



MTO 24.3 Examples: Albrecht, Expressive Meaning and the Empirical Analysis of Musical Gesture

(Note: audio, video, and other interactive examples are only available online)

<http://mtosmt.org/issues/mto.18.24.3/mto.18.24.3.albrecht.html>

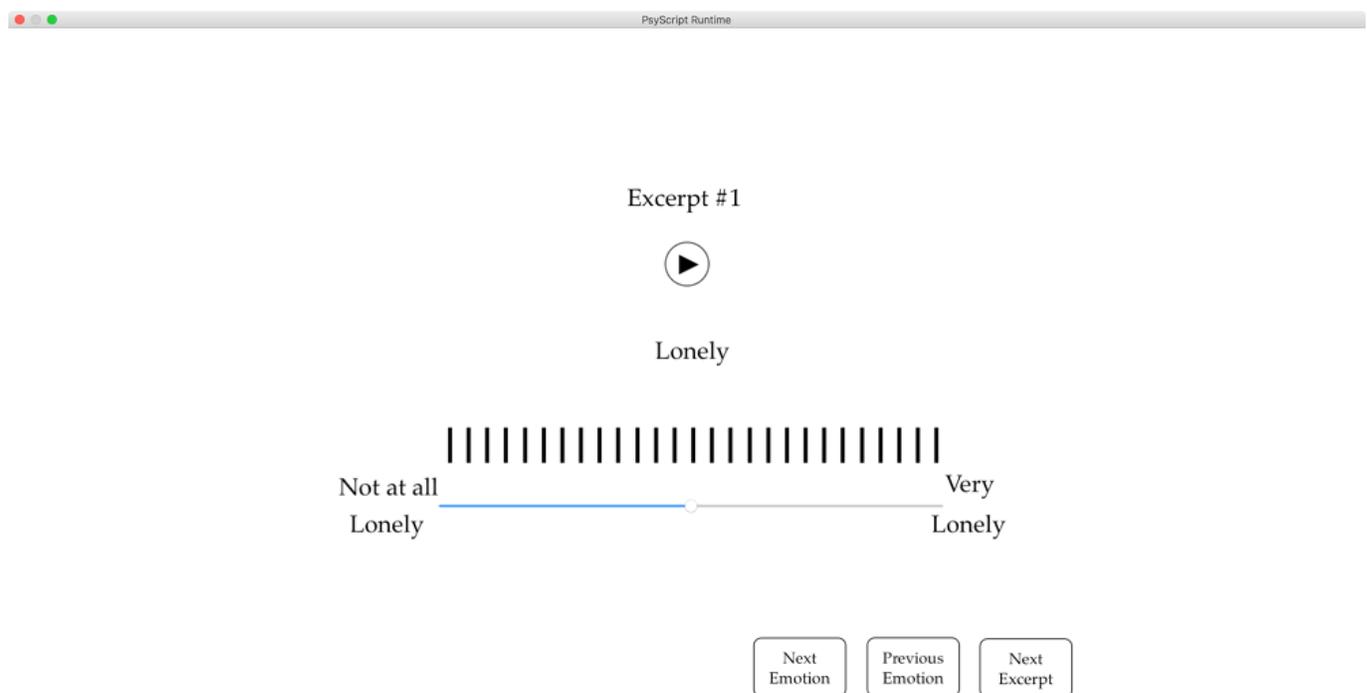
Example 1. Measures 29–44 of Beethoven *Pathétique* Sonata, II

The image displays a musical score for measures 29 through 44 of the second movement of Beethoven's Pathétique Sonata. The score is written for piano and is in the key of B-flat major (three flats) and 2/4 time. It is divided into three systems. The first system (measures 29-36) features a melody in the right hand starting with a piano (*p*) dynamic and a steady eighth-note accompaniment in the left hand. The second system (measures 37-40) shows the right hand playing a series of chords with a *pp* dynamic, while the left hand continues with eighth notes. The third system (measures 41-44) includes a *cresc.* marking, a *sf* dynamic, and a *f p* dynamic with a *decrsc.* marking. The score concludes with a final chord in measure 44.

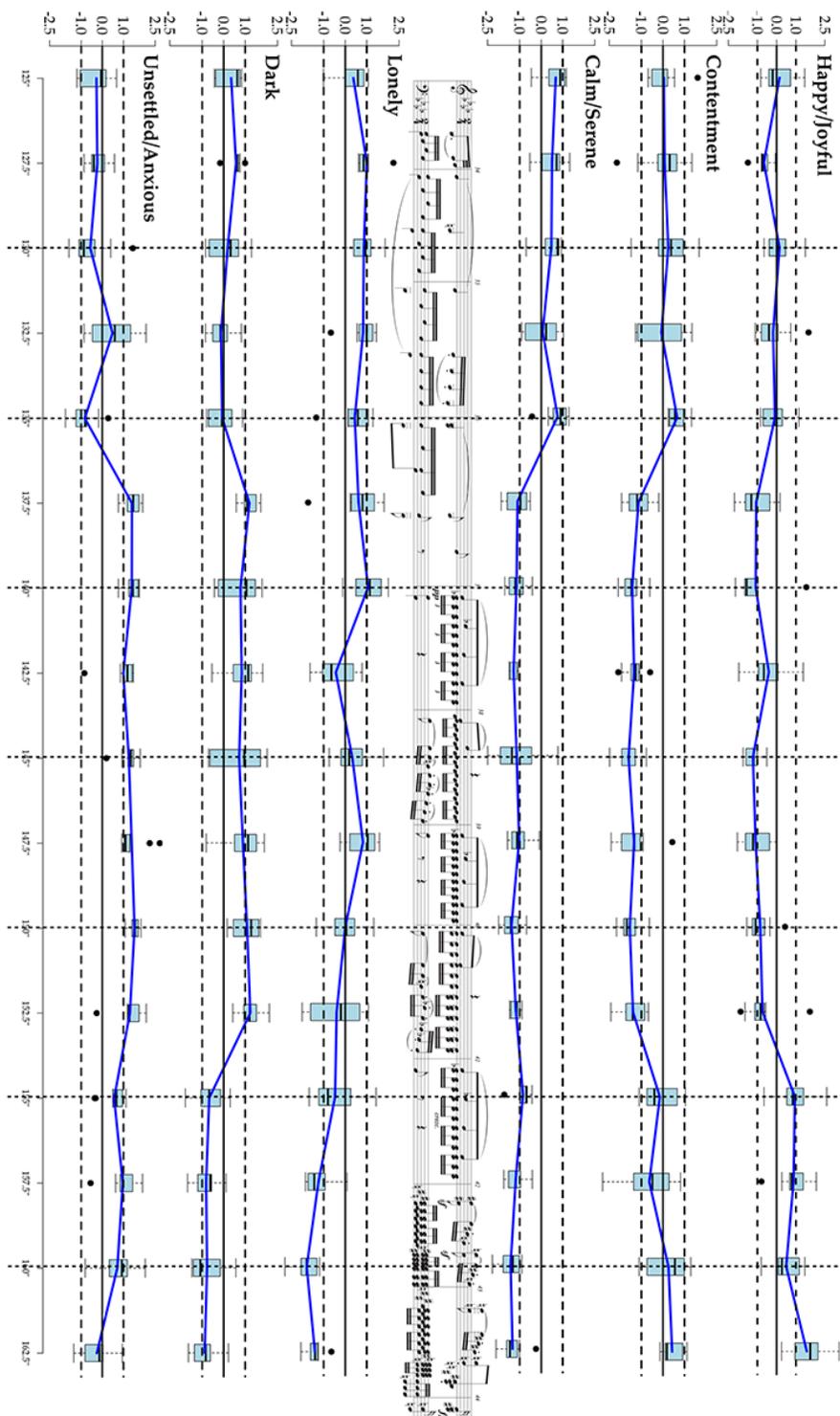
Table 1. Fifteen emotion terms derived from a content analysis of 592 discrete comments (totaling 453 of the 592 comments), along with the number of responses that were classified as belonging to each category in parentheses

Calm/Serene (21)	Emotional/Moody (8)	Striving/Yearning (23)
Carefree (12)	Happy/Joyful (73)	Suspense/Anticipation (55)
Cheeky/Sassy (11)	Important/Serious (35)	Truthful/Serious (20)
Contentment (55)	Lonely (11)	Unsettled/Anxious (46)
Dark (17)	Sad/Depressed/Tragic (48)	Weighty (18)

Example 2. A screenshot of the interface used in the empirical study. Participants listened to each segment first and then adjusted the slider for each of the three emotion categories assigned



Example 3. Expressive analysis of mm. 34–44 of Beethoven’s *Pathétique* Sonata, second movement The dotted lines indicate the five-second segments rated. Data points between the dotted lines represent ratings for segments between the lines. Horizontal lines have been added tracking means across contiguous segments for the purposes of easy comparison only; segments were rated in isolation and not continuously. Data points centered on the lines represent ratings for segments heard between the adjacent data points. Data have been normalized so that ratings are measured in standard deviations away from the mean for that emotion per participant.



Example 4. Average ratings for each of the five statements of the theme for sad/depressed/tragic, carefree, and weighty dimensions averaged over each segment comprising the statement. Circles represent mean ratings, where 0 is average for that dimension, positive numbers represent higher than average ratings, and negative numbers represent lower than average ratings. Bars represent 90% confidence intervals. Theme 1 and Theme 3 are realizations of the same notated music, Theme 2 is up an octave, Theme 4 employs faster rhythms, and Theme 5 combines higher pitches with faster rhythms.

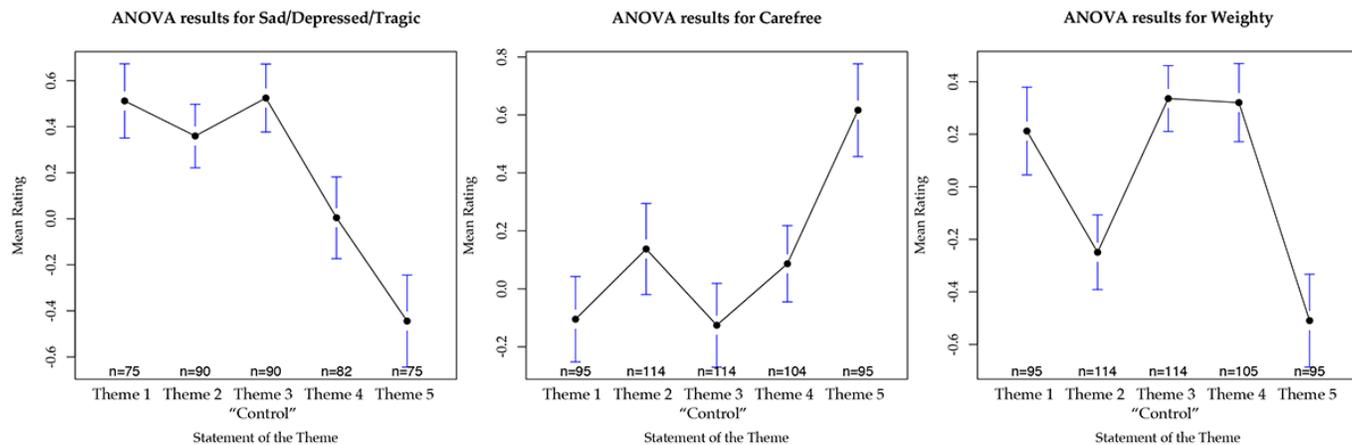


Table 2. Group means (standard deviations) for expressive dimensions averaged over each of the five statements of the theme. Mean ratings for each statement that are significantly different from mean ratings for the same dimension for the initial statement of the theme are marked with *, at $p < 0.1$. In the right-most column, fifth statement mean ratings that are significantly different from fourth statement mean ratings for the same dimensions are marked with §, at $p < 0.1$. These pairwise comparisons were calculated using Tukey’s HSD test, with corrections for multiple tests. Notice that throughout the movement, there is a gradual increase in positive and high-arousal expressive categories and a decrease in negative and low-arousal expressive categories.

Affect	Theme 1	Control (Theme 3)	Theme 2	Theme 4	Theme 5
Calm/Serene	0.630 (0.72)	0.615 (0.67)	0.579 (0.69)	0.311 (0.74)*	0.076 (0.83)*
Carefree	-0.108 (0.75)	-0.126 (0.78)	0.137 (0.85)*	0.086 (0.68)	0.607 (0.76)*§
Contentment	0.547 (0.72)	0.393 (0.78)	0.472 (0.63)	0.122 (0.82)*	0.225 (0.69)*
Dark	-0.012 (0.80)	0.054 (0.77)	-0.472 (0.71)*	-0.093 (0.69)	-0.464 (0.71)*§
Happy/Joyful	-0.171 (0.85)	-0.173 (0.75)	0.298 (0.82)*	0.159 (0.72)*	0.572 (0.71)*§
Lonely	0.568 (0.71)	0.618 (0.73)	0.390 (0.69)	-0.114 (0.76)*	-0.412 (0.76)*§
Sad/ Depressed/ Tragic	0.511 (0.69)	0.524 (0.71)	0.359 (0.66)	-0.004 (0.81)*	-0.465 (0.86)*§
Striving/ Yearning	0.047 (0.77)	0.064 (0.88)	0.164 (0.80)	-0.084 (0.80)	-0.041 (0.90)
Suspense/ Anticipation	-0.282 (0.93)	-0.224 (0.84)	-0.297 (0.84)	-0.142 (0.79)	-0.359 (0.88)
Unsettled/ Anxious	-0.596 (0.72)	-0.536 (0.79)	-0.417 (0.73)	-0.137 (0.76)*	-0.071 (0.77)*
Weighty	0.209 (0.79)	0.336 (0.67)	-0.249 (0.77)*	-0.320 (0.77)	-0.475 (0.87)*§

Table 3. Extreme ratings by formal section. The refrain sections elicit significantly fewer extreme ratings than episode and coda sections, consistent with Meyer, Narmour, and Huron’s hypotheses of increased emotional reaction to unpredictable music

Extreme ratings for refrain passages	Non-refrain passages
Refrain 1 (ms. 1-16): 867 extreme ratings	Episode 1 (ms. 17-28): 1,275 extreme ratings
Refrain 2 (ms. 29-36): 537 extreme ratings	Episode 2 (ms. 37-50): 1,423 extreme ratings
Refrain 3 (ms. 51-66): 858 extreme ratings	Coda (ms. 66-72): 781 extreme ratings
2,262 extreme ratings in 152.5 seconds (14.83 extreme ratings per second)	3,479 extreme ratings in 140 second (24.85 extreme ratings per second)

Example 5. Expressive analysis of measures 20–29 of Beethoven's *Pathétique* Sonata, II

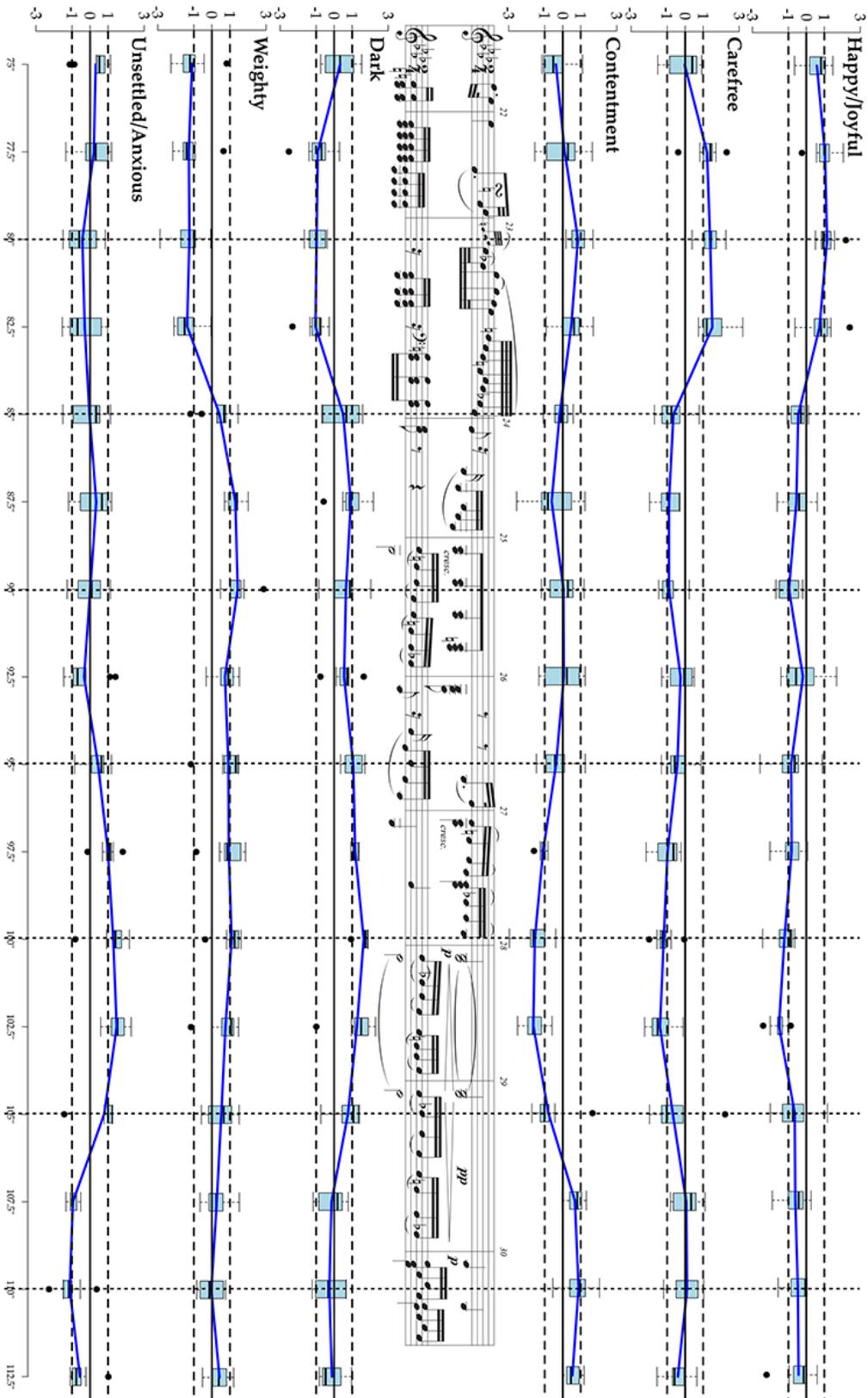


Table 4. The sixteen musical gesture parameters used as measured predictor variables in a regression analysis of the data from the movement. The manner in which each variable was encoded is given in the right column. These parameters were correlated with participant responses of perceived emotional expression for each of the eleven emotion categories to examine interrelationships between musical gestures and perceived emotion.

Regression parameter	Definition
Dynamic level	Performed relative dynamic level: ppp – fff (1 – 8)
Crescendo	Crescendo or Decrescendo: strong dim. – strong cresc. (-2 – 2)
Density	Maximum number of concurrently attacked notes
Surface rhythm	The number of onset moments
Tempo	Performed relative tempo: slow – fast (1 – 5)
Articulation	Performed articulation: legato – staccato (1 – 3)
Pitch height	Two separately encoded values: highest and lowest pitch in semitones
Pitch direction	Primary pitch direction: descending/neutral/ascending (-1/0/1)
Melodic succession	1st-order transition probability: common/neutral/uncommon (-1/0/1)
Tendency tone	Presence of tendency tones: present/absent (1/-1)
Mode	Primarily major or minor harmonies: major/neither/minor (1/0/-1)
Dissonant harmony	Presence of harmonic dissonance beyond major/minor triad (includes chordal 7ths or dissonant triads): triad/non-triad (0/1)
Harmonic succession	1st-order transition probability: common/neutral/uncommon (-1/0/1)
Harmonic tempo	The number of harmonies
Closure/cadence	Presence of cadence: authentic/other/no cadence (2/1/0)

Table 5. Regression models based on the analysis and perceived emotional expression of each five-second segment. Emotional dimensions are shown in the left column. The center column lists the musical parameters that were significantly correlated with the given emotion, along with an indication of the directionality of the effect. The right column displays variance accounted for (technically adjusted R^2), a measure of how much of the variance in listener response can be explained by the musical parameters alone.

Affect	Regression parameters
Calm/ Serene	Legato articulations; Major mode; Faster surface rhythms; Faster harmonic tempo; Lower high pitch; Less dense harmonies; Diminuendo; Common melodic succession; Fewer tendency tones
Carefree	Major mode; Higher highest pitch; Diminuendo; Cadences; Legato articulations; Dissonant harmony; Faster harmonic tempo; Higher lowest pitch; No tendency tones; Faster surface rhythms
Contentment	Major mode; Legato articulations; Faster harmonic tempo; Cadences; Common melodic succession; No tendency tones; Slower surface rhythms
Dark	Minor mode; Lower highest pitch; Slower harmonic tempo; Staccato articulations; No cadence; Lower lowest pitch; Tendency tones; Slower tempo; Uncommon harmonic progressions
Happy/ Joyful	Major mode; Higher highest pitch; Legato articulations; Decrescendo; Faster harmonic tempo; Presence of cadences; Faster surface rhythms
Lonely	Slower surface rhythms; Minor mode; No cadence; Less dense harmonies; Lower highest pitch; Faster tempo
Sad/ Depressed/ Tragic	Minor mode; No cadence; Slower surface rhythm; Lower highest pitch; Faster tempo; Less dense harmonies
Striving/ Yearning	Minor mode; No cadence; Crescendo; Faster tempo; Tendency tones; Lower lowest pitch
Suspense/ Anticipation	Minor mode; Slower harmonic tempo; Faster tempo; Faster surface rhythms; Uncommon melodic succession; Tendency tones; No cadence
Unsettled/ Anxious	Staccato articulations; Faster surface rhythm; Minor mode; More dense harmonies; Slower harmonic tempo; Uncommon melodic succession; More crescendos
Weighty	Lower highest pitch; Lower lowest pitch; Crescendo; No cadence; Tendency tones; Louder dynamic; Minor mode; More dense harmonies

Example A1. Histogram showing intra-participant correlations for each participant-scale. 76 participant-scales had correlations lower than $+0.25$, and so were eliminated from further analysis

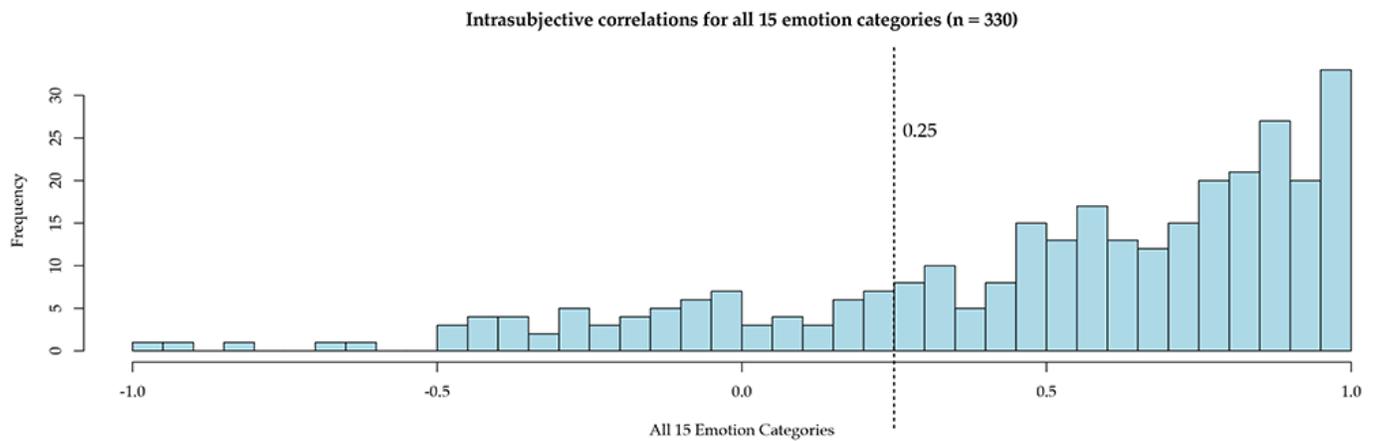


Table A1. Means (standard deviations) of intra-participant reliability for each affective category averaged across participant-scale. Cheeky/sassy was unable to be calculated because of perfect correlations due to consistent 0 ratings

Affect	Correlation Mean (SD)
Weighty	0.814 (0.64)
Contentment	0.810 (0.69)
Unsettled/ Anxious	0.758 (0.67)
Striving/ Yearning	0.732 (0.48)
Important/ Serious	0.729 (0.60)
Suspense/ Anticipation	0.686 (0.77)
Lonely	0.679 (0.65)
Dark	0.637 (0.72)
Carefree	0.632 (0.48)
Calm/ Serene	0.591 (0.62)
Happy/ Joyful	0.586 (0.59)
Sad/ Depressed/ Tragic	0.558 (0.76)
Emotional/ Moody	0.448 (0.61)
Sincerity/ Truthful	0.362 (0.50)
Cheeky/ Sassy	<i>cannot be calculated</i>

Table A2. The mean inter-participant correlations for all participant-scales below +.25 correlation. Participant-scales are labeled by their emotion category,¹ their offset group (0 or 2.5 seconds), and the mean inter-participant correlation

Correlation < +0.1	Correlation < +0.2	Correlation < +0.25
True; 2.5; 0.095	Import; 0; 0.112	Import; 0; 0.249
True; 2.5; 0.001	Import; 2.5; 0.139	Import; 2.5; 0.219
True; 2.5; 0.098	Import; 2.5; 0.172	Import; 2.5; 0.208
Moody; 0; 0.073	True; 0; 0.191	Yearn; 0; 0.219
Joy; 2.5; 0.097	True; 2.5; 0.167	Yearn; 0; 0.206
	True; 2.5; 0.139	Yearn; 0; 0.205
	True; 2.5; 0.153	Yearn; 0; 0.246
	True; 2.5; 0.110	Weight; 0; 0.248
	Yearn; 0; 0.169	Weight; 0; 0.222
	Yearn; 0; 0.142	
	Moody; 0; 0.169	
	Weight; 2.5; 0.194	
	Sad; 0; 0.141	