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.
Challenge of Modeling Multimedia-Evoked Emotions

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

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** (Hofstede six traits: Power Distance, Individualism, Masculinity, Uncertainty Avoidance, Pragmatism, Indulgence): Specific to the a ‘Group’

*These two human factors are shown to reliably capture individual differences in multiple domains like language, invocation 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

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

http://1drv.ms/1M1bnwU
### 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

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

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.

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

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]

# Results - Extended Model

## The Extended Fixed-Effect Multilevel Linear Regression Model Predicting Three Dependent Variables

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$df_{num}$</th>
<th>Positive Affect</th>
<th></th>
<th>Negative Affect</th>
<th></th>
<th>Enjoyment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$df_{num}$</td>
<td>$df_{den}$</td>
<td>$F$</td>
<td>$p$</td>
<td>$df_{den}$</td>
<td>$F$</td>
<td>$p$</td>
</tr>
<tr>
<td>Movie Clip</td>
<td>11</td>
<td>193.163</td>
<td>35.925</td>
<td>0.00</td>
<td>206.260</td>
<td>39.739</td>
<td>0.00</td>
</tr>
<tr>
<td>Frame Rate (FR)</td>
<td>2</td>
<td>1071.695</td>
<td>0.18</td>
<td>0.84</td>
<td>1045.660</td>
<td>0.48</td>
<td>0.62</td>
</tr>
<tr>
<td>Frame Size (FS)</td>
<td>1</td>
<td>1074.152</td>
<td>0.54</td>
<td>0.46</td>
<td>1061.874</td>
<td>2.10</td>
<td>0.15</td>
</tr>
<tr>
<td>Bit-Rate (BR)</td>
<td>1</td>
<td>1083.535</td>
<td>2.334</td>
<td>0.13</td>
<td>1044.851</td>
<td>0.06</td>
<td>0.807</td>
</tr>
<tr>
<td>Extraversion</td>
<td>1</td>
<td>1074.324</td>
<td>4.559</td>
<td>0.033</td>
<td>1059.767</td>
<td>0.08</td>
<td>0.78</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>1</td>
<td>1072.223</td>
<td>1.876</td>
<td>0.17</td>
<td>1059.481</td>
<td>24.314</td>
<td>0.00</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>1</td>
<td>1077.950</td>
<td>9.474</td>
<td>0.002</td>
<td>1041.655</td>
<td>3.964</td>
<td>0.047</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>1</td>
<td>1084.026</td>
<td>0.02</td>
<td>0.888</td>
<td>1050.845</td>
<td>25.227</td>
<td>0.00</td>
</tr>
<tr>
<td>Openness</td>
<td>1</td>
<td>1074.213</td>
<td>2.670</td>
<td>0.103</td>
<td>1058.628</td>
<td>2.110</td>
<td>0.147</td>
</tr>
<tr>
<td>Power Distance</td>
<td>1</td>
<td>1073.888</td>
<td>4.676</td>
<td>0.031</td>
<td>1055.500</td>
<td>0.00</td>
<td>0.985</td>
</tr>
<tr>
<td>Individualism</td>
<td>1</td>
<td>1070.708</td>
<td>2.148</td>
<td>0.143</td>
<td>1052.462</td>
<td>2.486</td>
<td>0.115</td>
</tr>
<tr>
<td>Masculinity</td>
<td>1</td>
<td>1074.304</td>
<td>4.874</td>
<td>0.027</td>
<td>1043.258</td>
<td>1.061</td>
<td>0.303</td>
</tr>
<tr>
<td>Uncertainty Avoidance</td>
<td>1</td>
<td>1077.284</td>
<td>0.534</td>
<td>0.465</td>
<td>1044.360</td>
<td>0.306</td>
<td>0.580</td>
</tr>
<tr>
<td>Pragmatism</td>
<td>1</td>
<td>1069.661</td>
<td>0.886</td>
<td>0.347</td>
<td>1064.578</td>
<td>0.175</td>
<td>0.676</td>
</tr>
<tr>
<td>Indulgence</td>
<td>1</td>
<td>1070.162</td>
<td>5.863</td>
<td>0.016</td>
<td>1051.545</td>
<td>4.863</td>
<td>0.028</td>
</tr>
</tbody>
</table>

*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**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$df_{num}$</th>
<th>Positive Affect</th>
<th>Negative Affect</th>
<th>Enjoyment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$df_{den}$</td>
<td>$F$</td>
<td>$p$</td>
</tr>
<tr>
<td>Movie Clip</td>
<td>11</td>
<td>178.713</td>
<td>42.312</td>
<td>0.00</td>
</tr>
<tr>
<td>Frame Rate (FR)</td>
<td>2</td>
<td>701.036</td>
<td>1.788</td>
<td>0.168</td>
</tr>
<tr>
<td>Frame Size (FS)</td>
<td>1</td>
<td>695.825</td>
<td>0.002</td>
<td>0.965</td>
</tr>
<tr>
<td>Bit-Rate (BR)</td>
<td>1</td>
<td>715.664</td>
<td>1.159</td>
<td>0.282</td>
</tr>
</tbody>
</table>

*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

**Comparison of Models**

<table>
<thead>
<tr>
<th>Models</th>
<th>Positive Affect</th>
<th>Negative Affect</th>
<th>Enjoyment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\Delta \bar{x})</td>
<td>(\sigma)</td>
<td>(t)</td>
</tr>
<tr>
<td>Baseline → Extended</td>
<td>0.013</td>
<td>0.193</td>
<td>2.311</td>
</tr>
<tr>
<td>Baseline → Optimistic</td>
<td>0.2253</td>
<td>0.924</td>
<td>8.552</td>
</tr>
</tbody>
</table>

+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]

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 uncertainty 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.
Thank you!

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

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