Modeling the Influence of Personality and Culture on Affect and Enjoyment in Multimedia

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What is a good ad campaign?

Storytelling components shaped into emotion-evoking communication, structured to stimulate action.

Volvo Trucks' The Epic Split

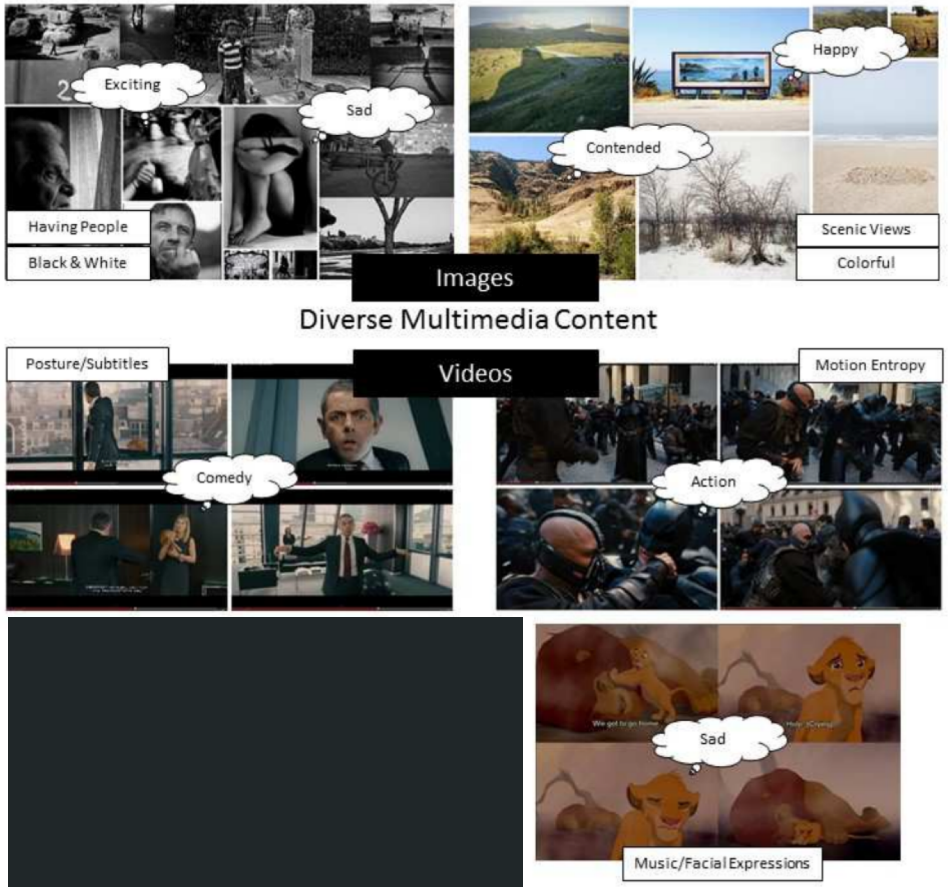
Couple of Other Examples

MOE Singapore

Dove Beauty Sketch

Challenge of Modeling Multimedia-Evoked Emotions

➔Not limited to content- or genre-based analysis
➔Role of users' cultural and psychophysical framework



Images

Diverse Multimedia Content

Videos

Modeling the Influence of Personality and Culture on Affect and Enjoyment in Multimedia

Research Questions

1. Can a model based on multimedia system characteristics (bit-rate, frame-rate and frame-size) and human factors (personality and culture) predict the intensity of affect (+ve/-ve) and enjoyment?
2. Which system characteristics and human factors influence these responses the most?
3. What is the relationship between experience of affect and enjoyment across stimuli?

Related Work

Modeling emotional response [1, 2] in videos using:

1. Cinematographic theories (audio-visual features)
2. Facial expressions of viewers
3. Complementary physiological sensors (e.g., heart rate)

Do they factor in the subjective intensity of affect (which vary as a consequence of users' innate psychology [3,4])?

Most Studies implicitly assume that, given a video, affect experienced by different users will be more or less the same.

Prior research shows that individual differences can lead to varied experiences [5,6,7].

[1] Z. Zeng, et. al, TPAMI, 2009.
[2] R. Calvo, et al., IEEE Tran. on Affective Comp., 2010.
[3] Anderson,et. al. Journal of Cog. neuroscience, 2002
[4] Ekman, Paul Ed, et. al. Oxford University Press, 1994.
[5] K. A. Winter et. al, Clinical psychology review, 1997
[6] W. Choe, et. al, Cognitive Science, 2013.
[7] M. K. Abadi, et. al, in ACII, 2013.

How to factor in individual differences?

Individual differences are subtle, owing to the complexity associated with the different dimensions of individuals.

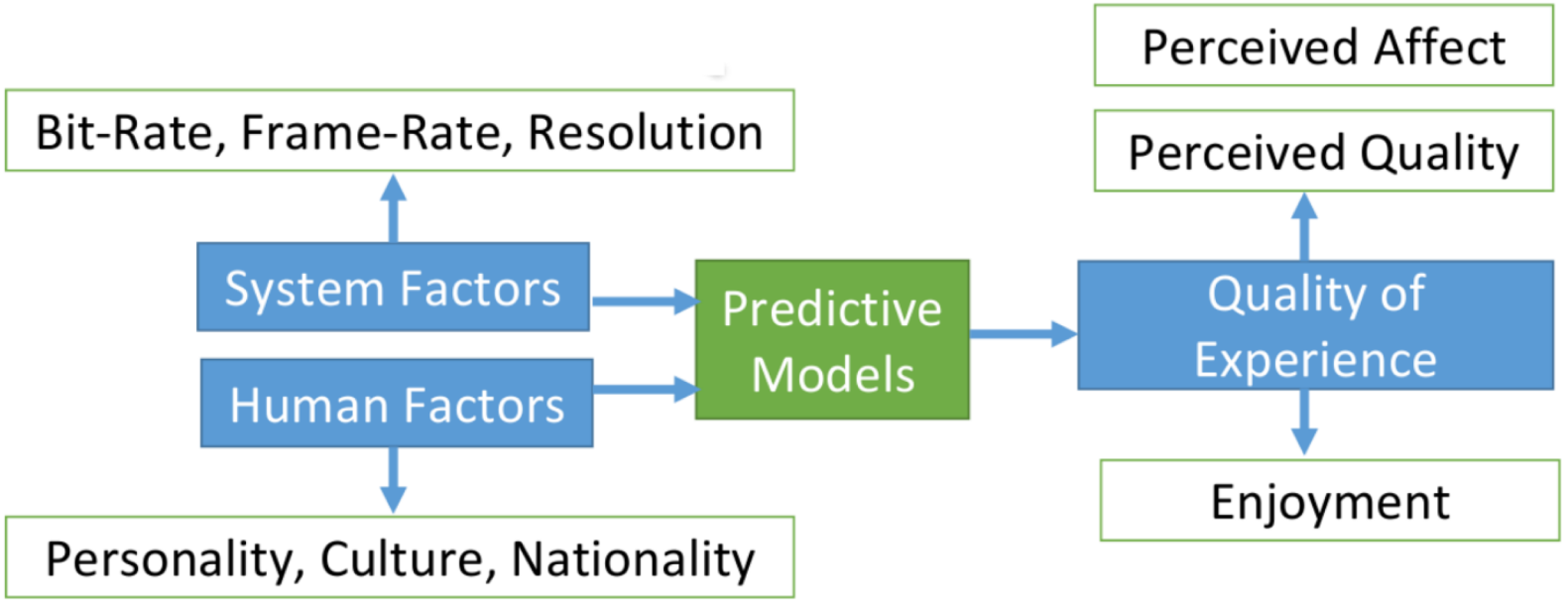
Personality (Big-5 traits: Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism): Specific to the Individual

Culture (Hofstedede six traits: Power Distance, Individualism, Masculinity, Uncertainity Avoidance, Pragmatism, Indulgence): Specific to the a ‘Group’

These two human factors are shown to reliably capture individual differences in multiple domains like language, invonation of voice while speaking, kind of photos one likes, type of people one befriends etc.

Our Work

Modeling the influence of personality and culture on quality, affect and enjoyment and also the correlations b/w them.



Dataset

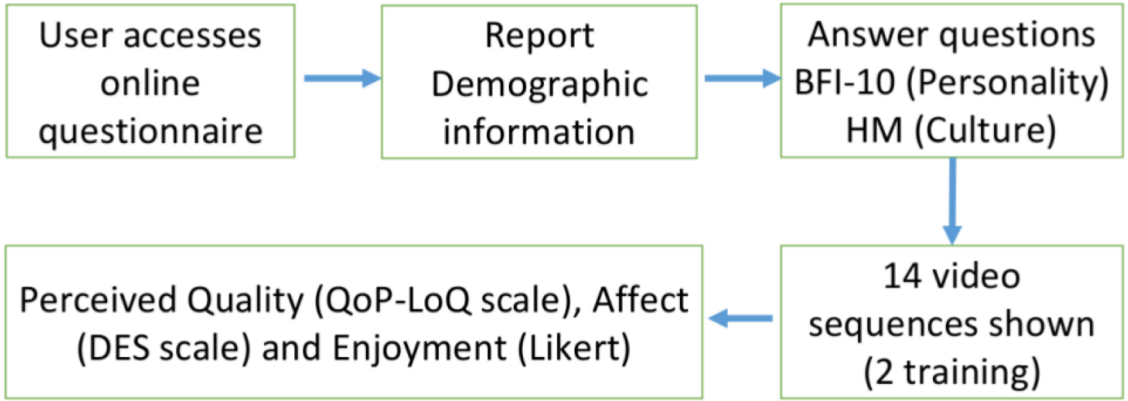
http://1drv.ms/1M1bnwU

144 video sequences

a.) 1 nominal parameter: content (12 short movie clips of different emotions)

b.) 3 ordinal parameters: bit-rate (384, 768 kbps); resolution (480, 720p); framerate (5, 15, 25 fps).

c.) 12 quality conditions and 12 emotion conditions



Video Clips - Stats

These clips are a part of FilmStim affective movie dataset

MARGINAL MEANS OF PERCEIVED RESPONSES (AFFECT AND ENJOYMENT) ON CLIPS, AFTER FIXING THE CO-VARIATES

MovieClip (Duration in Mins:Secs)	+ve Affect	-ve Affect	Enjoyment
A_FISH_CALLED_WANDA (2:56)	0.184	-0.536	-0.037
AMERICAN_HISTORY_X (1:06)	-0.397	0.756	-0.607
CHILDS_PLAY_II (1:07)	-0.231	0.698	-0.158
COPYCAT (1:04)	-0.33	0.418	-0.315
DEAD_POETS_SOCIETY_1 (2:34)	-0.331	0.341	-0.504
DEAD_POETS_SOCIETY_2 (2:23)	1.053	-0.553	0.725
FOREST_GUMP (1:47)	0.992	-0.523	0.656
SE7EN_1 (1:39)	-0.346	0.248	0.42
SE7EN_3 (0:24)	-0.431	0.03	-0.306
SOMETHING_ABOUT_MARY (2:00)	0.468	-0.72	0.471
THE_PROFESSIONAL (2:44)	-0.194	0.216	0.254
TRAINSPOTTING (0:40)	-0.477	-0.389	-0.654

Based on estimated marginal means of a mixed-effects regression model. Covariates in the model are evaluated at the following values: EXTRAVERSION = 5.42; AGREEABLENESS = 7.45; CONSCIENTIOUSNESS = 6.59; NEUROTICISM = 5.67; OPENNESS = 6.77; POWER DISTANCE = -34.29; INDIVIDUALISM = 22.44; MASCULINITY = -6.73; UNCERTAINTY AVOIDANCE = 40.83; PRAGMATISM = 22.82; INDULGENCE = -11.60.

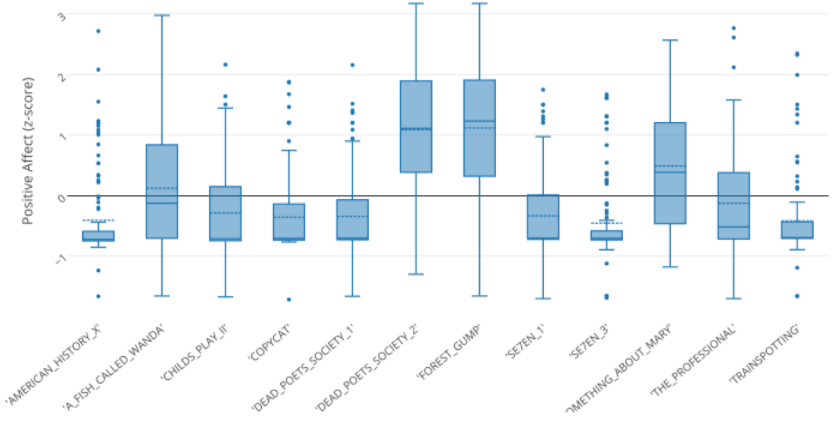
Participants - Stats

The participants were 114 university students drawn from NTU Singapore and Brunel University London. Exactly 50% of the sample was drawn from each institution.

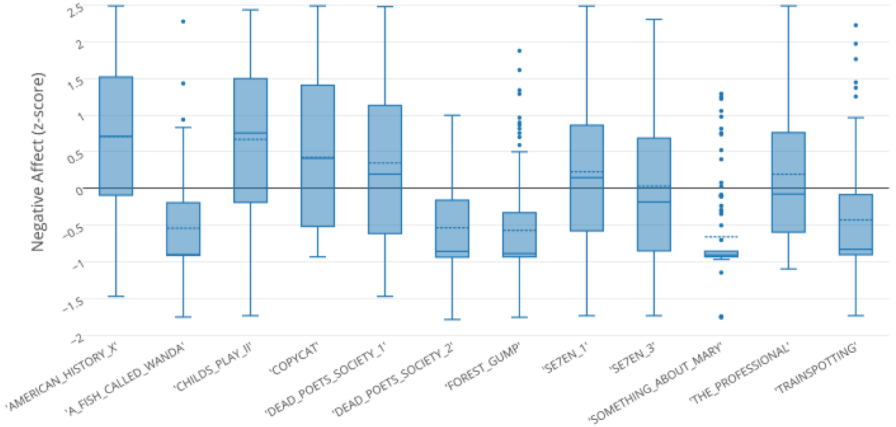
SAMPLE DESCRIPTIVES

Human Factors	Min	Max	$\bar{x}(NTU)$	$\bar{x}(BUL)$	$\bar{x}$	σ
Extroversion	2	9	5.61	5.46	5.54	1.689
Agreeableness	3	10	7.33	7.31	7.22	1.533
Conscientiousness	2	10	6.40	6.70	6.55	1.523
Neuroticism	2	10	5.56	5.68	5.62	1.716
Openess	4	10	6.60	6.91	6.75	1.424
Power Distance	-155	140	-35.61	-36.32	-35.96	53.219
Individualism	-140	140	25.79	11.67	18.73	50.619
Masculinity	-140	105	3.68	-6.14	-1.23	53.483
Uncertainty Avoidance	-120	130	52.54	36.67	44.61	47.182
Pragmatism	-130	155	16.14	17.54	16.84	58.090
Indulgence	-220	185	-22.63	-11.32	-16.97	65.522

Responses (+ve and -ve Affect)

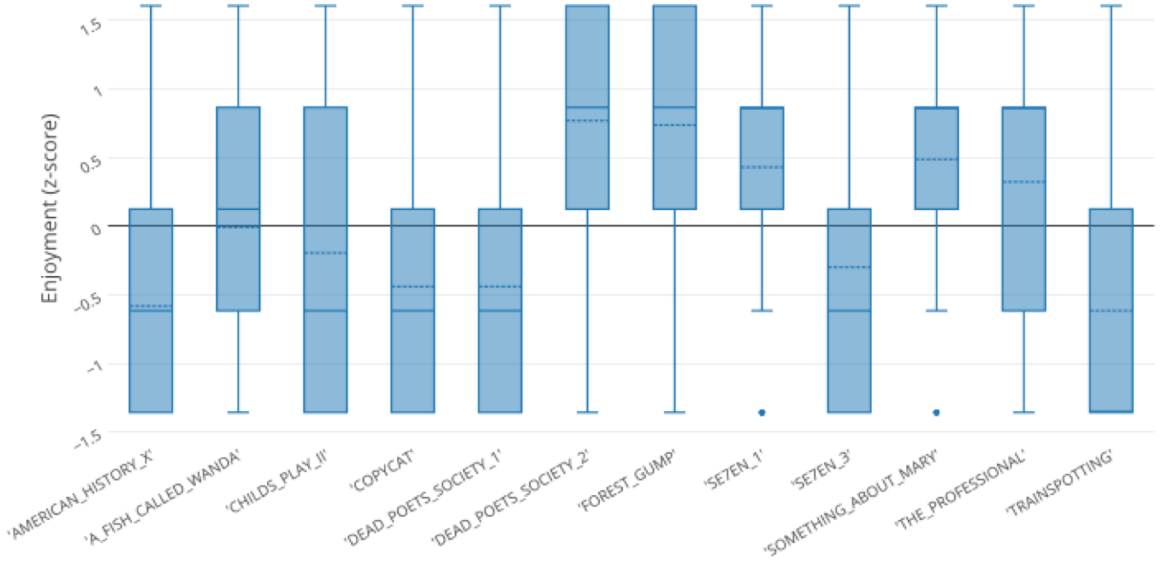


Relative Levels of +ve Affect on different video clips



Relative Levels of -ve Affect on different video clips

Responses (Enjoyment)



Relative Levels of Enjoyment
on different video clips

Statistical Models

We build three computational models (namely baseline, extended and optimistic) to investigate the influence of system factors (namely Bit-Rate, Frame-Rate and Frame-Size) and human factors (namely the five personality factors and six culture factors).

1. **Baseline:** Considers system factors (as factorial interactions) and the content parameter (to reflect differences in affect)
2. **Extended:** Adds human factors (as covariates) to the baseline model.
3. **Optimistic:** Each participant is modeled as a random effect, to take into consideration factors, other than system/human which we measured, that can play a role.

Results - Baseline Model

THE BASELINE FIXED-EFFECT MULTILEVEL LINEAR REGRESSION MODEL PREDICTING THREE DEPENDENT VARIABLES

Parameter	df_{num}	Positive Affect			Negative Affect			Enjoyment		
		df_{den}	F	p	df_{den}	F	p	df_{den}	F	p
Movie Clip	11	156.009	25.315	0.00	144.643	33.932	0.00	177.09	40.14	0.00
Frame Rate (FR)	2	803.739	0.32	0.73	710.192	0.056	0.95	1131.23	5.173	0.006
Frame Size (FS)	1	809.889	0.006	0.94	729.398	3.298	0.07	1146.39	2.846	0.092
Bit-Rate (BR)	1	816.675	1.724	0.19	714.909	0.30	0.58	1139.69	0.474	0.491

*Interactions of System Factors namely FR*FS, FS*BR, FR*BR, FR*FS*BR were found to be insignificant predictors and hence not included in the above table.*

Frame Rate had a statistically significant effect on enjoyment. This shows that system factors alone do not make a huge impact on how the content is perceived. [1]

[1] N. Yeung and A. G. Sanfey, “Independent coding of reward magnitude and valence in the human brain,” The Journal of Neuroscience, 2004.

Results - Extended Model

THE EXTENDED FIXED-EFFECT MULTILEVEL LINEAR REGRESSION MODEL PREDICTING THREE DEPENDENT VARIABLES

Parameter	df_{num}	Positive Affect			Negative Affect			Enjoyment		
		df_{den}	F	p	df_{den}	F	p	df_{den}	F	p
Movie Clip	11	193.163	35.925	0.00	206.260	39.739	0.00	171.956	39.733	0
Frame Rate (FR)	2	1071.695	0.18	0.84	1045.660	0.48	0.62	1136.577	4.695	0.009
Frame Size (FS)	1	1074.152	0.54	0.46	1061.874	2.10	0.15	1151.402	3.336	0.068
Bit-Rate (BR)	1	1083.535	2.334	0.13	1044.851	0.06	0.807	1145.171	0.257	0.612
Extraversion	1	1074.324	4.559	0.033	1059.767	0.08	0.78	1150.401	0.024	0.877
Agreeableness	1	1072.223	1.876	0.17	1059.481	24.314	0.00	1152.475	2.001	0.157
Conscientiousness	1	1077.950	9.474	0.002	1041.655	3.964	0.047	1141.249	5.271	0.022
Neuroticism	1	1084.026	0.02	0.888	1050.845	25.227	0.00	1146.479	0.05	0.823
Openness	1	1074.213	2.670	0.103	1058.628	2.110	0.147	1145.365	4.344	0.037
Power Distance	1	1073.888	4.676	0.031	1055.500	0.00	0.985	1152.465	9.138	0.003
Individualism	1	1070.708	2.148	0.143	1052.462	2.486	0.115	1150.026	0.674	0.412
Masculinity	1	1074.304	4.874	0.027	1043.258	1.061	0.303	1141.312	3.312	0.069
Uncertainty Avoidance	1	1077.284	0.534	0.465	1044.360	0.306	0.580	1144.106	5.751	0.017
Pragmatism	1	1069.661	0.886	0.347	1064.578	0.175	0.676	1160.7	0.604	0.437
Indulgence	1	1070.162	5.863	0.016	1051.545	4.863	0.028	1149.178	2.206	0.138

*Interactions of System Factors namely FR*FS, FS*BR, FR*BR, FR*FS*BR were found to be insignificant predictors and hence not included in the above table.*

Results - Optimistic Model

AN OPTIMISTIC MIXED-EFFECT MULTILEVEL LINEAR REGRESSION MODEL PREDICTING THREE DEPENDENT VARIABLES

Parameter	df_{num}	Positive Affect			Negative Affect			Enjoyment		
		df_{den}	F	p	df_{den}	F	p	df_{den}	F	p
Movie Clip	11	178.713	42.312	0.00	152.624	55.782	0.00	179.877	46.99	0.00
Frame Rate (FR)	2	701.036	1.788	0.168	945.140	1.392	0.249	1116.89	8.025	0.00
Frame Size (FS)	1	695.825	0.002	0.965	969.366	5.764	0.017	1120.818	3.13	0.077
Bit-Rate (BR)	1	715.664	1.159	0.282	972.050	1.457	0.228	1121.96	0.054	0.816

*Interactions of System Factors namely FR*FS, FS*BR, FR*BR, FR*FS*BR were found to be insignificant predictors and hence not included in the above table.*

Frame-Size and experience of affect has become significant.
The most notable difference, however, is a large increase in the variance explained as a result of including participants as random effects.

There are factors other than system, human and content factors which influence perception of affect and enjoyment.

Comparison of Models

PAIRED T-TEST COMPARING MODELS FOR ALL THREE RESPONSES (W.R.T MSR)

Models	Positive Affect				Negative Affect				Enjoyment			
	$\Delta\bar{x}$	σ	t	p	$\Delta\bar{x}$	σ	t	p	$\Delta\bar{x}$	σ	t	p
Baseline → Extended	0.013	0.193	2.311	0.021	0.039	0.277	5.008	0.00	0.039	0.430	3.219	0.001
Baseline → Optimistic	0.2253	0.924	8.552	0.00	0.2898	0.726	14.014	0.00	0.4199	1.129	13.069	0.00

+ve Affect: Extended model predicts about 5.6% variance to human factors

-ve Affect: 13.6%;

Enjoyment: 9.3%

Correlation between Affect and Enjoyment

Enjoyment is significantly correlated with interest, joy, satisfaction and the latent factor, positive emotion.

There are also very few instances of negative emotions (sad,fearful, guilty and ashamed) positively correlated with enjoyment. These might be associated with how certain users (possibly with high scores on neuroticism) perceive certain contents [1,2]

[1] R. J. Larsen et. al Journal of personality and social psychology, 1991
[2] E. Diener et. al. Annual review of psychology, 2003.

Correlation between Affect and Enjoyment

Nature of the content itself can arouse contradictory emotions.
For example, *enjoyment is observed to be positively correlated with sadness in the movie clip FOREST GUMP*

There will be certain users who need to experience negative emotions to connect to certain content's message.
These insight can aid content creators to better understand users with different personality and cultural traits to establish an emotional connection with them.
Very important to drive behavioral action!
(especially in scenarios involving ad campaign design etc.)

Research Questions - Revisited

1. Can a model based on multimedia system characteristics (bit-rate, frame-rate and frame-size) and human factors (personality and culture) predict the intensity of affect (+ve/-ve) and enjoyment?
2. Which system characteristics and human factors influence these responses the most?
3. What is the relationship between experience of affect and enjoyment across stimuli?

Research Questions - Revisited

1. Can a model based on multimedia system characteristics (bit-rate, frame-rate and frame-size) and human factors (personality and culture) predict the intensity of affect (+ve/-ve) and enjoyment?

For positive affect, negative affect and enjoyment, personality and culture represented 5.6%, 13.6% and 9.3% of the variance respectively. While this is an important proportion, further study is needed to discover other contributing factors, which could include sensory impairments and expertise.

Research Questions - Revisited

2. Which system characteristics and human factors influence these responses the most?

Traits of extraversion, conscientiousness, masculinity and indulgence are significant predictors for positive affect, and agreeableness, neuroticism, conscientiousness and indulgence were important predictors for negative affect, and conscientiousness, openness and uncertainity avoidance were significant predictors for enjoyment.

Research Questions - Revisited

3. What is the relationship between experience of affect and enjoyment across stimuli?

The majority of the movie clips which were enjoyed were also rated high on positive affect, with a small exception of clips having high correlation between negative affect and enjoyment. Such behavior is possibly due to the interplay between human factors (like neuroticism) and nature of the content.

Conclusion

1. Inclusion of human factors lead to a performance increase (w.r.t MSE) of 5.6%, 13.6% and 9.3% in predicting +ve affect, -ve affect and enjoyment
2. Lower system factors does not imply lower perception of enjoyment.
3. Enjoyment is significantly correlated with perception of joy, satisfaction and interest.
4. Positive correlation was observed for enjoyment and negative emotions (sad, fearful, guilty and ashamed) rated by neurotic users.

Future Work:

1. What are the other factors which contribute to the variance seen in affect and enjoyment?
2. Building predictive models.

Dataset can be downloaded from here: http://1drv.ms/1M1bnwU

Thank you!

Please contact sharathc001@e.ntu.edu.sg to discuss more about this work