On Identifying Pareidolia Phenomenon by Emulating Patient Behavior

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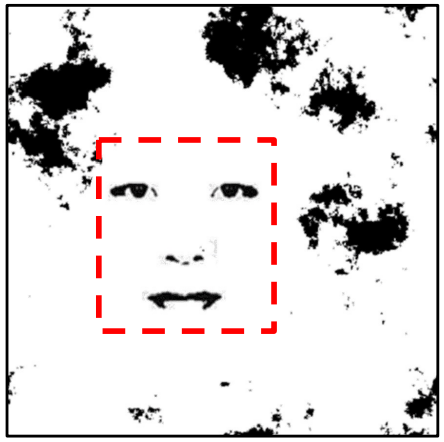
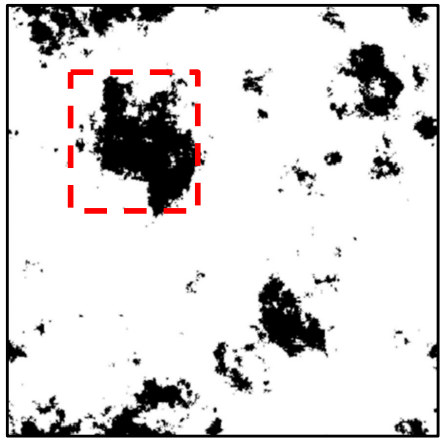
Introduction

Pareidolia Phenomenon



Not pareidolia

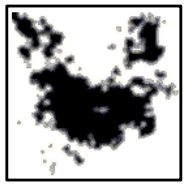
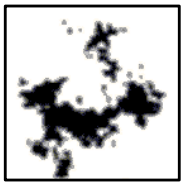
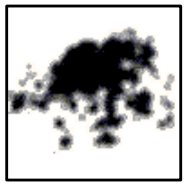


Pareidolia

Dementia with Lewy bodies (DLB)
↳ Pareidolia

Alzheimer's Disease (AD)
↳ Similar visual illusion

➢ **Some patterns that may be seen as faces by DLB patients**

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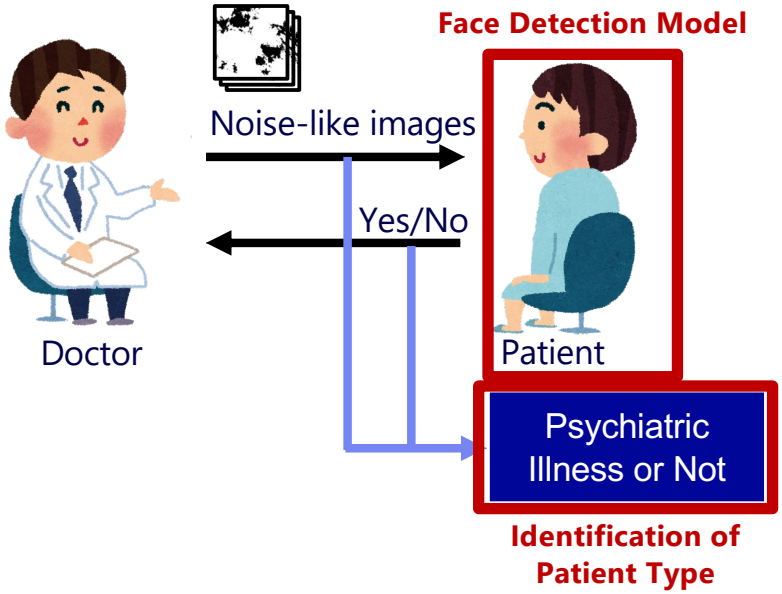
Introduction

Noise Pareidolia Test

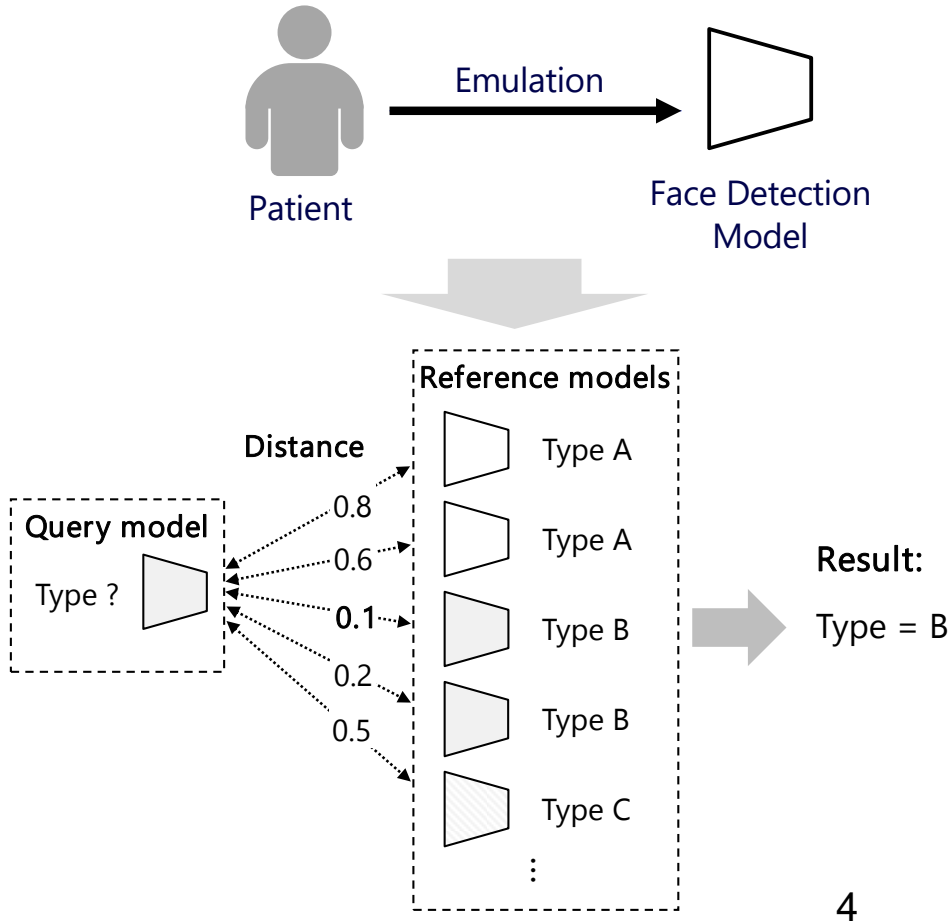


Limitations

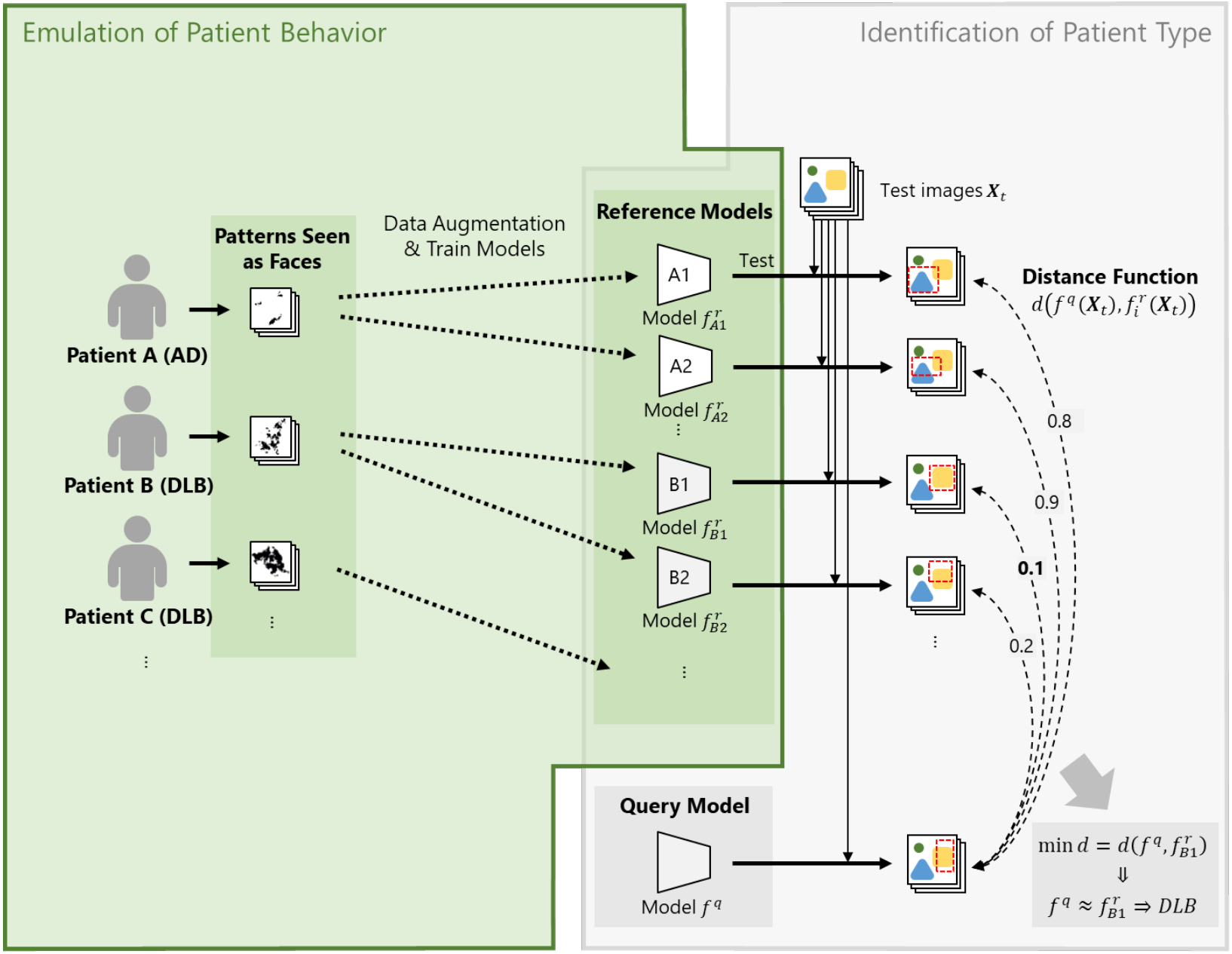
- A large number of test images
- AD patients may also see faces in the test

Computer-Assisted Diagnosis

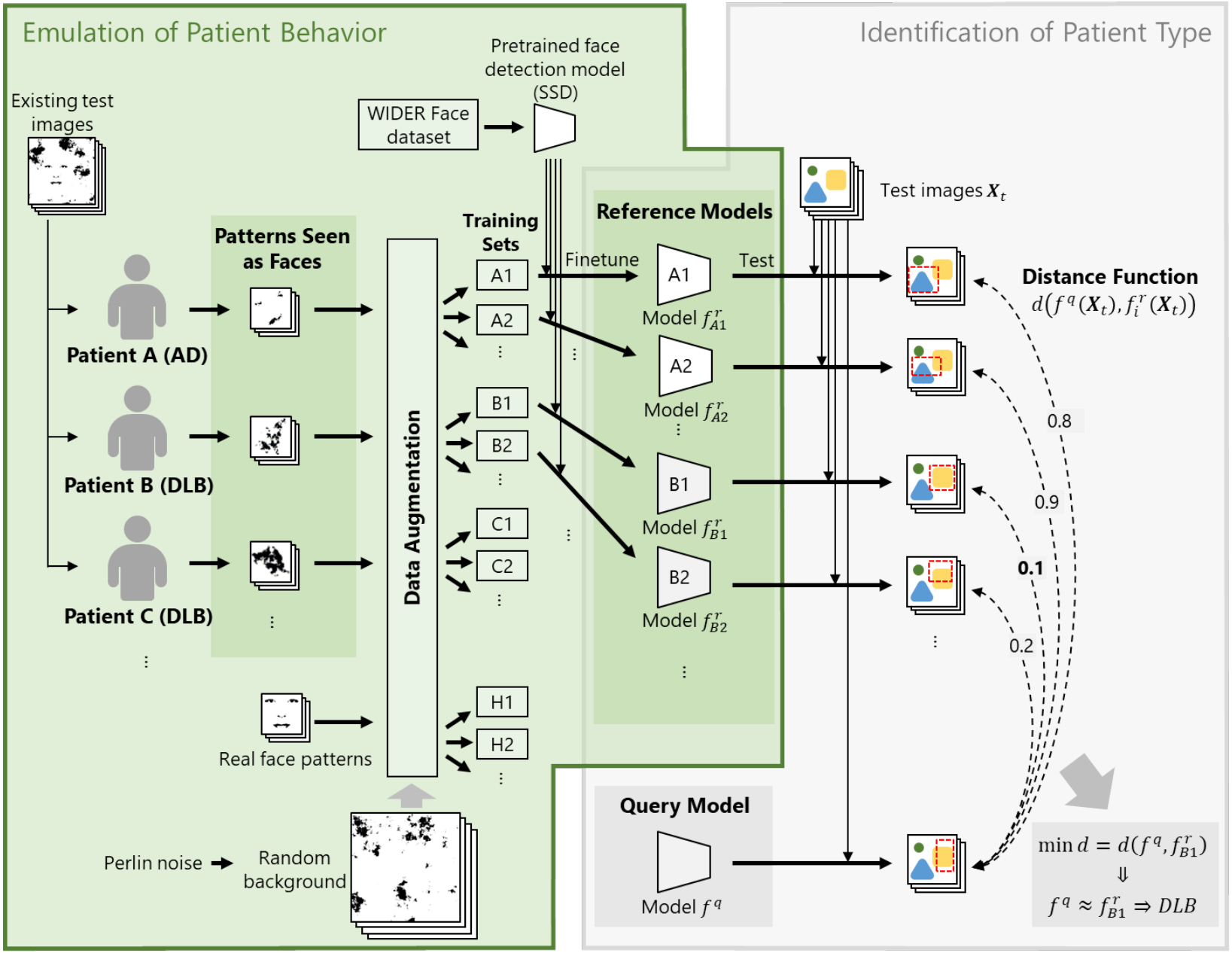
- Improve the efficiency
- Get a better understanding of the disease and patient types



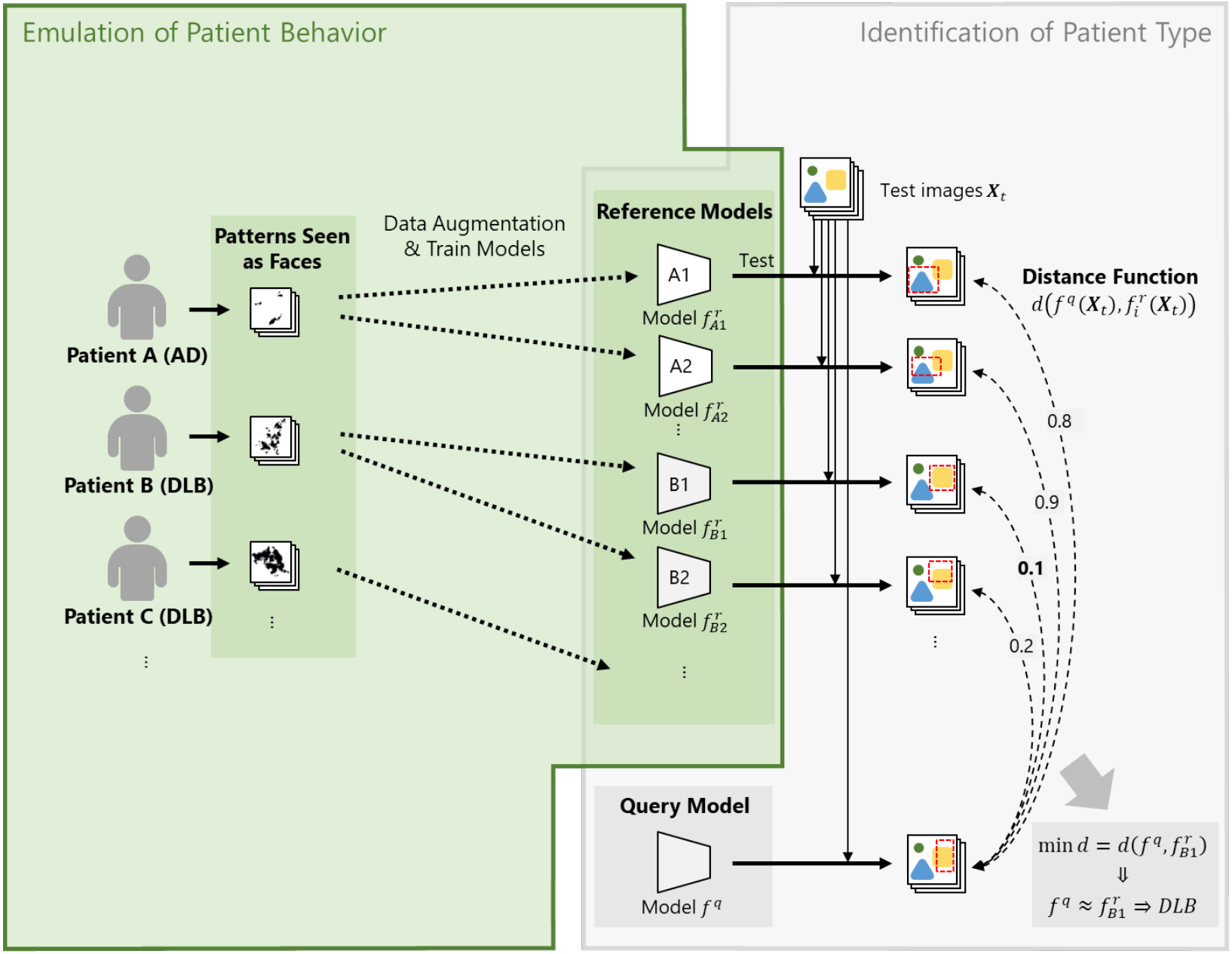
Proposed Method



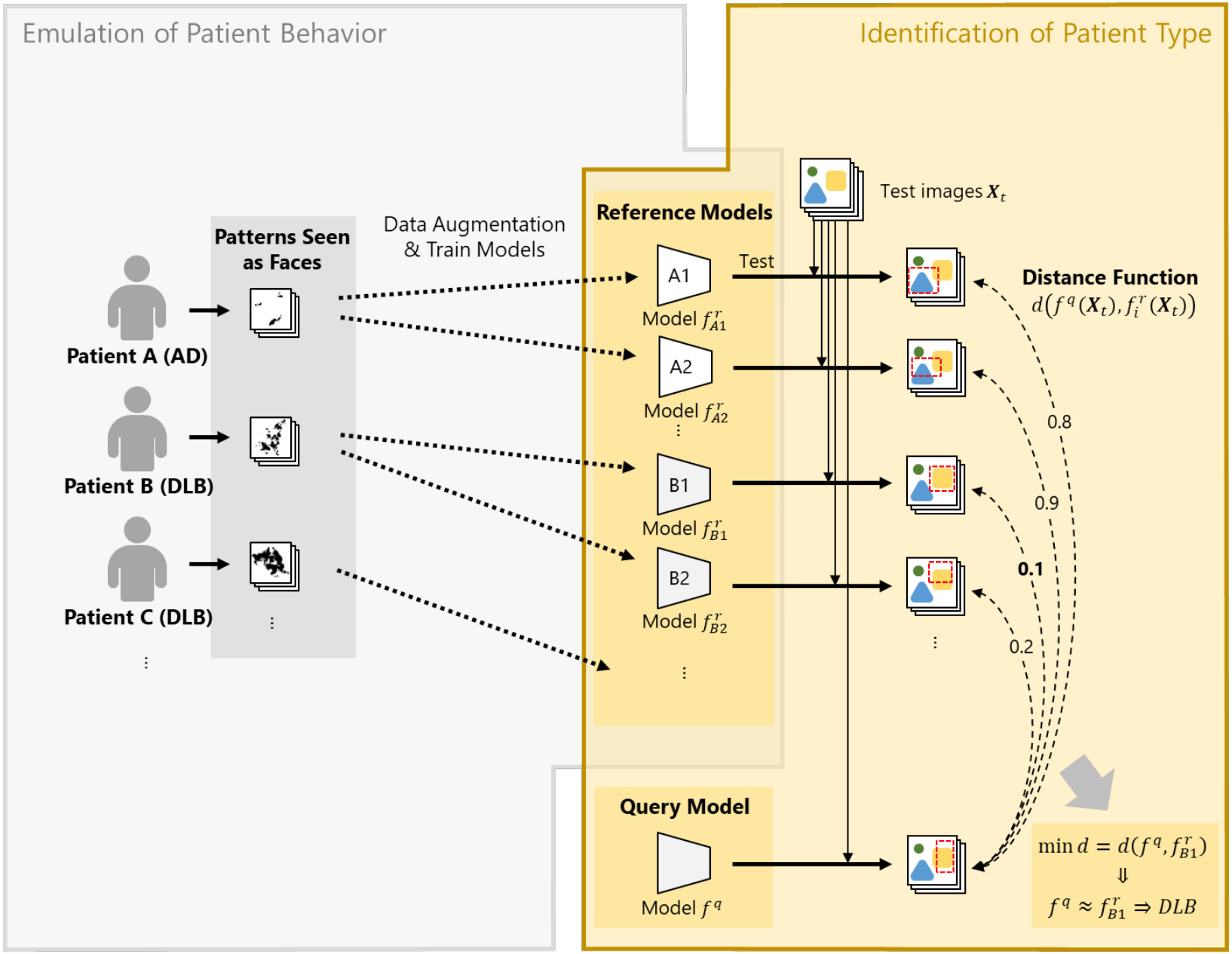
Proposed Method



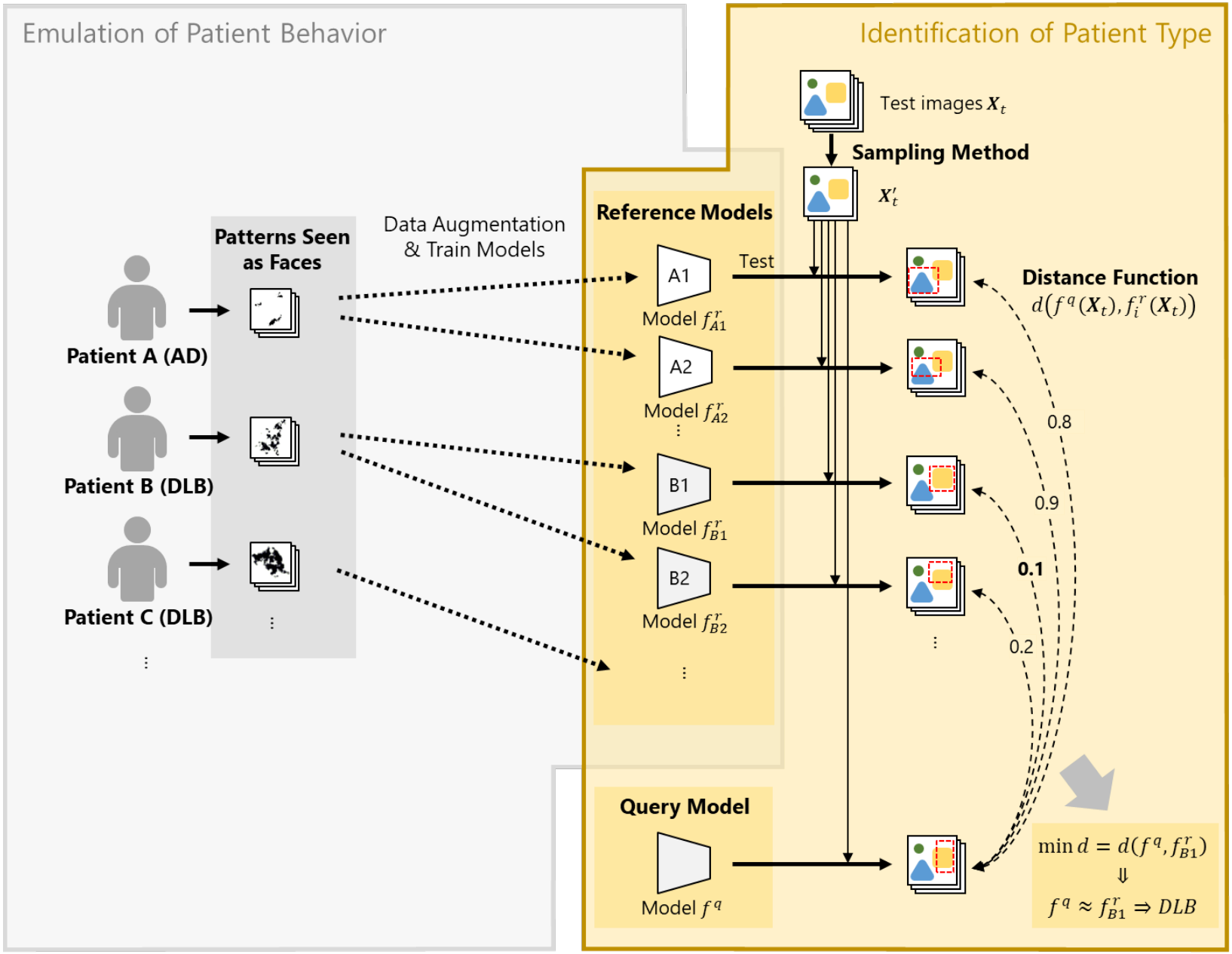
Proposed Method



Proposed Method

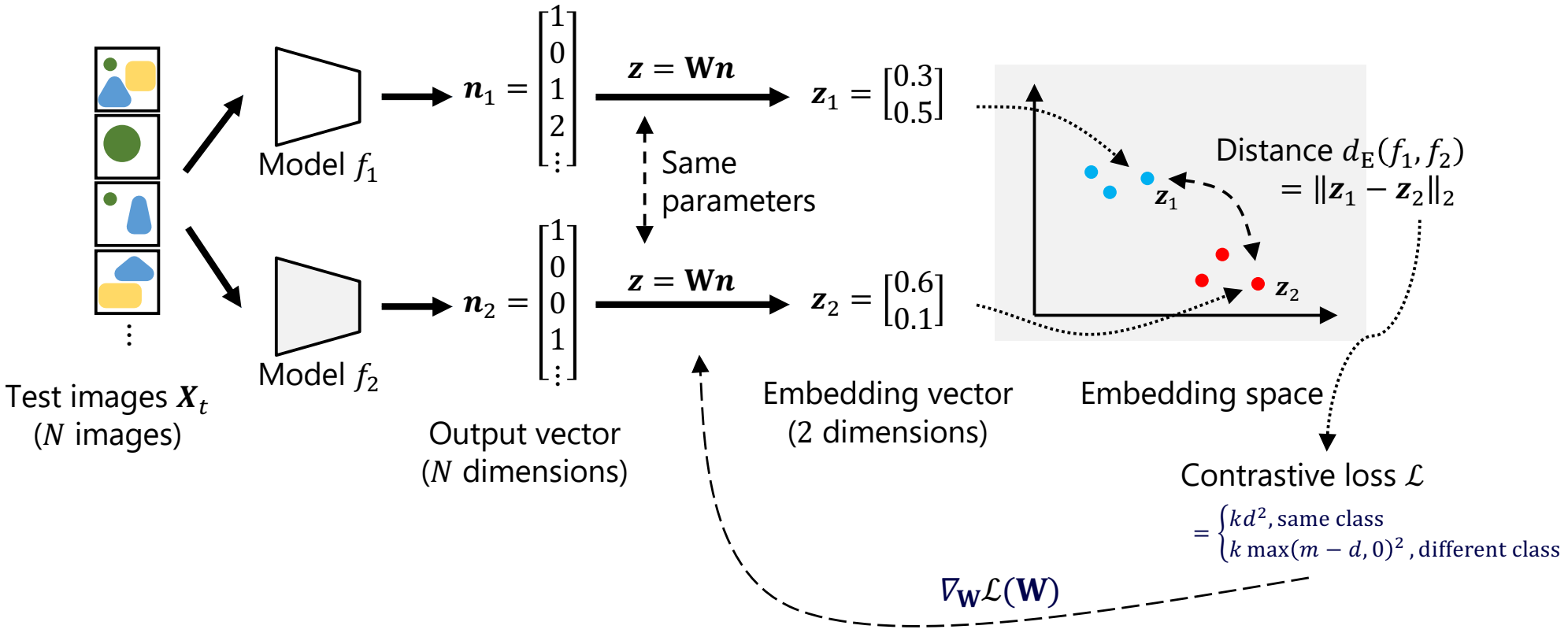


Proposed Method



Identification of Patient Type

Distance Function



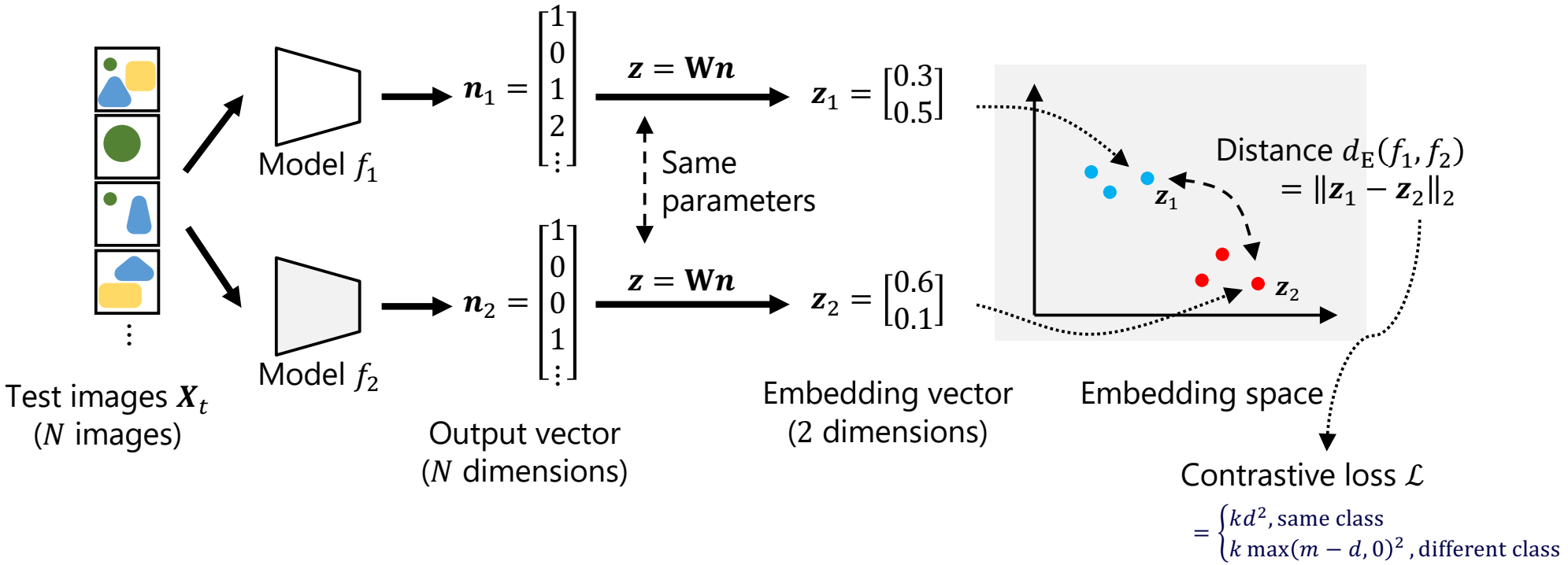
Update parameters to minimize the loss

(in a metric learning way)

→ Make the same class closer and make different classes further

Identification of Patient Type

Distance Function



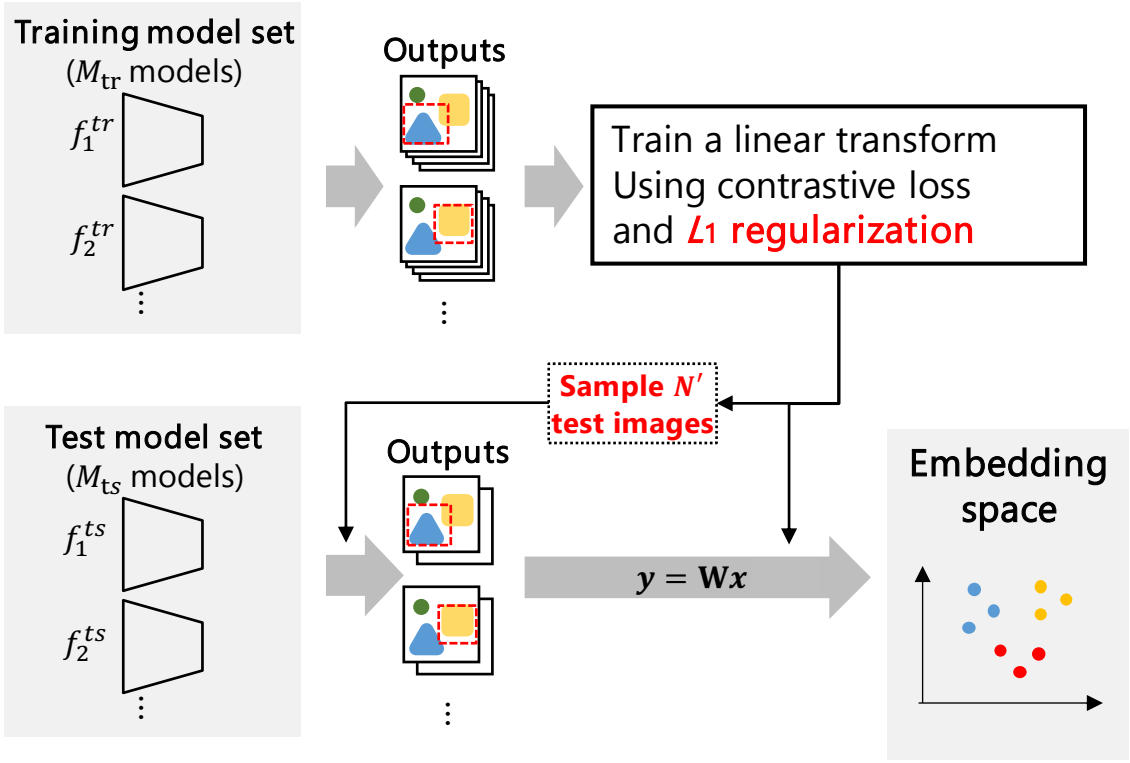
Contrastive Loss

- Type-level loss $\mathcal{L}_t$ → Separate models of different types (Pareidolia / Non-pareidolia)
- Patient-level loss $\mathcal{L}_p$ → Separate models of different patients (Patient A/B/C/D/E)

Identification of Patient Type

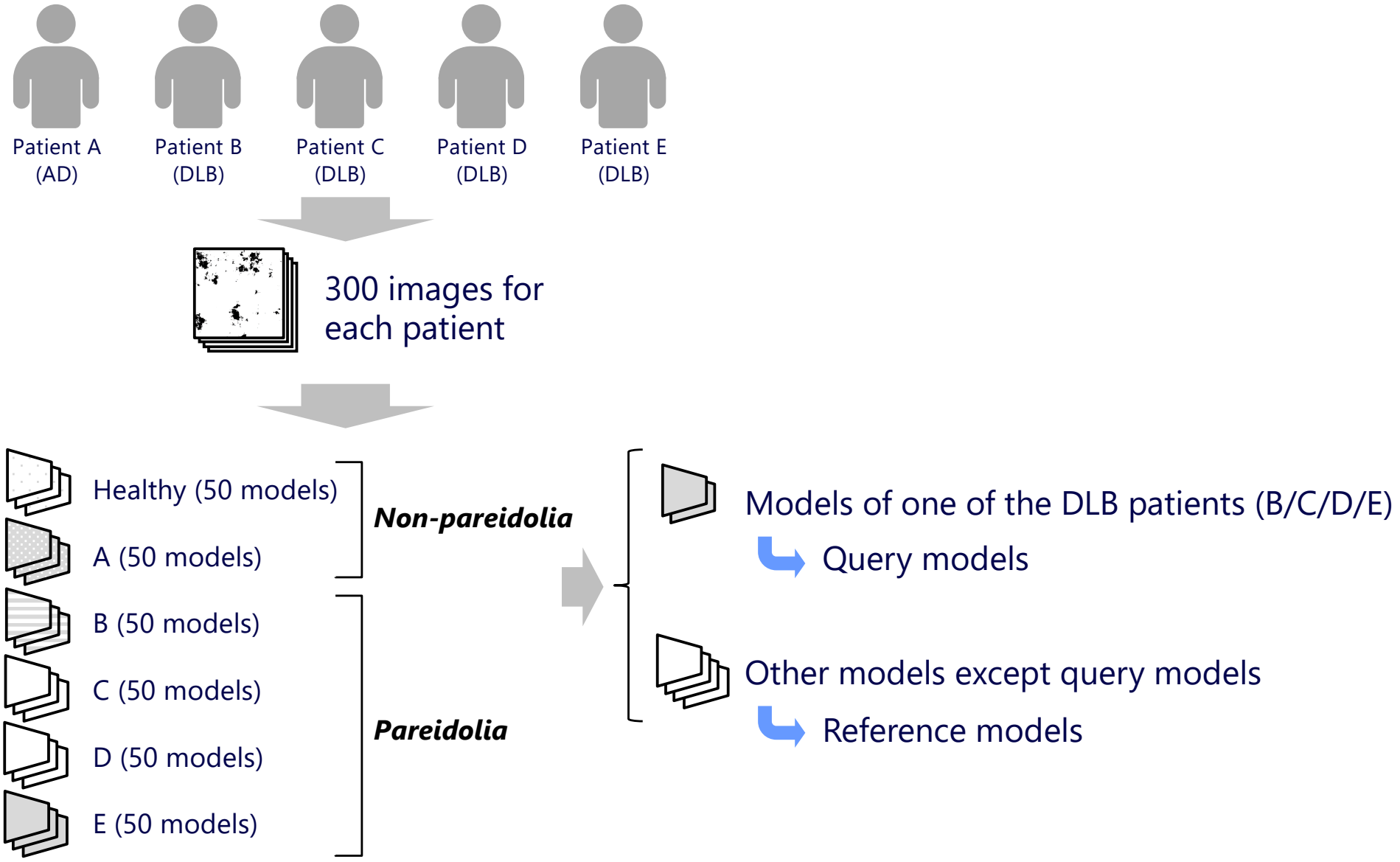
Sampling method

- Add an regularization term: L_1 regularization



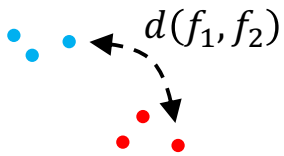
Minimize $(l + \lambda\|\mathbf{W}\|_{2,1})$ → More zero columns in $\mathbf{W}$ → Need less test images

Data for Evaluation Experiments



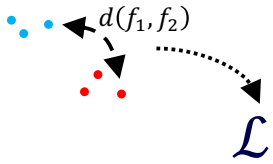
Comparison Experiments

Distance Functions



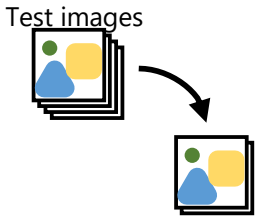
- Baseline 1 (d_N): Numbers of detected images
- Baseline 2 (d_H): Hamming distance
- Proposed (d_E): Embedding space

Loss Functions



- One-way loss $\mathcal{L}_t$
  Separate different types (Pareidolia/Non-pareidolia)
- Two-way loss $\mathcal{L}_t + \mathcal{L}_p$
  Separate different types and different patients

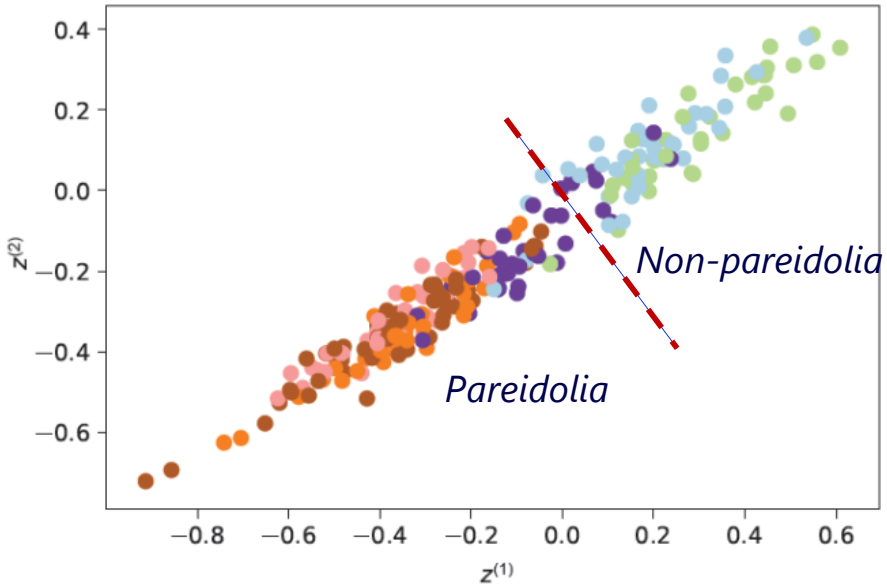
Sampling Methods



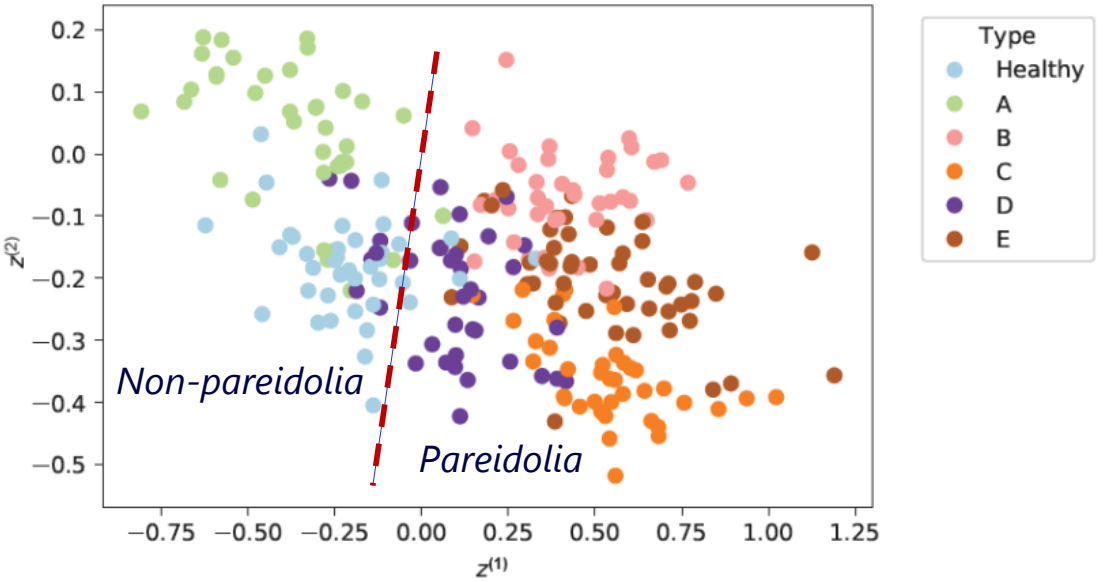
- Proposed sampling method
- Random sampling

Experimental Results

❑ Distribution on the embedding space



Trained with one-way loss



Trained with two-way loss

❖ *Non-pareidolia*: Healthy, A; *Pareidolia*: B, C, D, E

Experimental Results

❑ Performance of identifying type of the models

Distance Function	Loss Function	Sampling Method	Average Number of Test Images	Avgerage Value of mAP
Baseline 1 (d_N)	-	None	420	0.66
Baseline 2 (d_H)	-	None	420	0.53
Proposed (d_E)	One-way loss	Proposed	68.5	**0.90**
		Random	68.5	0.65
	Two-way loss	Proposed	78.5	**0.87**
		Random	78.5	0.74

❖ Proposed method outperforms baseline comparisons for both the distance functions and the sampling functions.

Conclusion

- Propose a method for the novel task to identify pareidolia phenomenon in patients through emulating patient behavior

  → A step towards a computer-assisted diagnosis for psychiatric conditions

- Show promising performance for discerning real pareidolia (in DLB) from similar visual illusions (such as AD)

- Provide a way to reduce the number of needed test images in clinical noise pareidolia tests

Thank you!

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