

## Facial mimicry and doctor-patient satisfaction: the feasibility of artificial empathy in a clinical video data

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## BACKGROUND



### Importance of Good Communication

- Effective doctor-patient communication is fundamental to establishing a therapeutic relationship.<sup>1</sup>
- Doctors must understand patients' perspectives through verbal and non-verbal behaviors.

**55%**



Facial expressions play a major role in human interpersonal communication



## A DEFINITION ...

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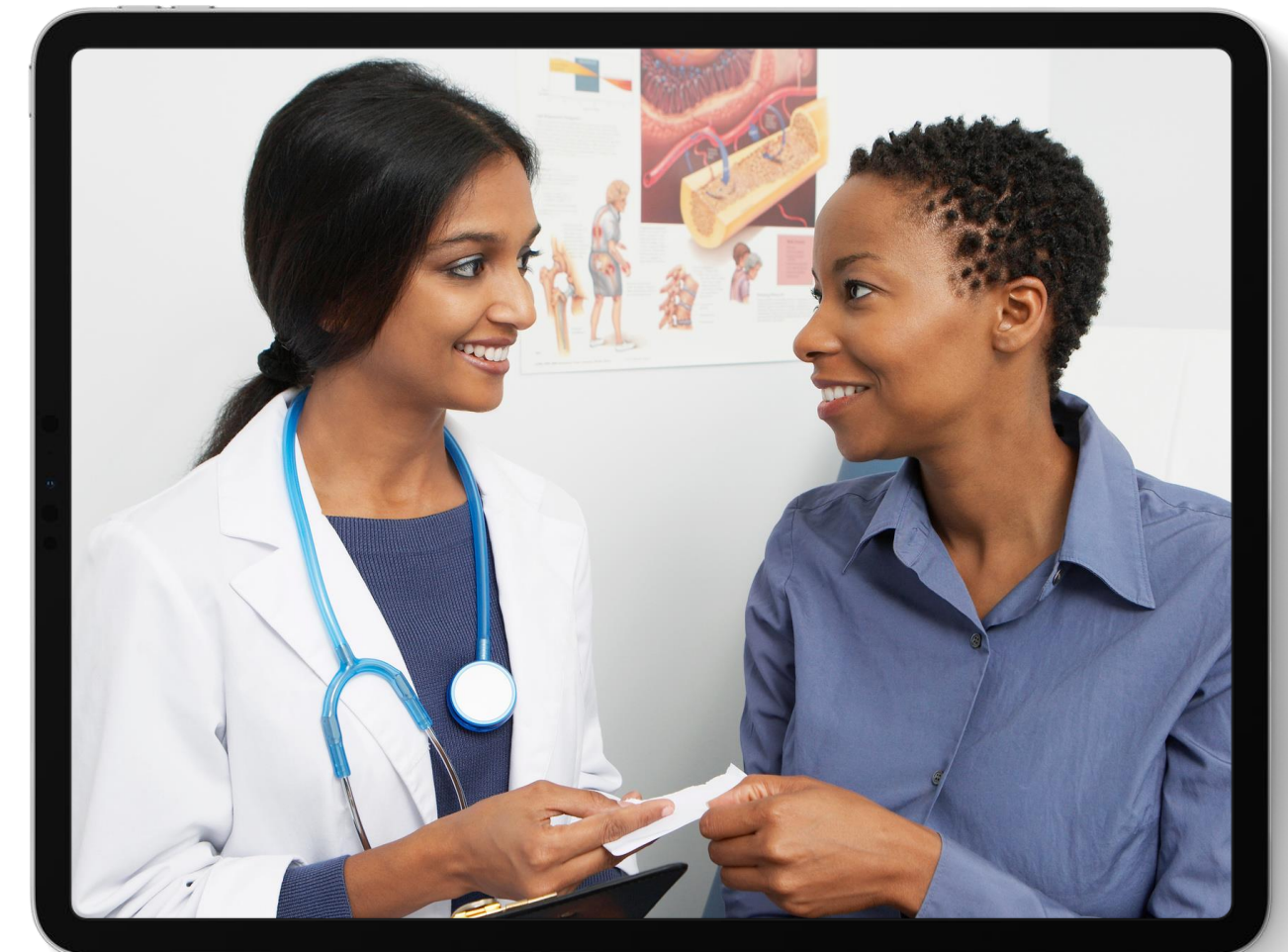
### Concept of **Facial mimicry**

Where one person's facial expressions match another's, plays a significant role in communication.<sup>2</sup>

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### **Facial mimicry and Empathy**

There is a suggested link between nonverbal behavioral mimicry, like facial mimicry, and empathy - the ability to understand and share the feelings of others.<sup>3</sup>



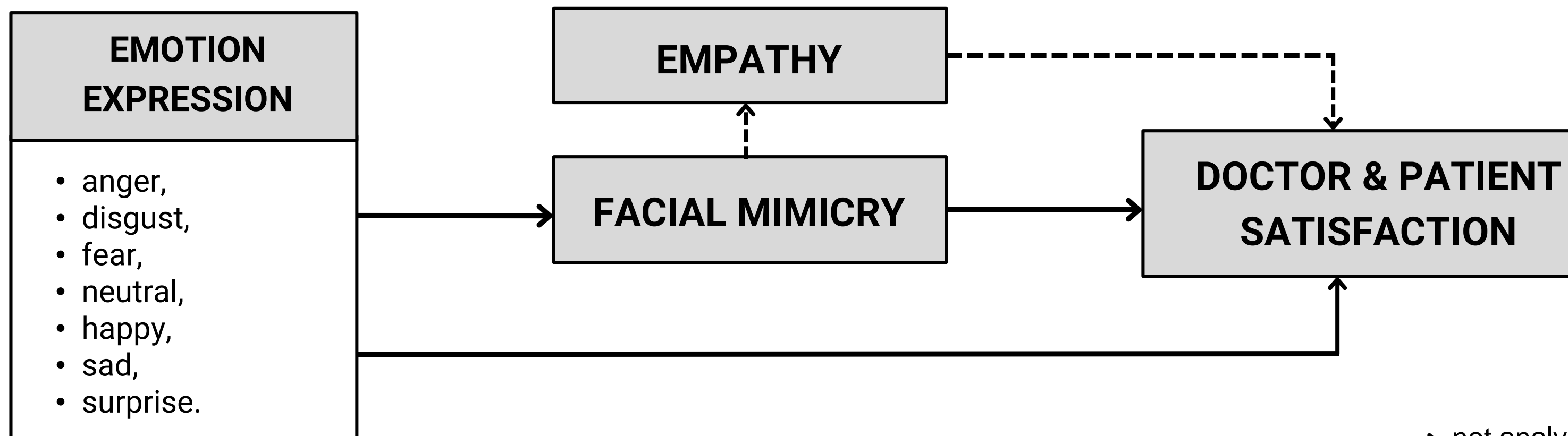
[2] A.C. Holland, G. O'Connell, and I. Dziobek, Facial mimicry, empathy, and emotion recognition: a meta-analysis of correlations, *Cogn Emot* 35 (2021), 150-168.

[3] K. Wu, C. Liu, and R.A. Calvo, Automatic Nonverbal Mimicry Detection and Analysis in Medical Video Consultation, *International Journal of Human-Computer Interaction* 36 (2020), 1379-1392.



## CONCEPTUAL MODEL

Our study aims to demonstrate how real-world clinical video data can be used to explore the influence of doctor's facial mimicry on doctor-patient interaction



---> not analyzed in the study

References:

A.C. Holland, G. O'Connell, and I. Dziobek, Facial mimicry, empathy, and emotion recognition: a meta-analysis of correlations, *Cogn Emot* 35 (2021), 150-168.

K. Wu, C. Liu, and R.A. Calvo, Automatic Nonverbal Mimicry Detection and Analysis in Medical Video Consultation, *International Journal of Human-Computer Interaction* 36 (2020), 1379-1392.

S.S. Kim, S. Kaplowitz, and M.V. Johnston, The effects of physician empathy on patient satisfaction and compliance, *Evaluation & the Health Professions* 27 (2004), 237-251.



## METHODS

### Data Sources

- A 10-month data collection study from March to December 2019
- Involving 4 physicians and 348 patients in a dermatology outpatient clinic, TMU-Wanfang Hospital, and TMU Hospital.
- The study was approved by TMU-Joint Institutional Review Board (TMU-JIRB No: N201810020).

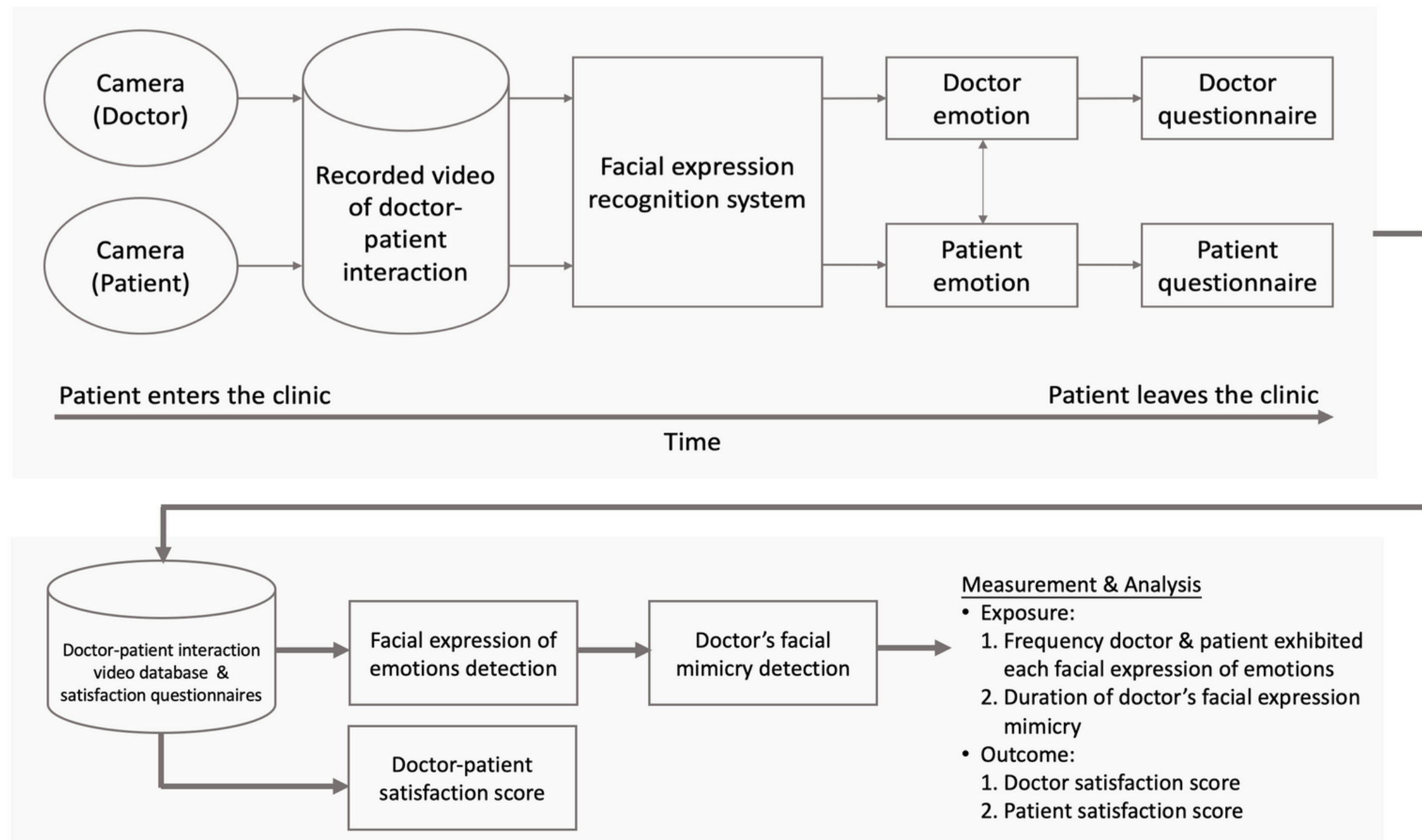
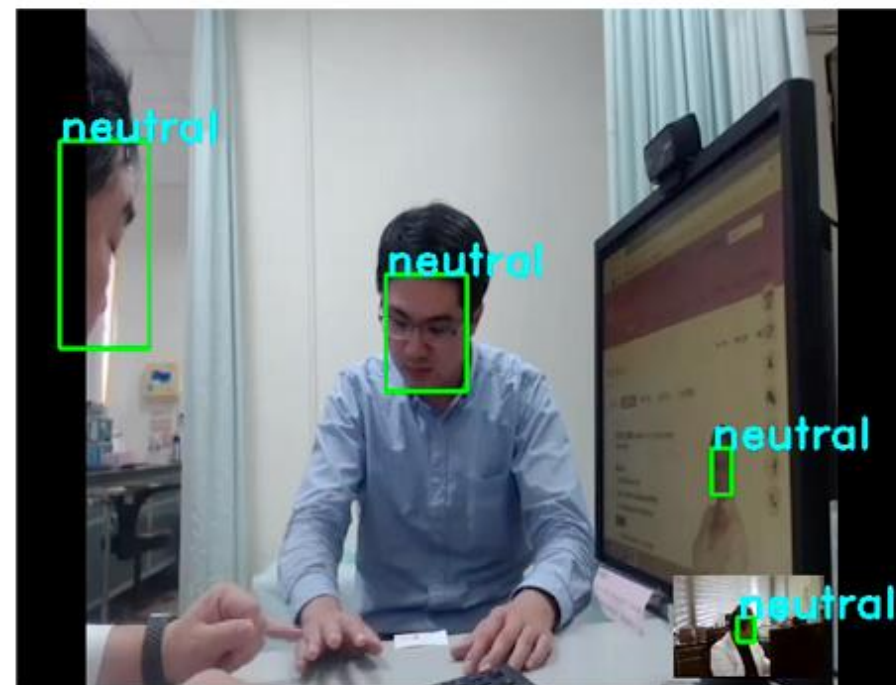
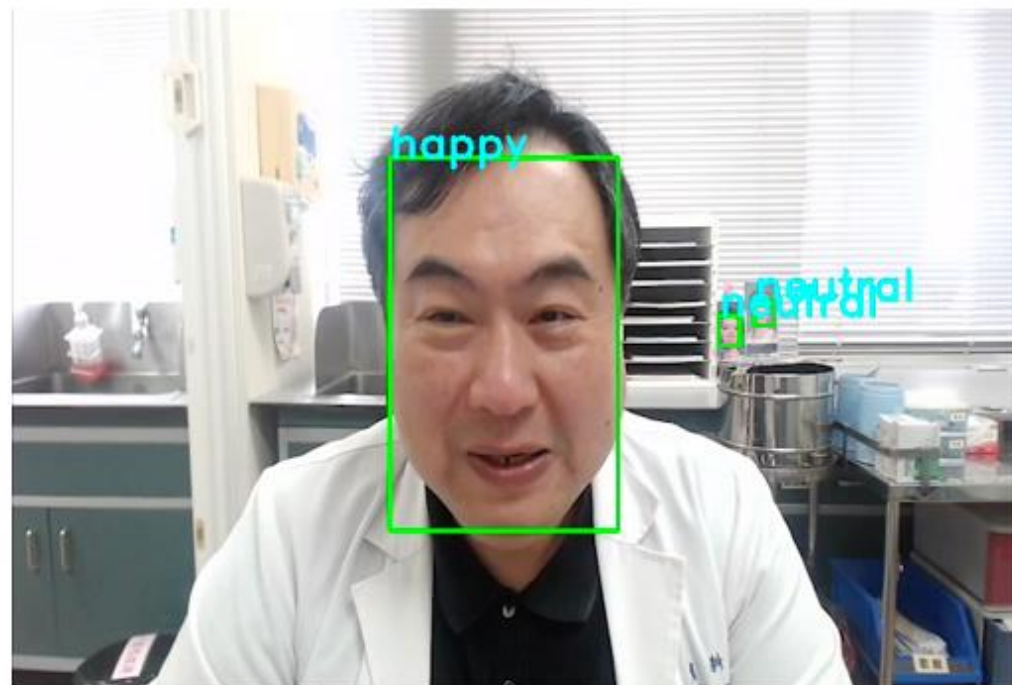


Fig 1. Study Workflow



## METHODS



**Fig 2. Screenshots of the recorded video simulation of the doctor-patient interaction in the dermatology outpatient clinic.<sup>4</sup>**

### AE2020 clinical video database

- Excluded video data from 33 patients due to video damage, lack of patient consent, and missing data, leaving only 315 eligible video data.
- Average video time length of 4.36 (SD = 2.97) minutes.
- The longest duration of consultation was 25.55 minutes, and the shortest was 0.33 minutes.



## METHODS

### Artificial Empathy

- Built using a facial expression recognition system developed by the Industrial Technology Research Institute (ITRI) that can recognize 7 basic emotions: anger, disgust, fear, neutral, happy, sad, and surprise.
- The system achieves a mean detection rate of over 80% from real-world data ( $80.28 \pm 27.76\%$  for doctors;  $82.56 \pm 22.24\%$  for patients).
- The system uses MobileNetV2 for recognizing facial expressions.

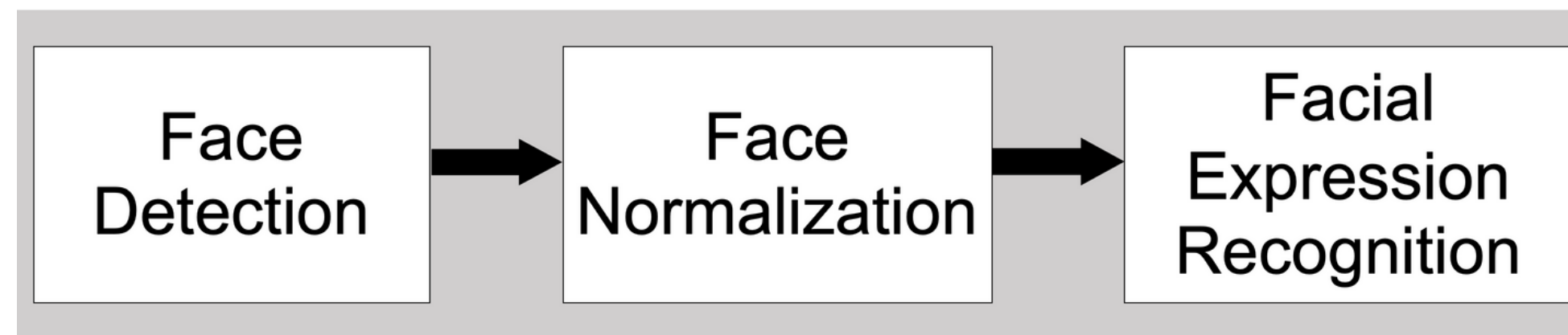


Fig 3. Face expression recognizer workflow <sup>5</sup>

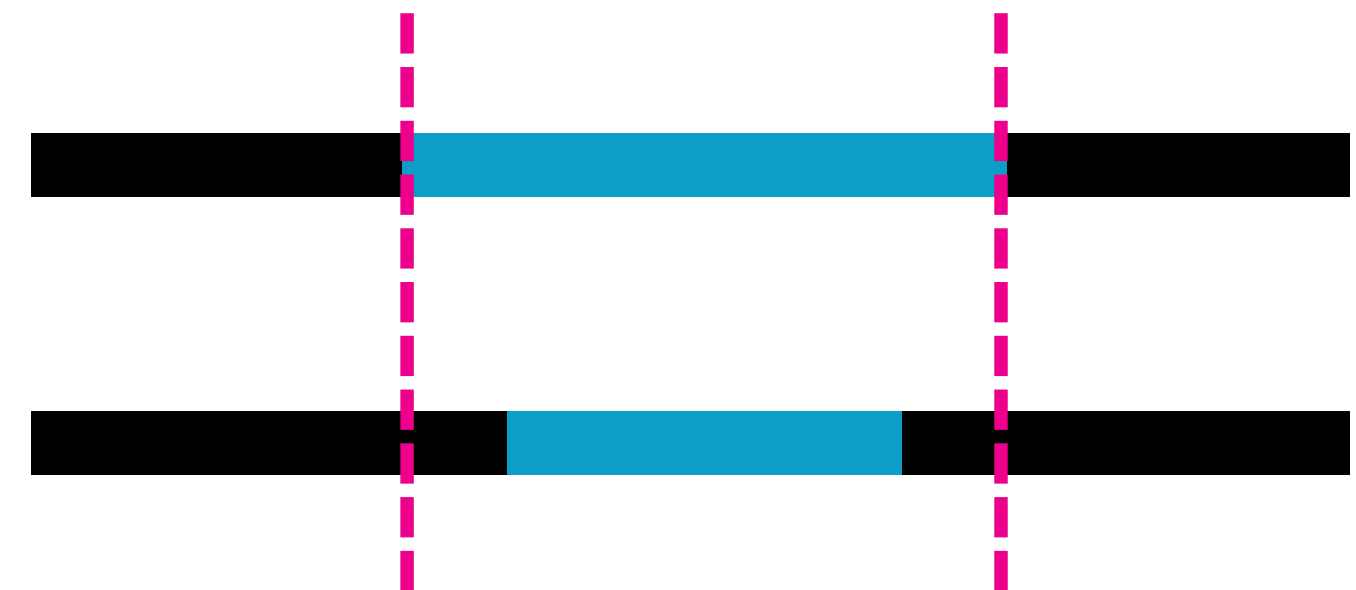


# METHODS

## Facial Mimicry Criteria

### Facial mimicry criteria

- Emotional Matching: One facial mimicry instance was counted as present if the doctor exhibited the same emotions 1 second after the patient, and ended this expression before the patient did.<sup>3</sup>



■ mimicked emotion  
■ other emotions



## METHODS

### Measurement & Analysis

#### Doctor-Patient Satisfaction

- A 5-point Likert scale satisfaction questionnaire was used (5 items for doctor's satisfaction and 7 items for patient's satisfaction).
- The questionnaire covered areas such as general satisfaction, interpersonal manner, communication, time spent with the doctor, and medical orders.
- The internal consistency for all items was above 0.90, indicating a high level of consistency among the questionnaire items.

#### Statistical Analysis

- The spearman correlation coefficient for continuous variables and the Mann-Whitney test for categorical variables.
- All the statistical analysis was performed using PASW Statistics for Windows, Version 18.0 (SPSS Inc., Chicago, Ill., USA).



## RESULT

### Facial mimicry and doctor-patient emotion

Table 1. The frequency distribution of doctors and patients exhibited each facial expression and doctor's facial mimicry during clinical encounters (n = 4 doctors; n=315 patients)

Emotion	facial expression		doctor's facial mimicry	
	doctor emotion (n, %)	patient emotion (n, %)	Mean duration	SD
angry	624 ( 0.76)	125 ( 0.15)	-	-
disgust	199 ( 0.24)	45 ( 0.05)	-	-
fear	10 ( 0.01)	5 ( 0.01)	-	-
happy	7,298 ( 8.86)	5,604 ( 6.80)	2.76	7.31
neutral	50,656 (61.50)	58,736 (71.31)	118.60	103,53
sad	8,210 ( 9.97)	5,687 ( 6.90)	1.85	4.45
surprise	433 ( 0.53)	863 ( 1.05)	0.02	0.23
unrecognized	14,941 (18.14)	11,306 (13.73)	-	-
<b>Total</b>	<b>82,371 (100)</b>	<b>82,371 (100)</b>	<b>122.95</b>	<b>107.35</b>



## RESULT **Facial mimicry, doctor-patient emotion, doctor-patient satisfaction**

### Patient characteristics

- The average age of patients was 51 years (SD = 19).
- The majority were female (62.5%),
- The average patient satisfaction score was 93.28 (SD = 10.32) and the physician satisfaction score (89.71, SD = 10.33).

### Bivariate analysis

- Significant negative correlation between the proportion of time patients exhibited sadness and neutral emotions with doctor satisfaction
  - Less time spent by the patient exhibiting emotions of sadness ( $r = -0.129$ ,  $p = .029$ ) and neutrality ( $r = -0.177$ ,  $p = .002$ ) were associated with higher doctor satisfaction scores.
- No significant correlation between the duration of the doctor's mimicking of the patient's facial expression and the patient satisfaction score.



## DISCUSSION

### Summary

- The study suggests that a patient's facial expressions, especially expressions of sadness and neutrality, can impact a doctor's satisfaction level during clinical encounters.
- No significant correlation between doctors' facial expressions and patient satisfaction, which could be due to the limitations of our emotion recognition-based artificial empathy model.

### Limitation

The study was limited by

- its focus on a single nonverbal modality,
- reliance on self-reported satisfaction questionnaires, and
- a specific setting (a dermatology outpatient clinic)



## CONCLUSION

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### Added Value and Challenge of the Study

- Emotion recognition-based artificial empathy measurement of a person's dynamic facial expressions is a valuable source of good nonverbal communication between doctor and patient.
- Studying individual facial mimicry using real-world video interaction itself is a very challenging task, so the outcome seems to largely depend on the study design and measurement definition.

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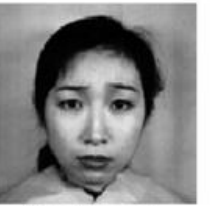


### Future Research Directions

- Incorporating other nonverbal modalities (eye contact, gestures, tone of voice, body posture) and expanding the study setting to other clinical scenarios to increase the generalizability of the findings.



# CURRENT WORK

## Facial Mimicry Criteria

Criteria	Facial Expression							
	Doctor	Patient						
Neutral mimicry	 Neutral Speech	 Anger	 Disgust	 Fear	 Happiness	 Neutral	 Sadness	 Suprise
Sad mimicry	 Sad Speech	 Sadness						
Happy mimicry	 Happy Speech	 Happiness						



## CURRENT WORK

### Facial mimicry, doctor-patient emotional expression

#### Input

- Neutral mimicry, Sad mimicry, Happy mimicry

#### Output

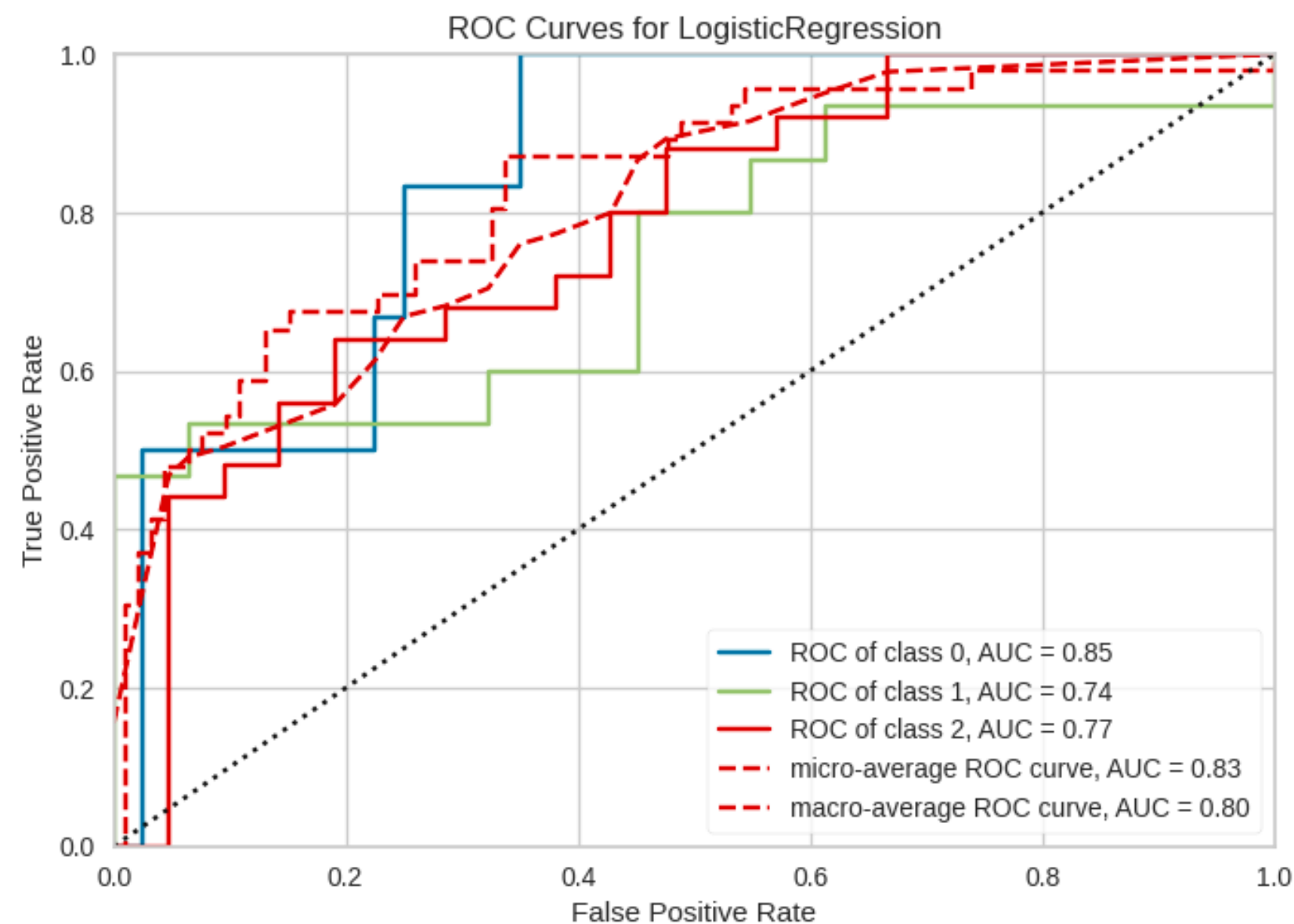
- Doctor empathy level: 0=low, 1=medium, 2=high

#### Facial mimicry

- Neutral mimicry: 25,424
- Sad mimicry: 356
- Happy mimicry: 635

#### Classification Performance

- AUC 0.75, Accuracy 0.66, Precision 0.60, Recall 0.66



Best Performing Classifier

## ACKNOWLEDGEMENT

### RESEARCH TEAM



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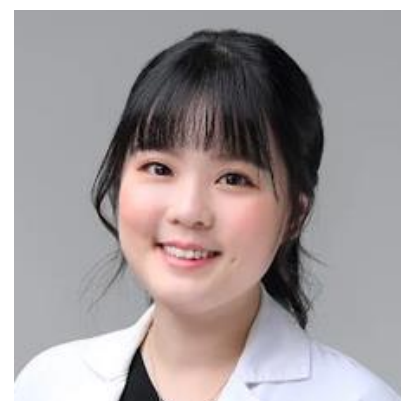
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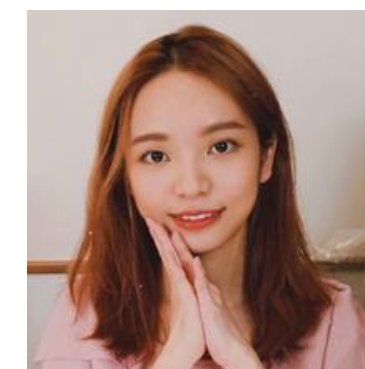
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# THANK YOU

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