RDM mixtures for predicting visual cortices responses

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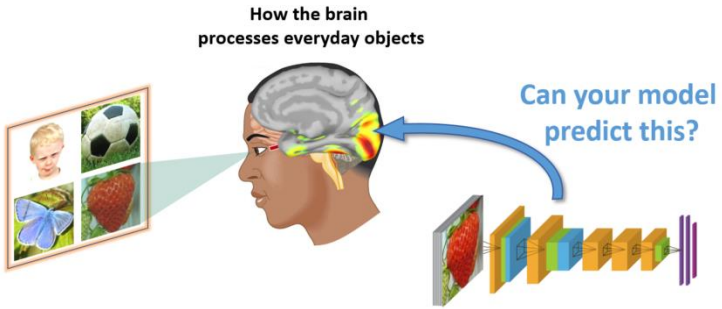
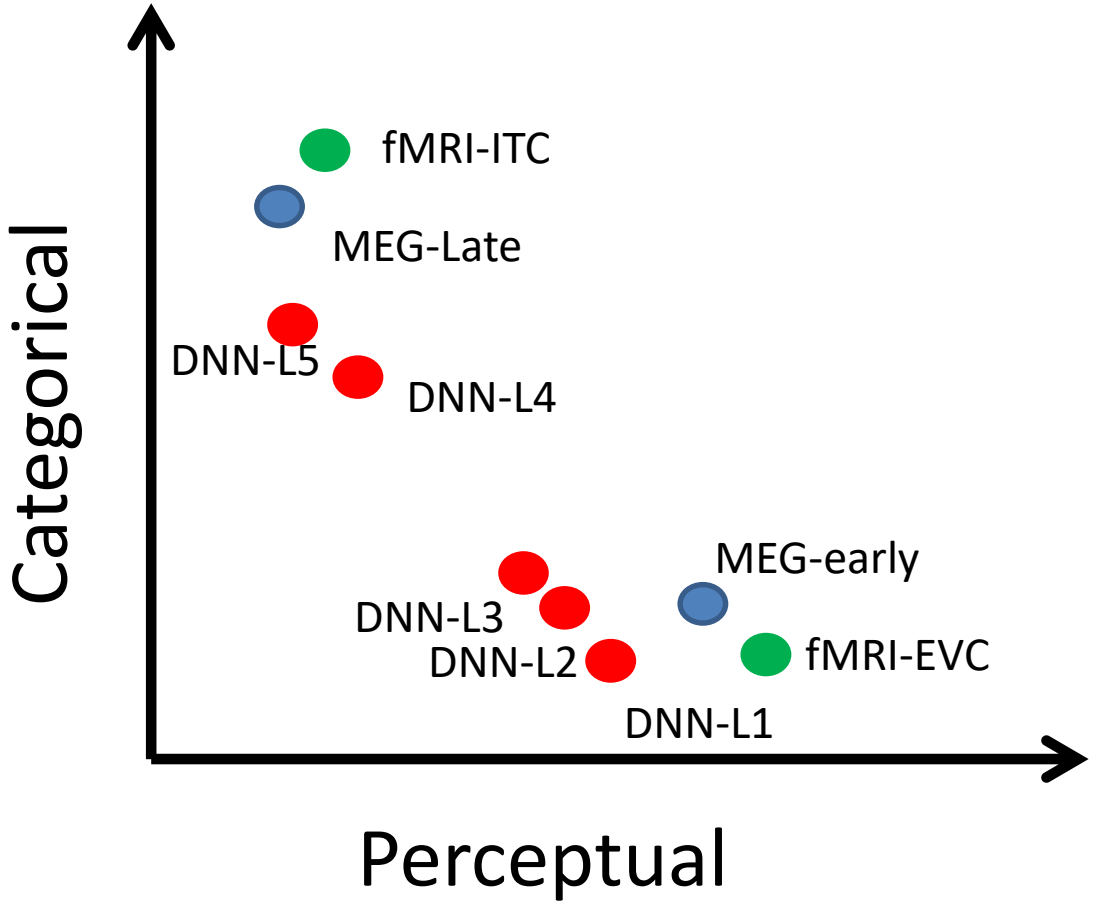


Intuition behind our method



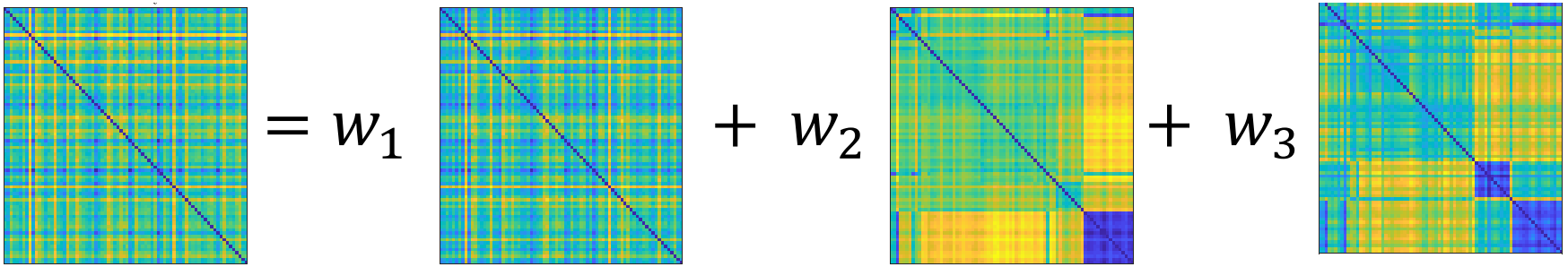
Combining RDMs to improve predictions

Predicted RDM

Perceptual

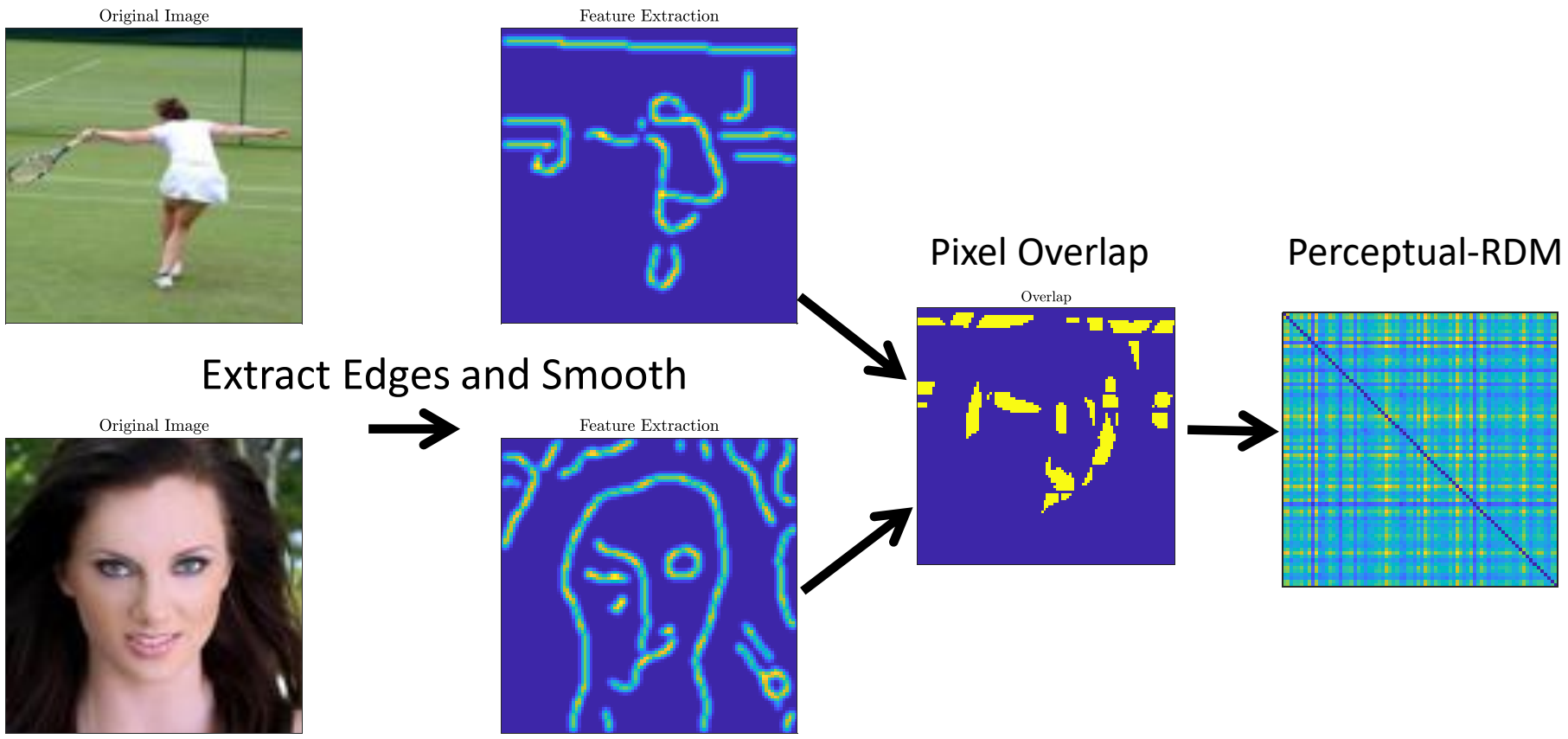
Categorical

DNN



Perceptual RDMs

Perceptual RDMs



Only uses image information

Categorical RDMs

Categorical Structure of the 92 image set

Objects-Scenes

animals

Human

Fruits-vegetables

Faces

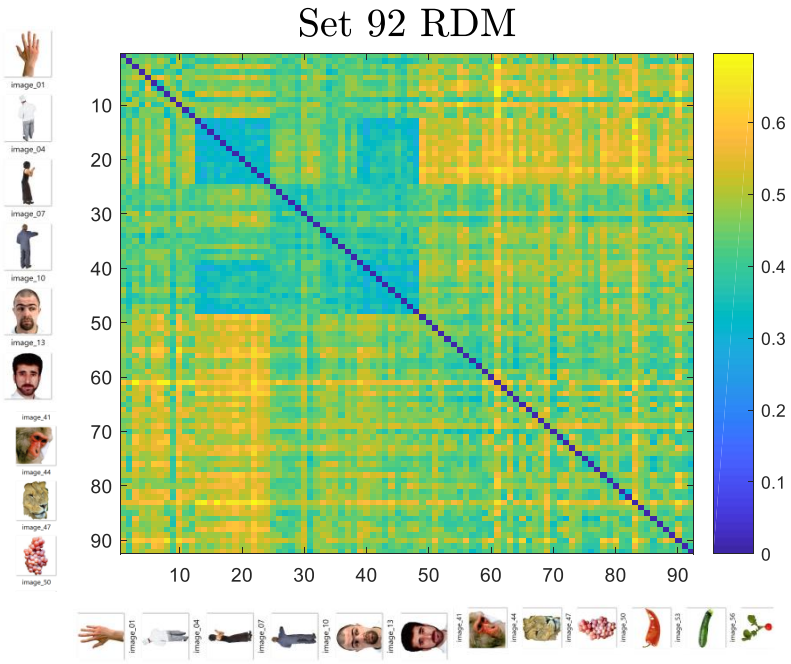
Hands

Monkey faces

Animal Faces

Within category RDM based on fMRI/MEG data similarity

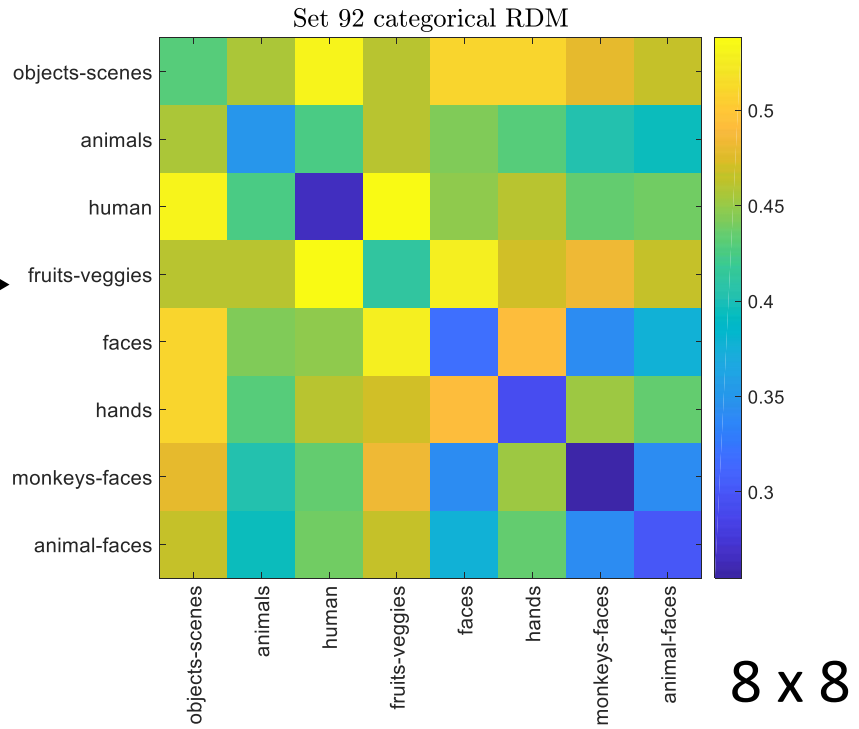
fMRI-ITC



92 x 92

Between image fMRI/MEG similarity

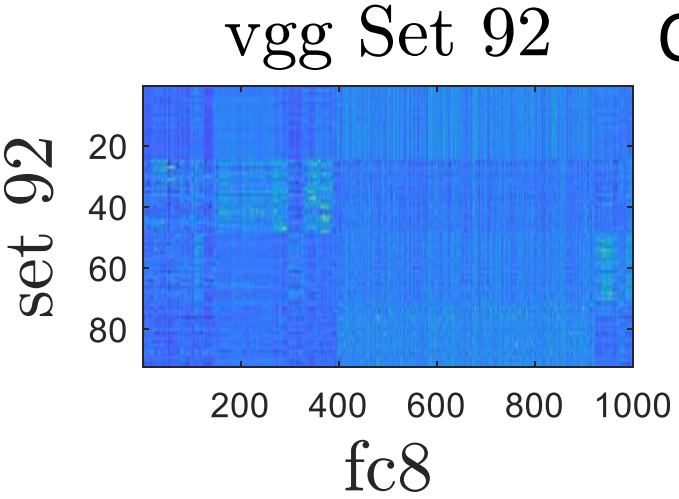
mean



8 x 8

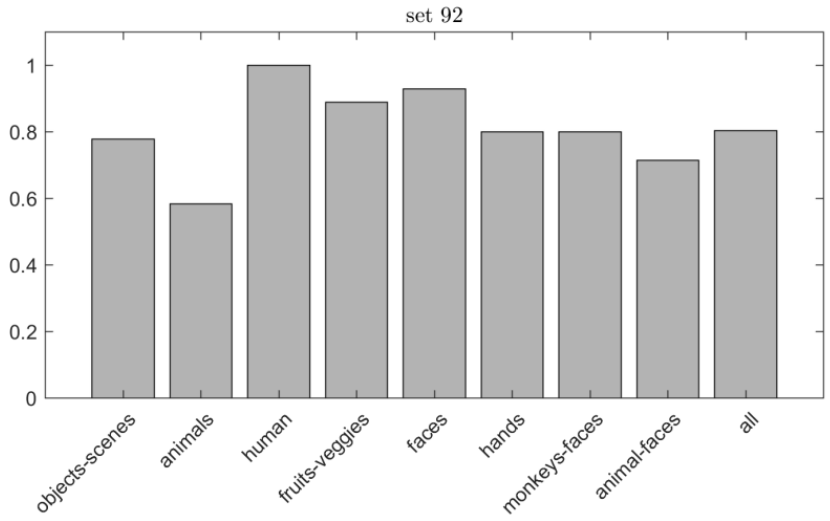
Between category fMRI/MEG similarity

Training a GNB classifier as predicting category



Class Labels

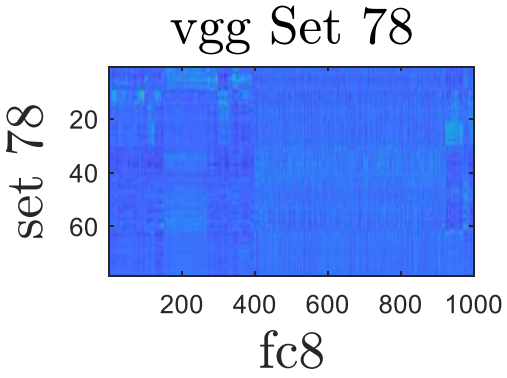
GNB



Last fully connected layer
(defines category membership)

Leave one out CV on the 92 image training set

Classification of the 78 test set images



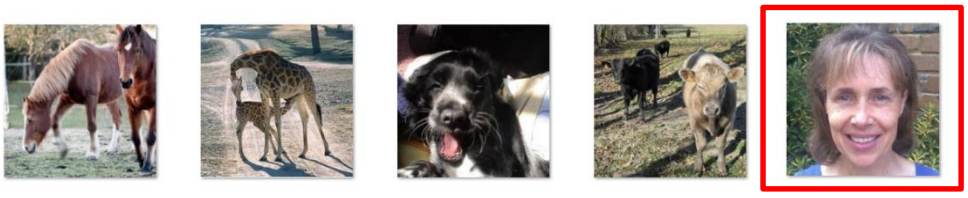
x W_{GNB} →

Predicted Labels

Objects-Scenes
animals
Human
Fruits-vegetables
Faces
Hands
Animal Faces

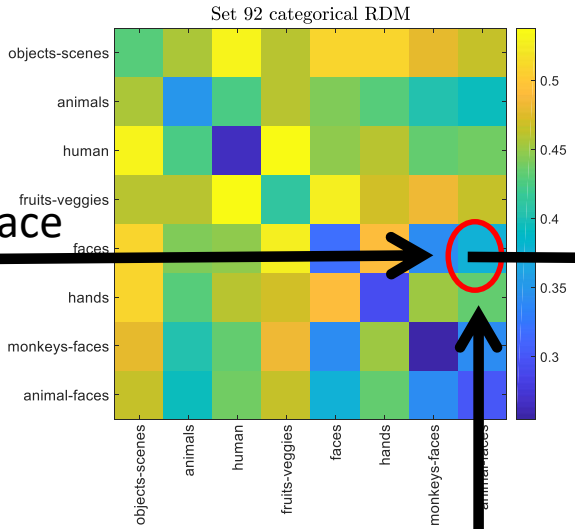
Predicted as Human Faces

Predicted as Animal Faces in the 78 set

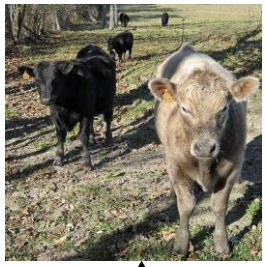


Assigning distances between new test images based on categorical RDM and predicted labels

Test Set Image 1



human face

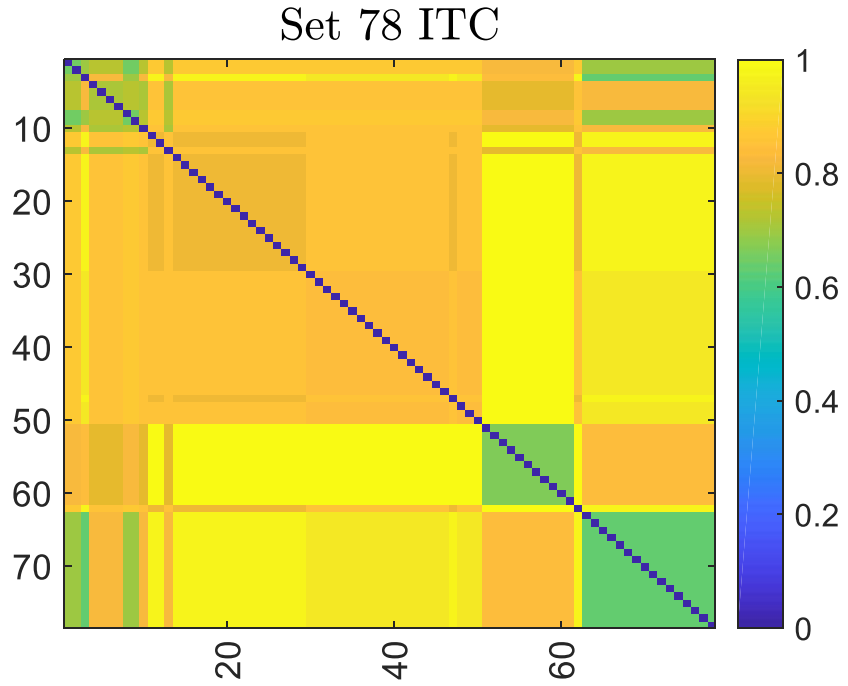


Assigned distance
0.37

animal face

Test Set Image 2

Predicted categorical RDM for the 78 images test data

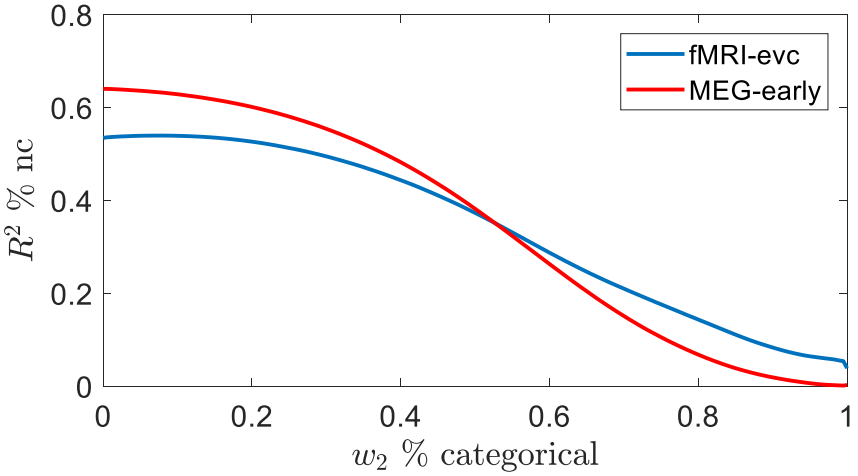


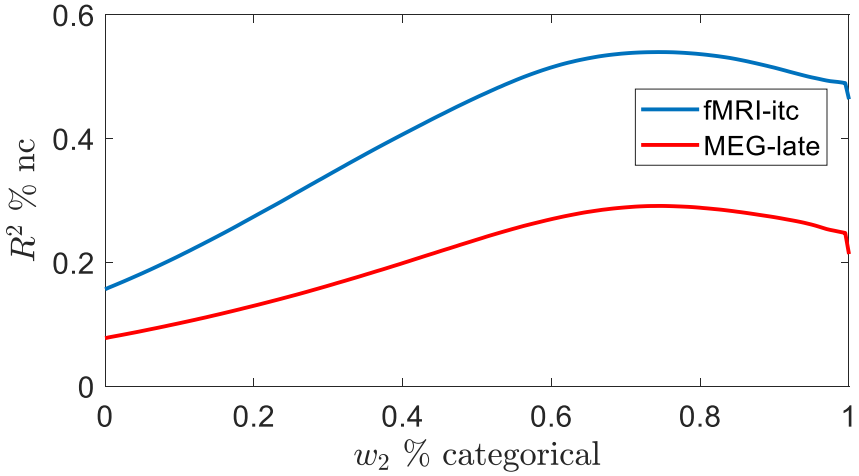
Same distance for all the images within the same category

Mixing perceptual and categorical components

$$R = (1 - w_2)R^{per} + w_2 R^{cat}$$

Training data: 92 image set





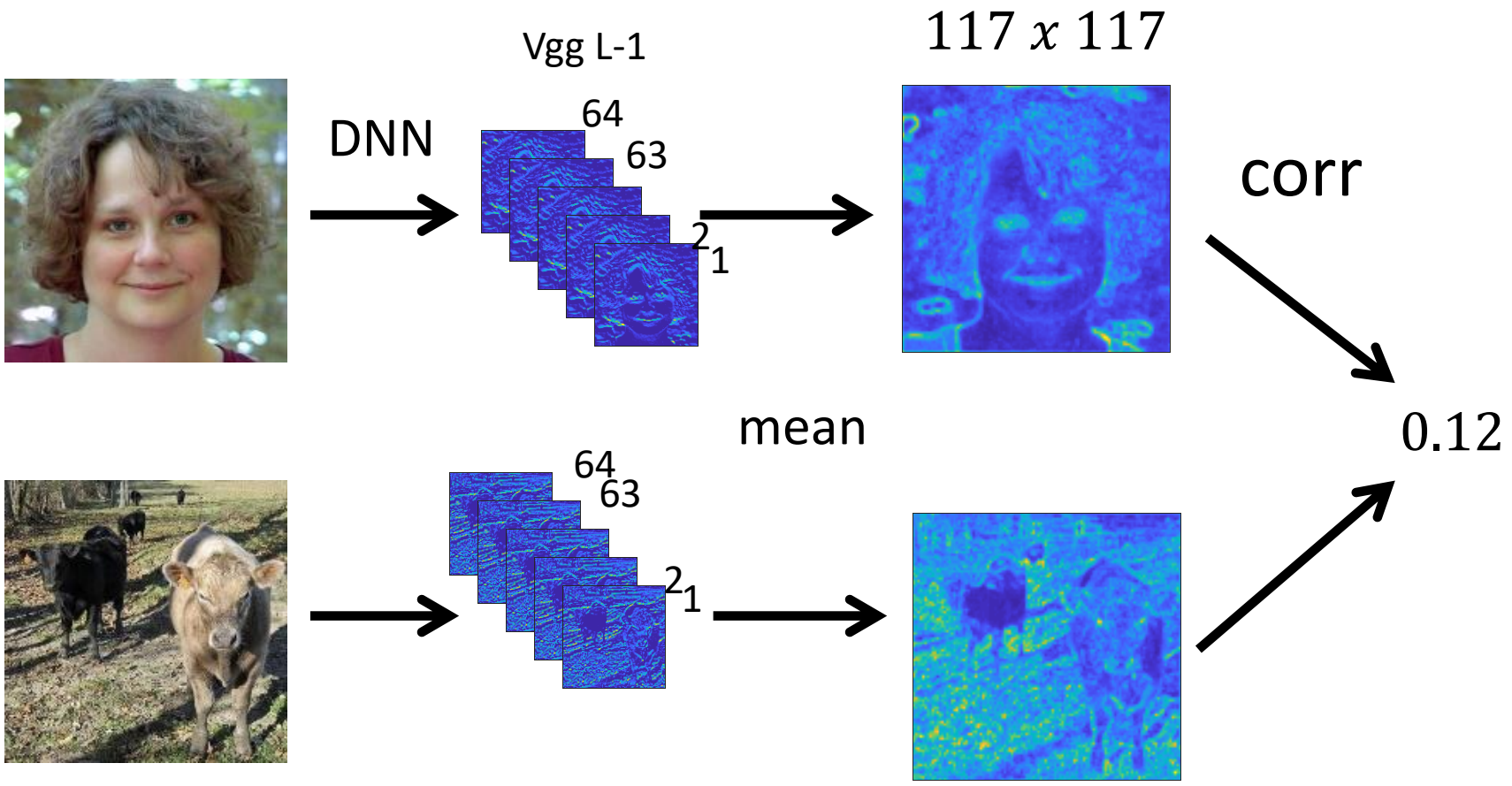
Large impact on fMRI-ITC and MEG-Late.

Results Test set: Perceptual + Categorical RDMs

	fMRI Noise Normalized R.^2 (%)		**MEG Noise Normalized R.^2 (%)**	
	EVC	**ITC**	**Early**	**Late**
Perceptual + Categorical	25.20	20.99	45.28	44.43

DNN based RDMs

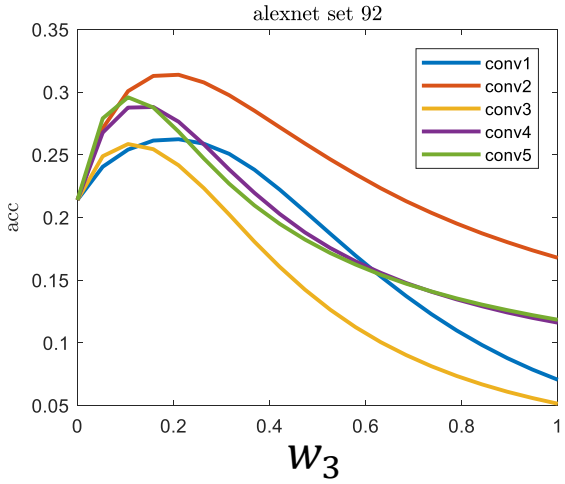
RDM based on DNN features at one layer

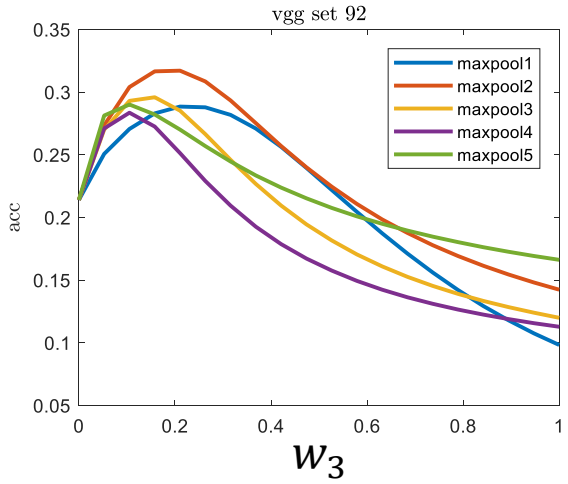


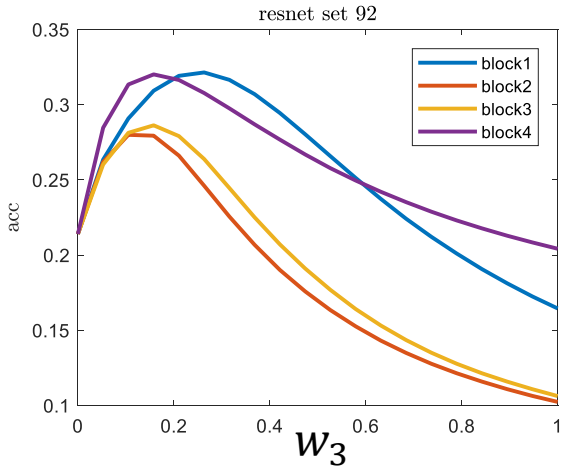
Model Improvement including DNN Based RDMs

$$R = (1 - w_3)R^{(per+cat)} + w_3 R^{dnn}$$

Improvement of R^2 (explained variance) in EVC for the 92 image set







Results Test set including DNNs

	fMRI Noise Normalized R.^2 (%)		MEG Noise Normalized R.^2 (%)	
	EVC	**ITC**	**Early**	**Late**
Perceptual + Categorical	25.20	20.99	45.28	44.43
Perceptual + Categorical + DNN	32.88 vgg-L3 vgg-L4 vgg-L5	-	50.95 alexnet L3,L5	53.59 alexnet L5 vgg L5 resnet L4

Conclusions

- A mixture of perceptual and categorical RDMs made the largest contribution to the prediction accuracy in fMRI-ITC/MEG-Late.
- VGG was the DNN that produced the largest improvement on the model performance.
- However, it is necessary to evaluate the perceptual-categorical vs DNN contribution in the inverse order.