# A SIAMESE CONTENT-ATTENTIVE GRAPH CONVOLUTIONAL NETWORK FOR PERSONALITY RECOGNITION USING PHYSIOLOGY

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Background

What are personalities
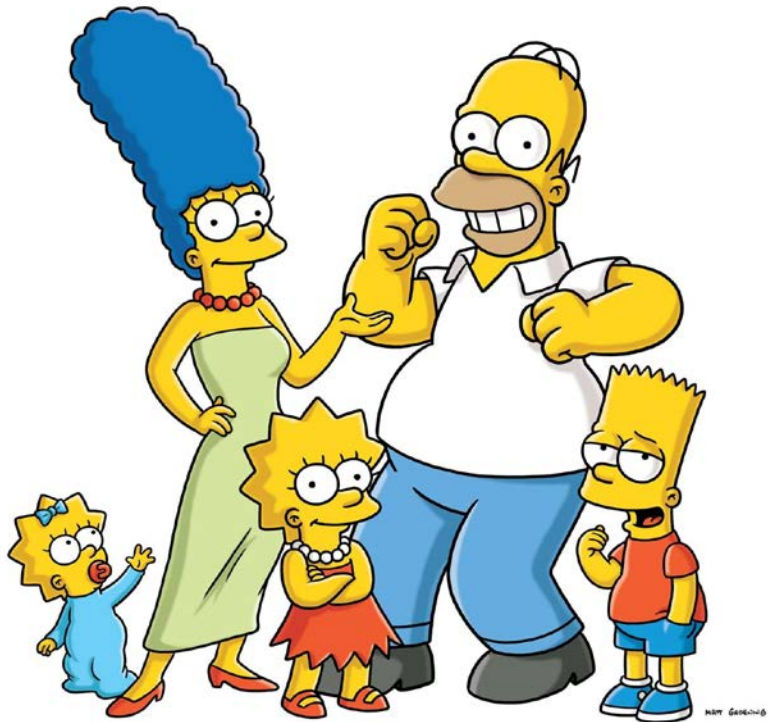
- A psychological construct
- Stable & Measurable attributes
- Influence:
  - Emotion Feeling
  - Behavior Responses
  - Decision Making

Personality as External Functions

- **Previous researches show that …**

- **Personalities could be observed through expressive cues:**
  - Questionaire (have been long developed in psychology)
  - Text: writing style, word choice [1]
  - Social Profiles: #Likes, #status updates, #friends, #groups [2]
  - Preference: music genre, TV programs [3,4]

- **All these requires subject's (spontaneous) external behaviors !**

Personality as Internal Reactions

- **What we proposed here:**

- **Personality traits could be "Aroused" unconsciously !**
  - Inference subject's personality through stimulated physiology
  - No need the subject to *"TO ANYTHING"*

- **Through monitoring subject's internal (physiology) responses, we could have a peek on their personalities**

Contribution

- **Multimodal Personality recognition using physiology by Graph Learning**

- **Integrate Visual Semantic Vectors for Siamese Attention Network**

- **Multimedia impact toward personality induction on physiology**
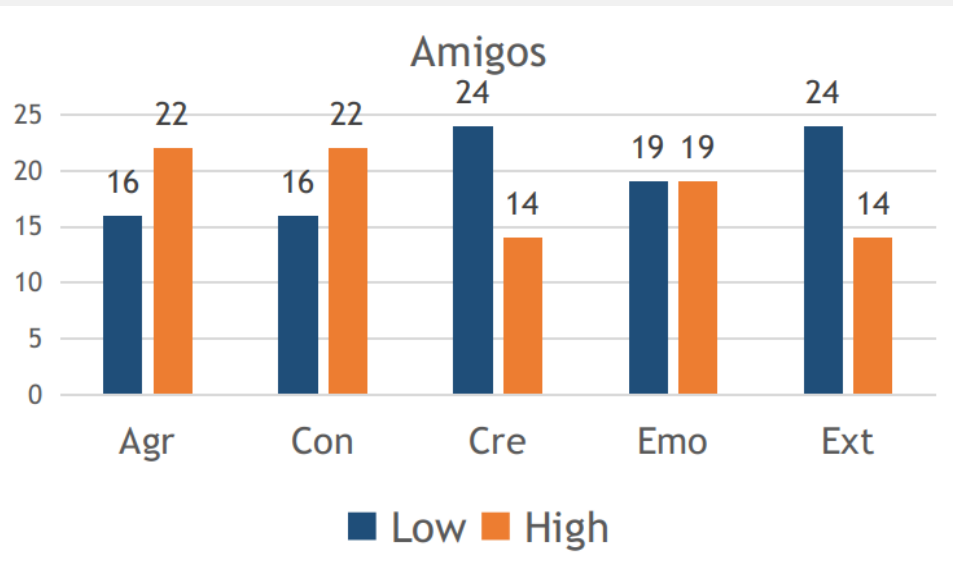
Experiment Setup

Dataset

- **Dataset: Amigos[5]**
- **Stimuli:**
  - 16 short emotional videos (duration < 250s)
  - Intended stimuli: High/Low Arousal or Valence (4 in each quadrant)
- **Modalities**
  - ECG (Shimmer 2R, 256 Hz, 12 bit)
  - EDA (Shimmer 2R, 128 Hz, 12 bit)
  - EEG (Emotiv EPOC, 14 channel, 128 Hz, 14 bit)
- **Subjects**
  - 40 (age 21~40, mean 28.3) => 38
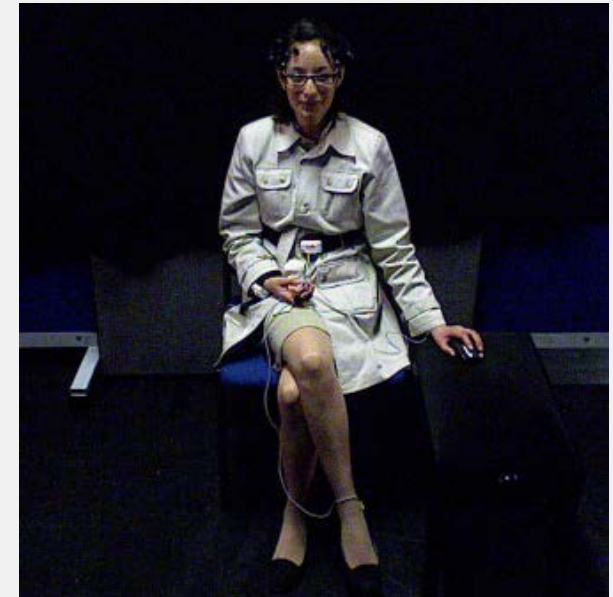
Big5 Personalities

Amigos

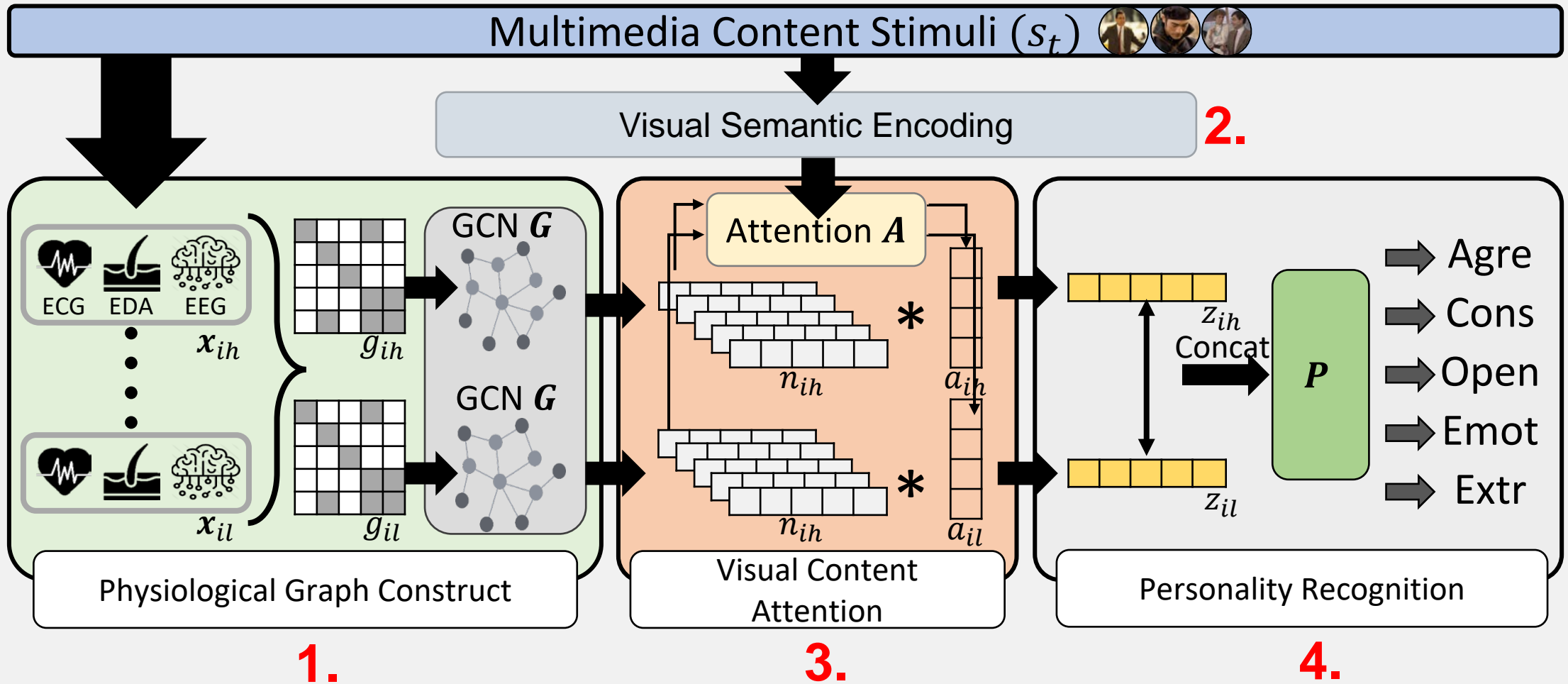| Personality Trait	Adjectives
Agreeableness (Agr)	Appreciative, Forgiving, Generous, Kind, Sympathetic
Conscientiousness (Con)	Efficient, Organized, Planful, Reliable, Responsible, Thorough
Creativeness (Cre)	Artistic, Curious, Imaginative, Insightful, Original, Wide Interests
Emotion Stability (Emo)	Unenvious, Relaxed, Unexcitable, Patient, Undemanding, Imperturbable
Extraversion (Ext)	Active, Assertive, Energetic, Enthusiastic, Outgoing, Talkative

Chart (Amigos):
- Agr: Low 16, High 22
- Con: Low 16, High 22
- Cre: Low 24, High 14
- Emo: Low 19, High 19
- Ext: Low 24, High 14

Legend: Low, High
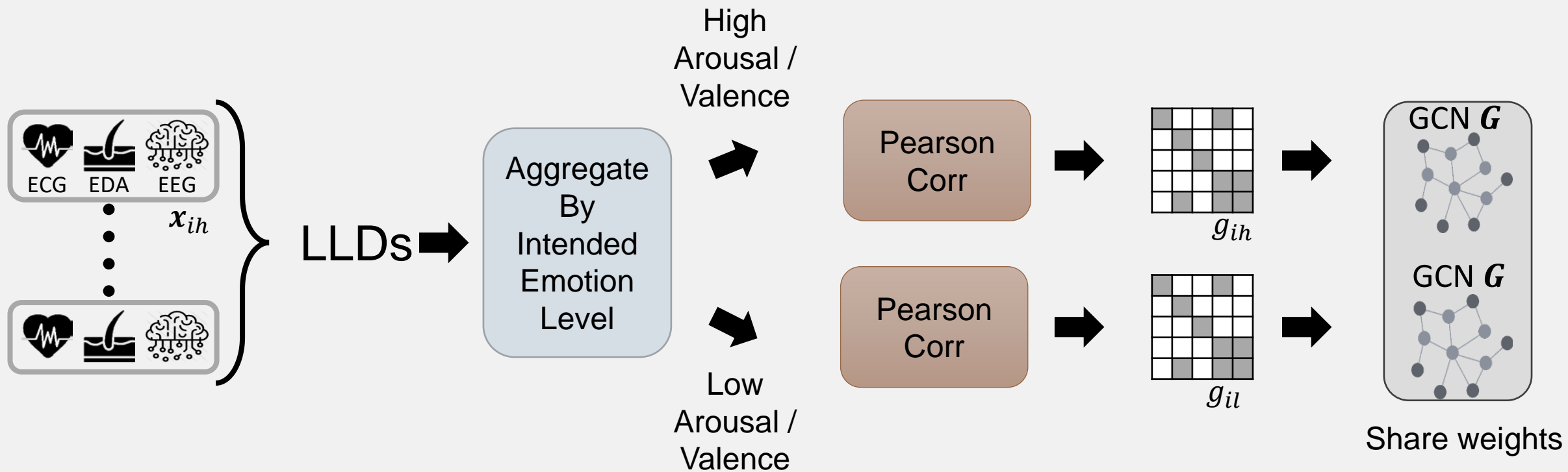
Proposed Architecture

Framework
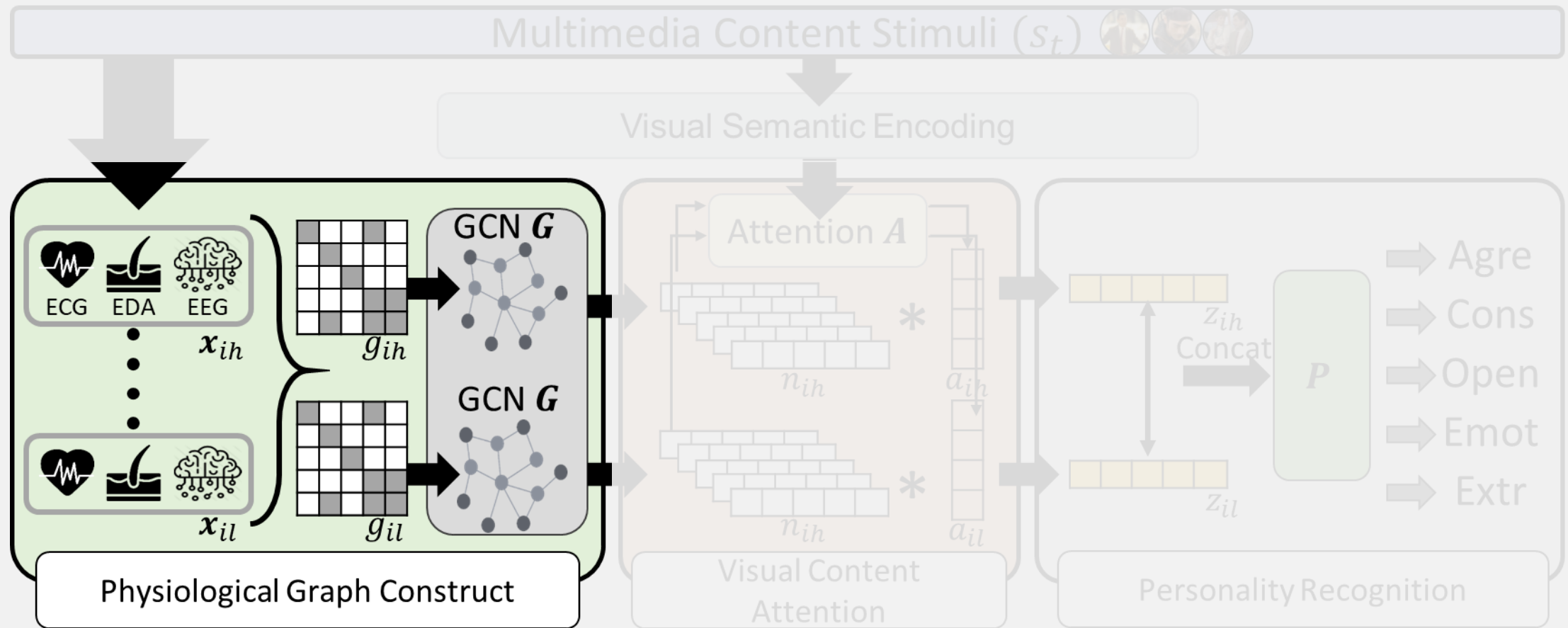
Low-Level Physiology Descriptors

Table 1. An overview of physiological low-level descriptors extracted from [12]. "F*" indicates 15 statistical functions[2]. EEG features are calculated for each channel then concatenated as a single feature vector.

Modality	Low-Level Descriptors
EEG(378)	Hjorth, Kurtosis, Skewness, First_diff_mean, First_diff_max, Sec_diff_mean, Sec_diff_max, Slope_mean, Slope_var, Wavelets, MaxPwelch, Entropy, ARMPB
ECG(51)	number_of_artifacts, RMSSD, meanNN, sdNN, cvNN, CVSD, medianNN, madNN, mcvNN, pNN50, pNN20, Triang, Shannon_h, ULF, VLF, LF, HF, VHF, Total_Power, LFn,HFn, LF/HF, LF/P, HF/P, DFA_1, DFA_2,Shannon, FD_Higushi, Average_Signal_Quality, F* Cardiac_Cycles_Signal_Quality
EDA(68)	F*SCR_Onsets, F*SCR_Peaks_Amplitudes, F*EDA_Phasic, F*EDA_Tonic_Component

- **ECG:**
  - Heart Rete Variabilities
- **EDA:**
  - Phasic / Toni components
  - Skin Conductance Responses
- **EEG:**
  - Functional Statistics

$$\alpha_{ic}^k = \frac{exp(\boldsymbol{A}(concat[n_{ic}^k, s_c^k]))}{\sum_{k=1}^{n_c} exp(\boldsymbol{A}(concat[n_{ic}^k, s_c^k]))}$$
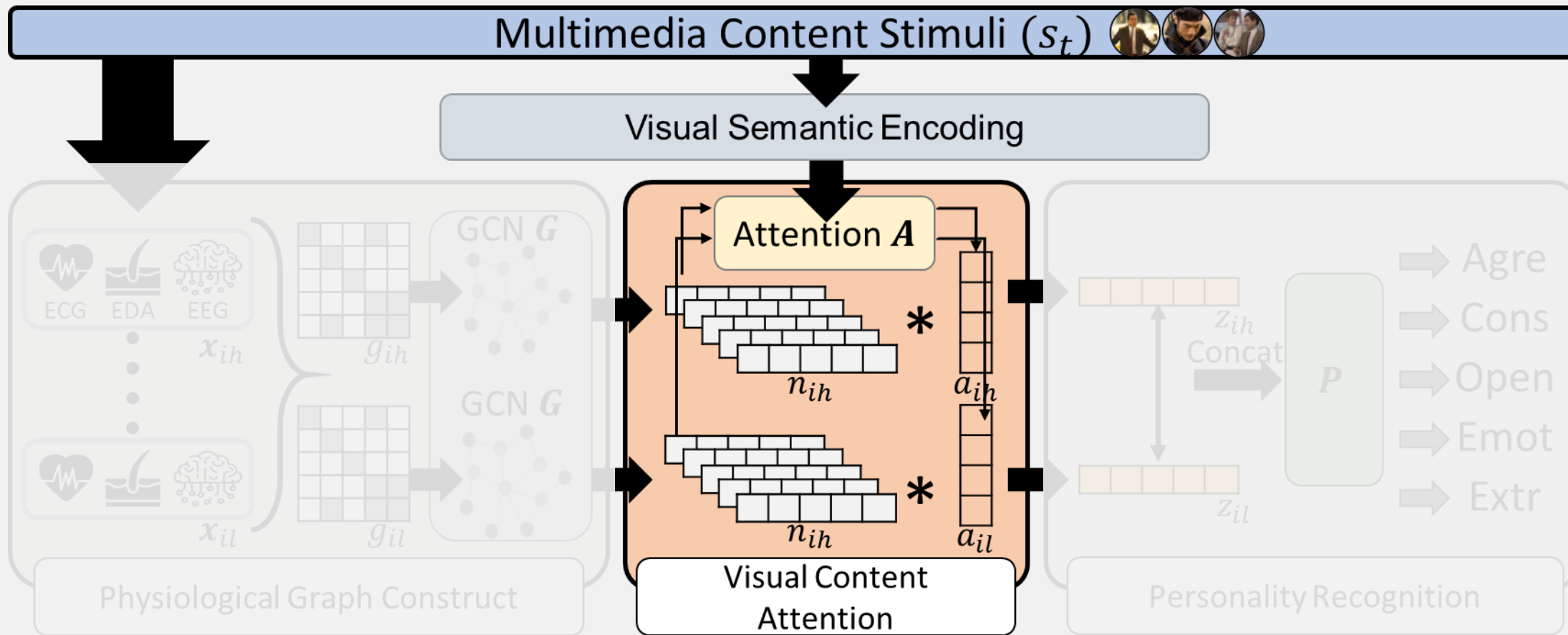
Multimedia Content Stimuli (s_t)

Visual Semantic Encoding
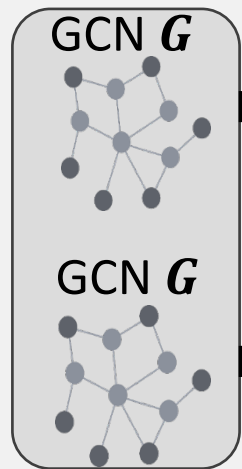
GCN G

GCN G

Attention A

g_{ih}

g_{il}

x_{ih}

x_{il}

ECG EDA EEG

n_{ih}

n_{ih}

a_{ih}

a_{il}

Physiological Graph Construct

Visual Content Attention

z_{ih}

Concat

z_{il}

P

Agre

Cons

Open

Emot

Extr

Personality Recognition

BIIC
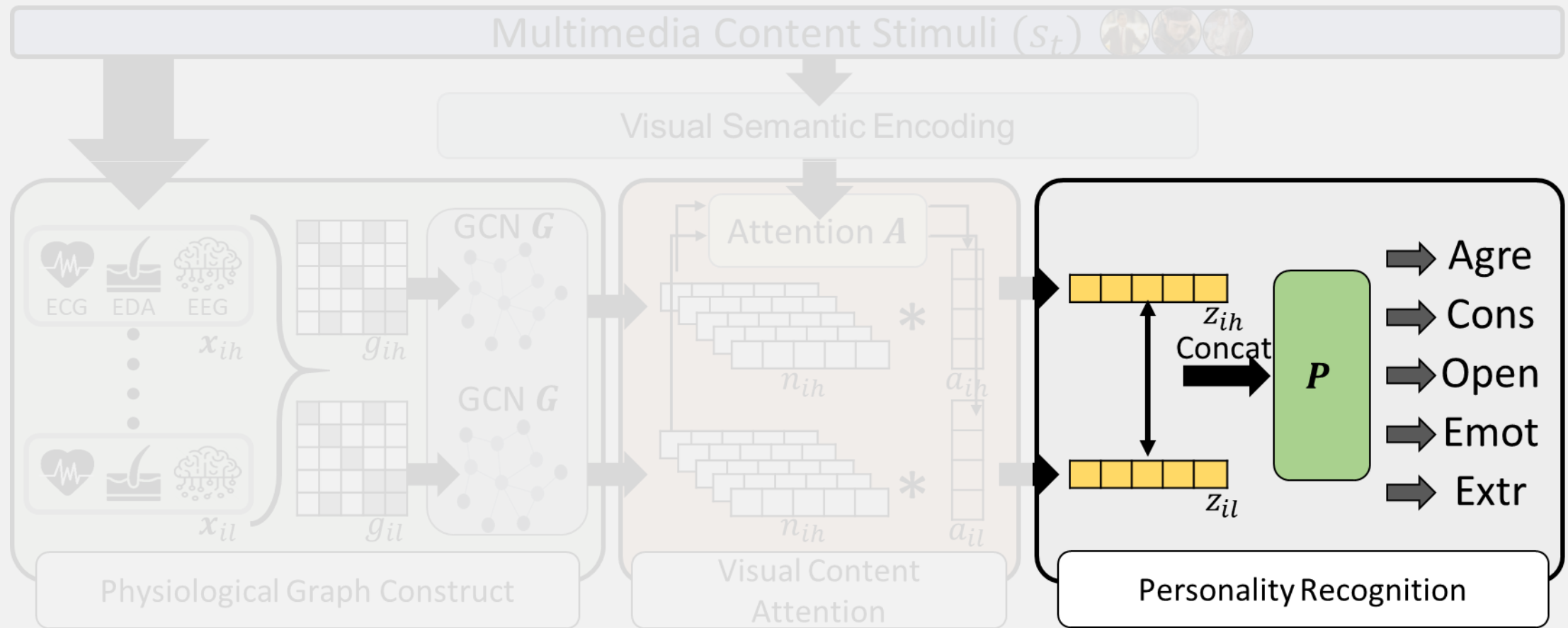
Results and Analysis

Parameter Settings

- **10-fold subject independent CV**
- **Hyperparameter grid searches:**
  - Dropout rate between [0:2; 0:5]
  - learning rate among [0:01; 0:005; 0:001]
  - Batchsize:16, the max
  - Epoch: max 200 with early stop
- The final evaluation metric used is the unweighted average recall (UAR).

Results

Table 2. A summary of recognition results. '-c': concatenate a subject's all physiological responses as a single vector for classification [8]; '-v': predict personality though majority voting of each response; Aro: Arousal; Val: Valence. Both of these two indicate the emotional reference during sub-graph splitting. The chance UAR is 0.5.

	SVM-c	SVM-v	DNN-v	AMIL	G-1-a	G-1-b	G-1-c	G-1-d	G-2-a		G-2-b		G-2-c		G-2-d	
									Aro	Val	Aro	Val	Aro	Val	Aro	Val
Agre	0.500	0.389	0.534	0.563	0.500	0.527	0.510	0.532	0.558	0.566	0.563	0.605	0.574	**0.642***	0.558	0.603
Cons	0.455	0.406	0.549	0.508	0.507	0.509	0.489	0.524	0.553	0.537	0.563	**0.579***	0.537	0.566	0.526	0.526
Open	0.500	0.452	0.517	0.529	0.505	0.510	0.512	0.593	0.647	0.655	0.674	0.676	0.682	0.674	0.676	**0.721***
Emot	0.473	0.553	0.605	0.553	0.611	0.608	0.613	0.618	0.637	0.618	0.671	0.624	0.689	0.624	**0.695***	0.650
Extr	0.500	0.509	0.543	0.538	0.602	0.583	0.585	0.587	0.679	0.656	0.676	0.663	0.668	0.671	**0.682***	0.661

Baseline Models
SVM-c: Directly concatenate a person's all responses using SVM
SVM-v: Majority vote a person's all responses using SVM
DNN-v: Majority vote a person's all responses using DNN
AMIL: Attention Multi-Instance Learning

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a. No self-attention
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Through attention analysis ...

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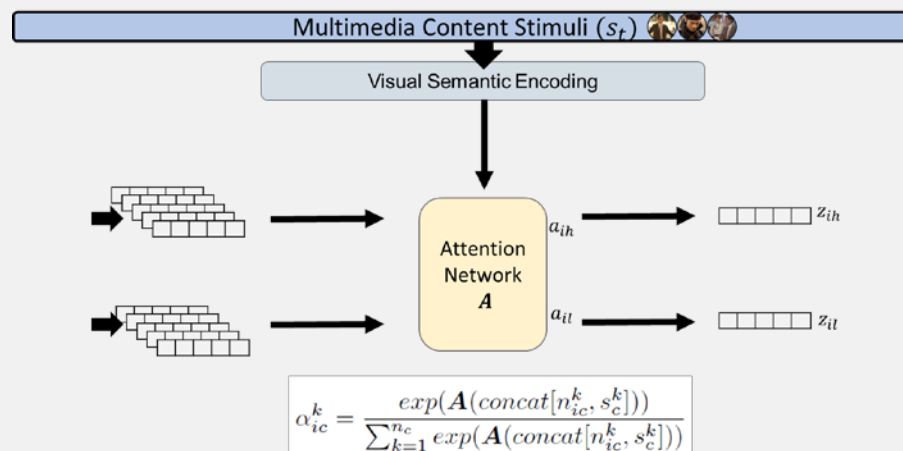
Table 3. A summary of average attention weights along 16 video stimulus. The bold part refers to weights larger than 0.2. '*': The highest among all videos.

Personality	Model	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Open	**G-2-b**	0.1	0.12	0.12	0.15	0.14	0.13	0.1	0.13	0.11	**0.22***	0.11	0.12	0.15	0.12	0.17	0.14
	G-2-d	0.09	0.1	0.03	0.12	**0.72***	0.05	0.11	0.04	0.02	0.06	0.04	0.09	**0.36**	0.09	0.12	0.1
Emot	**G-2-b**	0.11	0.13	0.12	0.14	0.15	0.14	0.12	0.15	0.11	0.19*	0.12	0.11	0.12	0.15	0.14	0.11
	G-2-d	0.11	0.09	0.07	0.08	**0.43***	0.1	0.02	0.19	0.09	0.16	0.12	0.15	0.1	0.14	0.14	0.12
Extr	**G-2-b**	0.12	0.13	0.1	0.16	0.12	0.12	0.1	0.14	0.09	**0.26***	0.13	0.13	0.13	0.14	0.12	0.14
	G-2-d	0.08	0.09	0.09	0.06	**0.33***	0.06	**0.29**	0.15	0.11	0.11	0.12	0.12	**0.22**	0.07	0.12	0.13

Through attention analysis …

- **Key stimuli for Openness, Emotion Stability, Extraversion**

  The Exorcist (1973)   *Pink Flamingos (1972)*   *When Harry Met Sally (1989)*

- **Key stimuli <u>specific</u> for Extraversion**

  My Bodyguard (1980)

Conclusion

- **Multi-media visual information help personality recognition**
- **Openness, Emotion Stability, and Extraversion closely related with physiological responses**
- **Certain emotional multi-media stimuli could largely arouse a person's trait on physiology**
- **The mechanism of affective multimedia content triggering personality traits on physiology remains unknown**

Reference

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2. Golnoosh Farnadi, Geetha Sitaraman, Shanu Sushmita, Fabio Celli, Michal Kosinski, David Stillwell, Sergio Davalos, Marie-Francine Moens, and Martine De Cock, "Computational personality recognition in social media," User modeling and user-adapted interaction, vol. 26, no. 2-3, pp. 109–142, 2016.
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4. Tomas Chamorro-Premuzic and Adrian Furnham, "Personality and music: Can traits explain how people use music in everyday life?," British Journal of Psychology, vol. 98, no. 2, pp. 175–185, 2007.
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THANK YOU !!