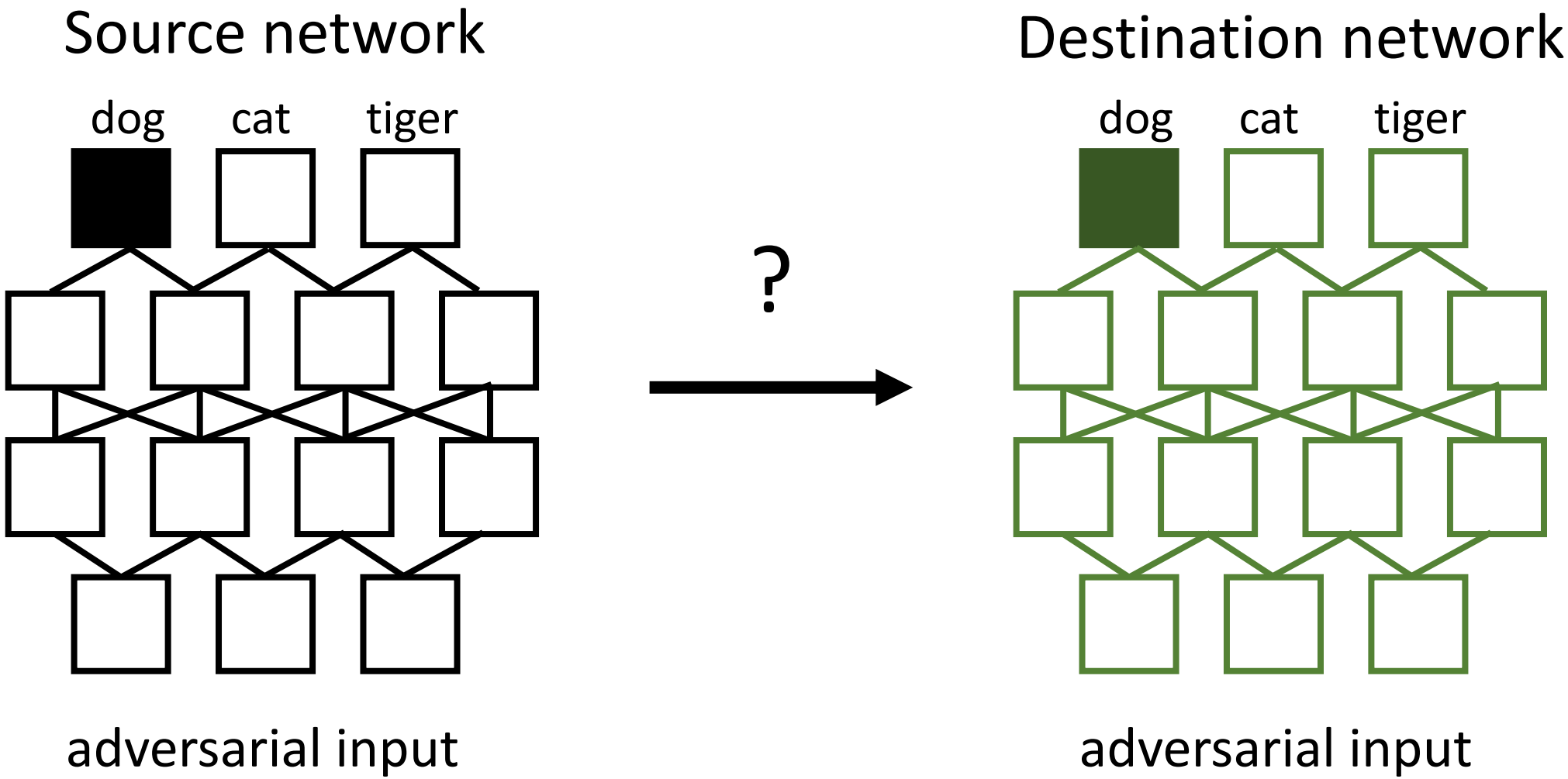
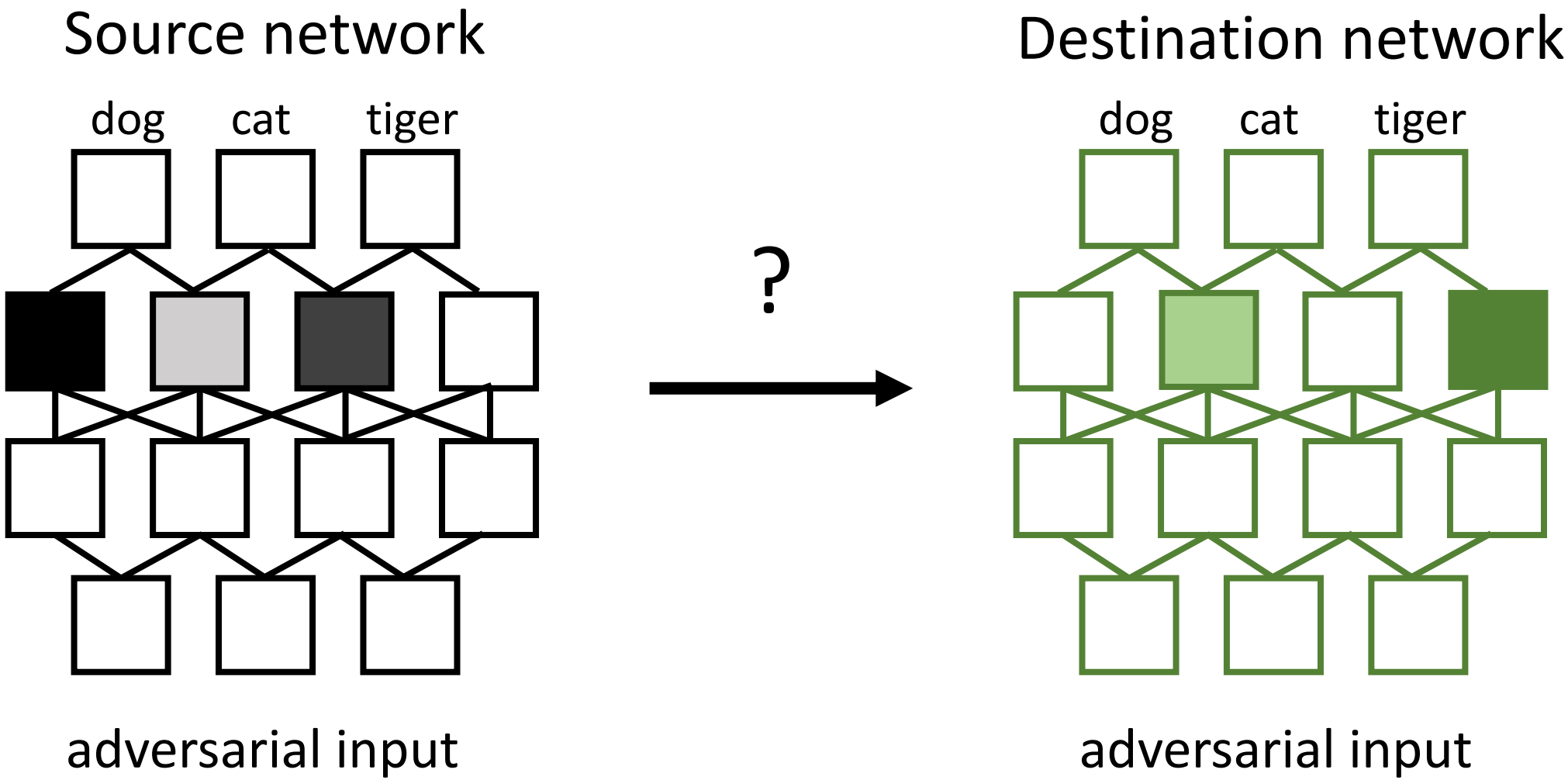
Baseline transfer rate


DenseNet161, $\varepsilon = 3$
VGG16, $\varepsilon = 3$
MobileNetV2, $\varepsilon = 3$
ResNeXT50, $\varepsilon = 3$
ShuffleNetV2, $\varepsilon = 3$
Targeted transfer success rate
1.0
0.5
0.0
0
2
4
Source model ε-robustness
Perturbation size:
8
12
16
24
Baseline

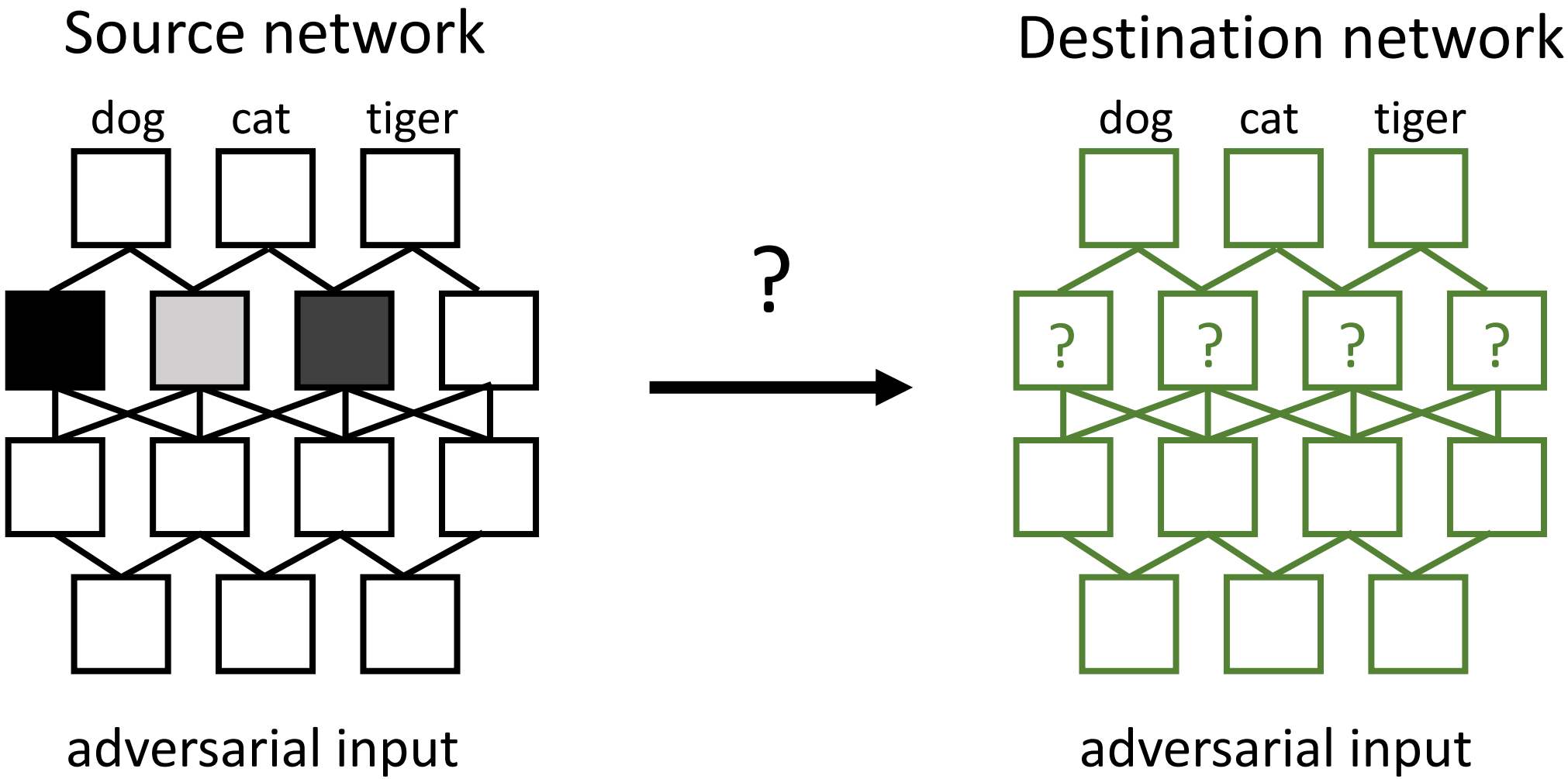
Class-targeted transferability



Representation-targeted transferability



Representation-targeted transferability



Source classifier

Destination classifier

reference

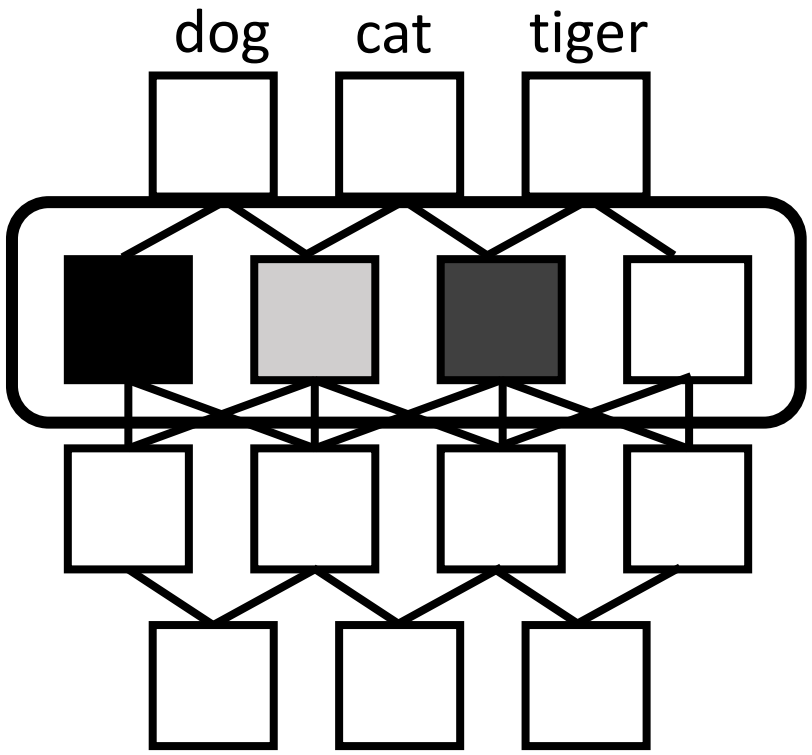
dog cat tiger

reference in destination

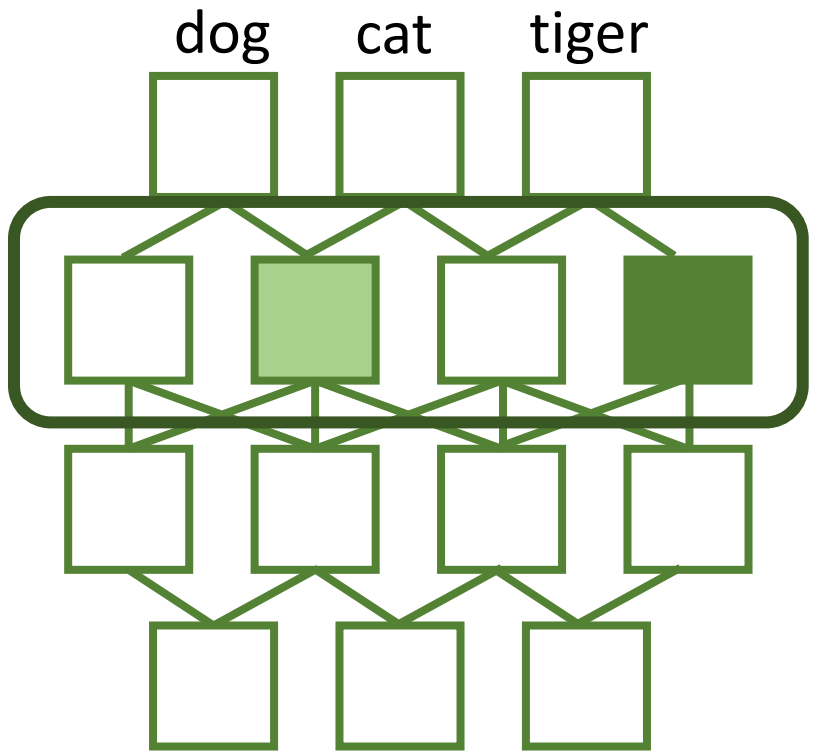
dog cat tiger

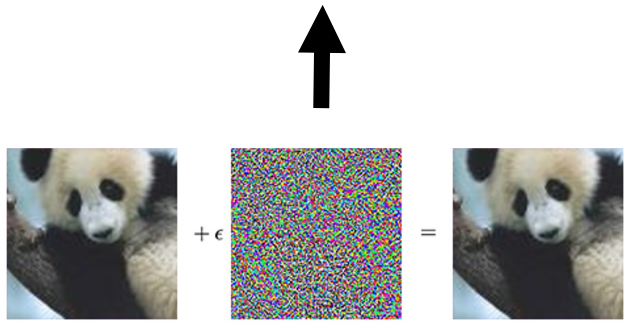
Source classifier

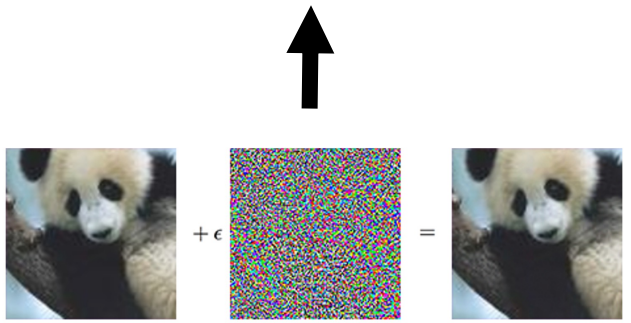
Destination classifier

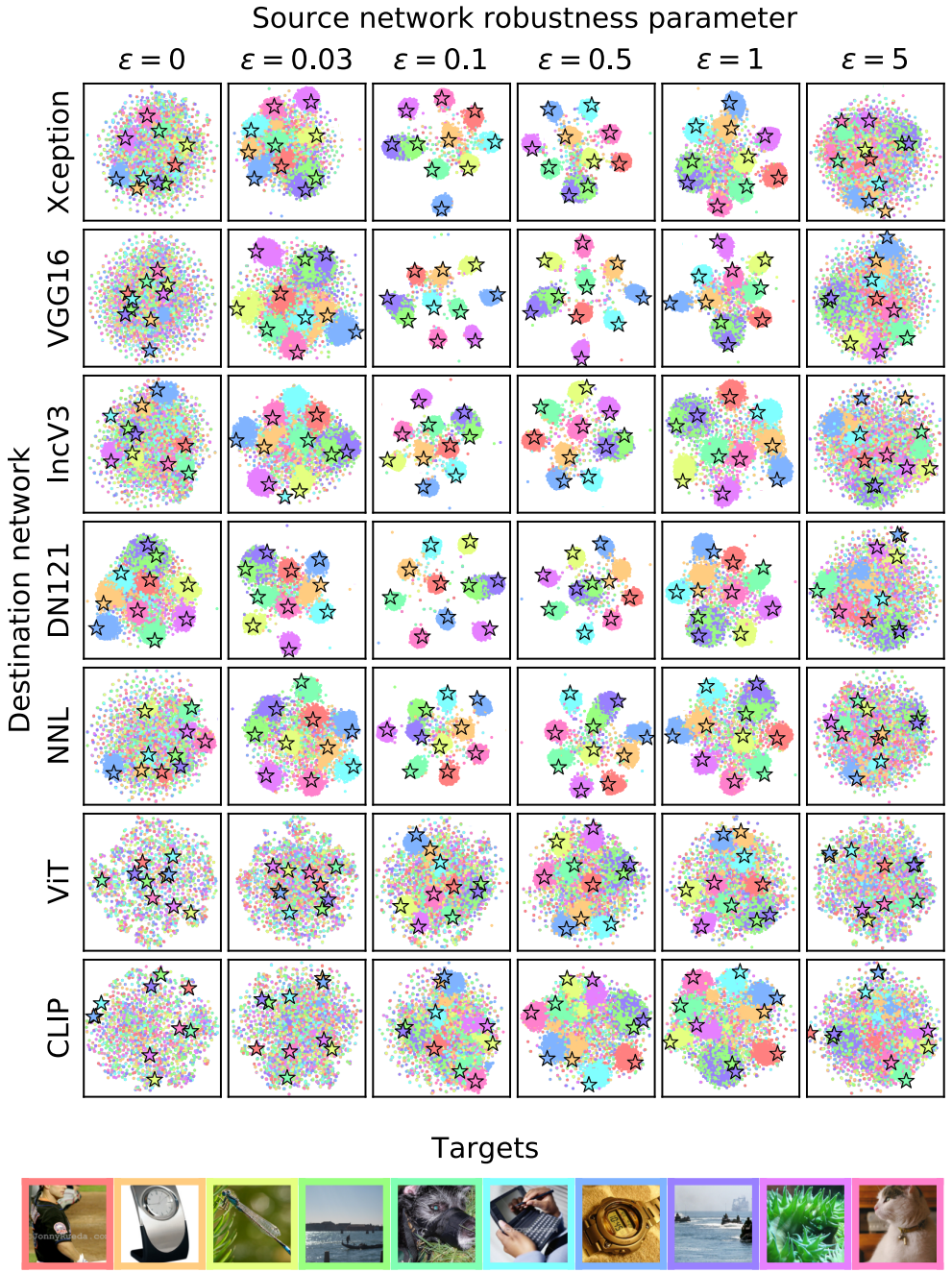


?








Source network robustness parameter
$\varepsilon = 0$
$\varepsilon = 0.03$
$\varepsilon = 0.1$
$\varepsilon = 0.5$
$\varepsilon = 1$
$\varepsilon = 5$
Destination network
Xception
VGG16
IncV3
DN121
NNL
ViT
CLIP
Targets

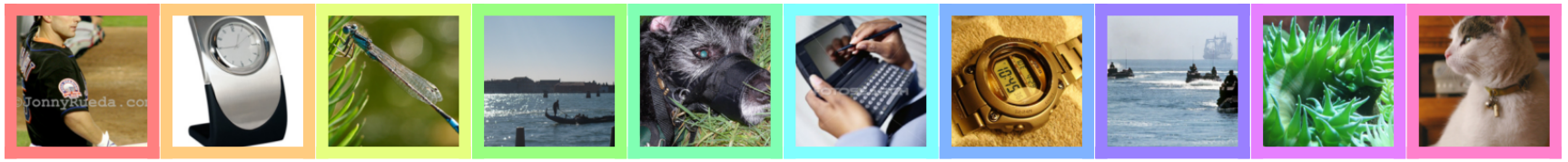
Source network robustness parameter

$\varepsilon = 0$ $\varepsilon = 0.03$ $\varepsilon = 0.1$ $\varepsilon = 0.5$ $\varepsilon = 1$ $\varepsilon = 5$

Xception

CLIP

Targets



Destination	Source network robustness parameter (ε)									
	0	0.01	0.03	0.05	0.1	0.25	0.5	1	3	5
Xception	0.462	0.505	0.531	0.563	**0.594**	0.585	0.572	0.543	0.449	0.404
VGG16	0.333	0.401	0.417	0.494	**0.528**	0.520	0.520	0.486	0.383	0.333
ResNet50V2	0.284	0.348	0.379	0.432	0.497	0.496	**0.510**	0.484	0.380	0.321
InceptionV3	0.577	0.612	0.627	0.644	**0.673**	0.662	0.655	0.636	0.572	0.539
MobileNetV2	0.431	0.459	0.460	0.493	**0.517**	0.513	0.513	0.504	0.455	0.425
DenseNet121	0.672	0.689	0.685	0.713	**0.726**	0.714	0.706	0.679	0.616	0.584
NasNetLarge	0.356	0.422	0.452	0.488	**0.541**	0.513	0.482	0.437	0.315	0.271
EfficientNetB4	0.085	0.111	0.137	0.144	**0.237**	0.220	0.226	0.202	0.112	0.074
ViT	0.066	0.087	0.109	0.129	0.195	**0.206**	**0.206**	0.203	0.120	0.086
CLIP	0.529	0.541	0.550	0.563	0.585	0.599	0.606	**0.613**	0.581	0.566

Cosine similarity of representation layer activations of adversarial example and target, in destination networks

1. Adversarial training of source networks can improve transferability of adversarial examples

2. Slightly-robust classifiers transfer features effectively, but non-robust classifiers do not