

What Causes an Emotional Response?

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ABSTRACT

In this report, we research to develop a deeper understanding of the causes behind our emotional responses so that we can learn beneficial strategies for coping with them appropriately. Previous studies show that emotional responses have been found to vary from person to person and reflect involvement in the various daily activities of an individual, such as exposure to the news and listening to music, and can even predict something yet to occur. In our first (correlational) study, we tested the strength of these relationships by examining naturalistic daily changes in their variables longitudinally over a two-week period. We measured exposure to news by rating personal relevance to daily news exposure and induced mood, rated moods after exposure to music, rated uncertainty of each given day, and emotional response levels using a modified version of the Profile Of Mood States (SUM-POMS) scale. Data pooled across participants in our correlational study demonstrated significant correlations of increased emotional response with personal connection to music, personal relevance to news, and to confidence levels in daily events. Based on the strength of the correlation found between personal connection to music and emotional response, we then conducted an experimental study to test for a causal relationship between these two variables. Over a two-week period, we randomly assigned participants each day to either purposefully listen to music that they felt a personal connection to or to listen to no music and measured their emotional response. The results of our experimental study established a causal role of personal connection to music on emotional response. A possible practical application of these findings could be that when feeling overwhelmed by uncertainty and the negative news, listening to music with personal meaning can help us to have more positive emotional responses, and in turn boost our overall mood and sense of well-being.

1. Introduction

1.1 Research Problem

There are various reasons why people experience different emotional responses in their lives and understanding what

contributes to these responses can help us have better insight into ourselves and those around us. In a rapidly changing world, reading too much negative news can cause feelings of anxiety, fear or panic, sometimes leading to larger problems. Certain stimuli, such as music, trigger powerful emotions that completely redirect one's thoughts and

overall emotional state. Sometimes even an imagined outcome will elicit an emotional response, such as fear or excitement, to events that have yet to occur. Emotions can drive or hinder personal growth; by comprehending what causes these emotional responses, we hope to develop strategies to cope with these emotions in order to lead a healthier, more fulfilling life.

1.2 Literature Review

Reading too much negative news can add stress and anxiety to daily life while positive news can add positive feelings; however, personal relevance to issues in the news can be a contributing to how someone reacts, and not everyone is affected equally. Few studies have been done to conclude the impact that news has on our emotions. One of the first of its kind, de Hoog and Verboon conducted a convenience study of 63 willing participants in their neighbourhood in Germany to determine the effects of daily exposure to the news (de Hoog and Verboon, 2020). Using an ecological momentary assessment (EMA), the research was carried out over the course of 10 days, with each participant checking in up to 5 times per day (minimum of 17/50 check ins). It is important to note that the sample used for this study was very limited and does not properly represent the Dutch community involved, or the world, accurately; however, results showed that negative news every day added more negative affect and less positive affect to emotional state. When personal relevance to the news was higher, the participant would be affected more negatively, however personality traits did not seem to have a relevant effect on the results (de Hoog and Verboon, 2020).

Music has been previously found to have connections to causing and changing in

emotional states by activating different sections in the brain. In an experiment by Anne J. Blood and Robert J. Zatorre (2001), McGill University students aged 20 to 30 were told to select a section of a classical piece that had previously given them chills. Each student was connected to a polygraph device in order to record heart rate, electric currents, respiration depth, electrodermal response and skin temperature, as well as undergoing a positron emission tomography (PET) scan to determine activities in the brain. With all equipment hooked up and turned on, each student listened to four sections of music, their selected music, control music, amplitude-matched noise, and silence in no particular order. After each music section, students rated their chills intensity and emotional intensity on a scale of 1 to 10 (10 being most intense) along with unpleasant versus pleasant on a scale from -5 to +5 (+5 being the most pleasant). In the results, Anne J. Blood and Robert J. Zatorre (2001) found changes in brain structure similar to those found with arousal and motor processes more so when the subjects heard their selected music piece compared to the controls. Based on these results, certain music pieces that an individual personally connects with have the ability to cause emotional responses.

When faced with unfamiliar or potentially unpleasant circumstances, our minds will often overestimate the probability of negative outcomes. In an experiment by Dieterich et al. (2016) researchers presented participants with a series of randomly generated images. Each image was preceded by a visual cue, either “O”, “X” or “?”, indicating the emotional nature of the image would be neutral, negative, or uncertain, respectively. After the cue, participants were to indicate their expectation of the type of image to follow, on a scale of 0 – 100 (0 meant the following

image would be neutral, and 100 meant that the following image would be negative). The images were presented in random order, and never more than two of the same valences presented in a row. During the experiment, an EEG was recorded. After the task, participants were then asked to estimate what percentage of the images following the uncertain cue, were of a negative nature, on a scale of 0 – 100. The results showed that despite a true 50% split of neutral and negative images, the participants both over-expected negative images ($M=52.99$, $SD = 6.61$) and overestimated the total recurrence of negative images. The EEG revealed that there was significant increase in amplitudes responding to the uncertain cues. This seems to indicate that in the absence of certainty, our minds will predict the worst. (Dieterich et al., 2016).

1.3 Hypotheses

Based on the above literature review, we predicted the following hypotheses:

- Hypothesis #1: If personal relevance to negative news increases, then emotional response will increase.
- Hypothesis #2: If personal connection to music increases, then emotional response will increase.
- Hypothesis #3: If uncertainty increases, then emotional response will increase.

2. Methods

2.1 Participants

The three authors of this paper served as the participants in its studies. The participants ranged in age from 19 - 33 years old, with an average age of 26.33 years, and included three females. The participants

were all undergraduate students at Camosun College who completed the current studies as an assignment for Psyc 110 (“Experimental Psychology”) and were grouped together due to their mutual interest in emotions.

2.2 Materials and Procedure

2.2.1 Correlational Study Methods

We first performed a correlational study to test concurrently all of our hypotheses by examining naturalistic daily changes in their variables longitudinally. Each participant kept a study journal with them at all times over this study’s two-week period in order to record self-observations of the following four variables: (1) amount of news exposure, (2) personal connection to music, (3) uncertainty throughout daily events, and (4) emotional response levels.

To measure the amount of news exposure, each participant recorded each time they were exposed to the news, their personal relevance to said exposure on a scale of 0 - 100, and their emotional response to that news. The following response anchors were used on the personal relevance scale: 0 = no personal relevance, 25 = little personal relevance, 50 = some personal relevance, 75 = quite personally relevant, 100 = entirely personally relevant.

To measure the personal connection to music, each participant noted each time they heard or listened to music and rated their personal connection to this music on a scale of 1 -10, 1 = not at all, 5 = somewhat, 10 = strong.

To measure uncertainty through daily events, participants rated how confident they were in the upcoming events of the day. Participants recorded their confidence in their study journals upon waking using a scale of 0 - 10. On this scale, 0 = not at all

confident, 5 = somewhat confident, and 10 = completely confident.

To measure emotional response levels, each participant rated how they felt using the Shortened Unidirectional Multifaceted version of the Profile of Mood States (SUM-POMS) Scale. Participants indicated how they felt from a list of eight basic emotions: Sadness, Anxiety, Anger, Tiredness, Confusion, Joy, Contentment, Love, Energy, or Acuity. Each emotion was rated on a scale of 0 - 100 to indicate the intensity of the emotion felt: 0 = not at all, 25 = a little, 50 = moderately, 75 = quite a lot, 100 = extremely. Participants also rated their overall mood/valence on a scale of -100 to 100: -100 = extremely unpleasant, -50 = moderately unpleasant, 0 = neutral, 50 moderately pleasant, and 100 = extremely pleasant.

To assess the strength and statistical significance of associations between variables predicted by our three hypotheses, we performed Pearson product moment correlations of their predictor variables (amount of news exposure, personal connection to music, uncertainty throughout daily events) with their outcome variable (emotional response levels). For testing Hypothesis #1, we correlated the amount of news participants were exposed to each day and it's personal relevance to them, with their emotional response to the news. For testing Hypothesis #2, we correlated the participants' personal connection to music with the impact each song had on their emotional response. For testing Hypothesis #3, we correlated the daily measure of confidence in daily events of each participant with their emotional response. We performed all of the above correlations separately for each participant as well as using data pooled across all of the participants. For the correlations using pooled data, in addition to using the raw

data, we also performed correlations after we had first transformed the data from each participant into z-scores in order to standardize differences in averages and variability seen between the participants in their data and thus make them more comparable. A correlation coefficient was considered statistically significant if the probability of its random occurrence (p) was $< .05$ (i.e., less than 5% of the time expected by chance alone).

2.2.2 Experimental Study Methods

Based on the strong correlation of personal connection to music and emotional response demonstrated by our correlational study, we have selected the variables from Hypothesis #2 for an experimental study of their casual relationship.

We manipulated the independent variable, personal connection, by randomizing each participant's exposure to music with which they have an emotional connection over a two-week period. On experimental days, participants spent 30 minutes purposefully listened to music that they felt a personal connection to. On control days, the participant did not purposefully listen to music they had a personal connection to, rather, they were subject to any music that they had heard randomly throughout the day, or none at all.

To avoid order effects, we randomly assigned each day of the experiment to either be experimental or control days. Each participant flipped a coin each day, heads meant an experimental day, and tails meant a control day, allowing for a 50% chance each day. In order to include an objective evaluation, each participant enlisted a friend/relative who lived with them to act as a blind assistant. The assistant was unaware of the parameters of the experiment, or whether the participant had or had not purposefully listened to music that day. The

assistant recorded their observations of the participant's emotional state each day of the two-week period but did not inform the participant when they did so. The participants also recorded their emotional response on both experimental and control days. These ratings were reported on the same scales and with the same procedures as described in the above correlational study.

To assess the statistical significance of differences seen in emotional response on exposure to music with which participants felt a personal connection, experimental days vs. no exposure to music with personal connection control days, Student's *t*-tests were performed. We performed *t*-tests separately for each participant as well as using data pooled across all participants. For the *t*-tests using pooled data, in addition to using the raw data, we also performed *t*-tests after we had first transformed the data from each participant into *z*-scores in order to standardize differences in averages and variability seen between the participants in their data and thus make them more comparable. An average difference between conditions was considered statistically significant if, using a two-tailed distribution (i.e., allowing this difference to be positive or negative), the probability of its random occurrence (*p*) was $< .05$ (i.e., less than 5% of the time expected by chance alone).

3. Results

3.1 Correlational Study Results

Table 1 illustrates the significant correlation of personal relevance of news, personal connection to music, and confidence in upcoming events with emotional response. Although only statistically significant for two of the three participants (one participant had $r \leq -0.31$, and $p \geq 0.29$), confidence in upcoming

events showed a strong correlation with emotional response using both the pooled raw data ($r = -0.44$, $p = 0.0029$; see Figure 3) as well as the pooled standardized data ($r = -0.55$, $p = 0.0002$). Both personal connection to music and personal relevance to news showed statistical significance for all three participants individually, and were significantly correlated using the pooled raw data, with personal connection to music (all $r > .89$, $p > 1.84$) and personal relevance to news ($r > .67$, $p > 0.0054$). Based on our observations, personal connection to music appears to have the most significant correlation with emotional response.

Table 1 also illustrates the significance of the correlations between personal connection to music and confidence in upcoming events with mood. In confidence in upcoming events, all of the participants showed statistical significance, and a strong correlation with overall mood appeared through the use of pooled raw data ($r = .77$, $p = 2.98$); see Figure 6) and pooled standardized data ($r = .77$, $p = 1.33$). Similarly, personal connection to music was statistically significant across all participants, and using pooled raw data ($r = .83$, $p = 2.35$) On the other hand, personal relevance of news showed no statistical significance with mood using any single participant's data (all $r \leq -.42$, and $p \geq .1414$), pooled raw data ($r = -.01$, $p = 0.9584$; see Figure 4), or pooled standardized data ($r = -.16$, $p = .3457$). When comparing the correlation coefficients including pooled raw data or pooled standardized data, personal connection to music had the strongest correlation to mood.

3.2 Experimental Study Results

As seen in Table 2, significant differences were found in emotional response levels for personal connection to

music. Statistically significant differences between these conditions were seen in two of three participant's data (both $p < .05$), as well as with raw data pooled ($p = 2.35E-13$) (see Figure 7) and pooled standardized data ($p = 8.07E-06$).

As seen in Table 3, significant differences were also found in the blind observations of one participant's emotional response level on experimental vs. control days. However, the pooled raw data and pooled standardized data from these observations across participants were not statistically significant.

4. Discussion

4.1 Summary of Results

The results of previous studies led us to hypothesize that the increase of personal relevance to news (Hypothesis #1), personal connection to music (Hypothesis #2), and uncertainty (Hypothesis #3) will produce an increase in emotional response. The data pooled in the correlational study for each participant confirmed our predictions that an increase in emotional response will result from the increase in personal relevance to news, personal connection to music, and uncertainty (Hypothesis #1, 2, &3).

4.2 Relation of Results to Past Research

The strong relationship found between emotional response and personal relevance to news in our correlational study is consistent with the research conducted by de Hoog and Verboon (2020) in their previous study. Their research showed that reading negative news can create a negative emotional response while positive news can create a positive emotional response; however personal relevance to the news played a significant role in the level of

emotional response felt. de Hoog and Verboon (2020) based their results off of a mixed group of males and females ranging from 18 to 82 who were selected using advertisements in the researchers' social neighbourhood while we assessed the results based off of only female college students. The previous study only included data from participants who checked in at least five times a day, while our research demonstrated emotional response based on normal daily exposure with no set minimum. The similarities in these two studies suggests that a general relationship exists between personal relevance to news and the intensity of the emotional response.

Our correlational study supports the results of previous studies relating emotional response to a personal connection to music. The 2001 study by Blood and Zatorre found an increase in reported emotional intensity and pleasantness when subjects were exposed to their selected music with which they felt an emotional response. The study by Blood and Zatorre (2001) measured physical responses and reactions within the brain as well as self-reported emotions and emotional intensity, while our study focused solely on self-reported emotions and emotional intensity ratings. The results of our correlational study show a resemblance to that of the study by Blood and Zatorre (2001) regardless of the measurements selected, therefore, there is a strong relationship between personal connection to music and emotional response. Our correlational study allowed for each participant's exposure to random and naturally occurring music while our experimental study specifically allowed for each participant to actively listen to music that they had a connection to or not actively listen to music, depending on the day. However, participants may have encountered other circumstances that

affected their emotional response. We recommend that future studies test our theory in an environment that controls confounding variables that could potentially influence the participant's emotional response.

The findings of our correlational study on the relationship between uncertainty of future events and emotional response demonstrates consistency with the research done by Dieterich et al. (2016). Though Dieterich et al. (2016) had participants in a lab setting predict the nature of an upcoming image when there was an equal chance it could be neutral or aversive, and indicate their personal emotional response to that prediction and the actual image, our research methods measured emotional response in relation to the potential certainty or uncertainty in the events of our upcoming days. Despite using different methods to study the correlation between uncertainty and emotions, both studies demonstrated an increased emotional response as certainty (confidence) decreased, suggesting that a relationship exists between these variables.

4.3 Implications of Results

A possible practical application of these current findings could be that when feeling overwhelmed by uncertainty and the negative news, listening to music one connects with can help to experience more positive emotional responses, and in turn boost overall mood and sense of well-being.

We originally conducted the current studies to understand what causes our

emotional responses and potentially develop strategies to cope with these emotions, leading to healthier, more fulfilling lives. Fortunately, our findings suggest that listening to music one has an emotional connection to can be an effective strategy for reorienting perceived unpleasant emotions, and possibly contribute to a sense of control over emotional response. This understanding of our emotional responses can be an initial step towards better emotional health, control, and well-being.

References

- Blood, A. J., & Zatorre, R. J. (2001). Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. *Proceedings of the National Academy of Sciences*, 98(20), 11818-11823. <https://www.pnas.org/content/98/20/11818.short>
- de Hoog, N., & Verboon, P. (2020). Is the news making us unhappy? The influence of daily news exposure on emotional states. *British Journal of Psychology*, 111(2), 157-173. <https://onlinelibrary.wiley.com/doi/epdf/10.1111/bjop.12389>
- Dieterich, R., Endrass, T., & Kathmann, N. (2016). Uncertainty is associated with increased selective attention and sustained stimulus processing. *Cognitive, Affective, & Behavioral Neuroscience*, 16(3), 447-456.

Table 1

Correlation coefficient (r) values, with number of daily trials (n) per correlation in brackets.

Variables correlated	Participant #1	Participant #2	Participant #3	Pooled raw data	Pooled standardized data
Personal relevance to news & emotional response	.67(15)*	.97(10)*	.88(14)*	.83(39)*	.82(39)*
Personal connection to music & emotional response	.89(14)*	.95(13)*	.95(14)*	.93(41)*	.93(41)*
Confidence in daily events & emotional response	-.55(14)*	-.31(14)	-.73(14)*	-0.44(42)*	-0.53(42)*
Personal relevance to news & mood	.09(15)	-.17(10)	-.42(14)	-.01(39)	-.16(39)
Personal connection to music & mood	.79(14)	.79(13)	.88(14)*	.83(41)*	.82(41)*
Confidence in daily events & mood	.06(14)*	.76(14)*	.94(14)*	.77(42)*	.77(42)*

* $p < .05$.

Table 2

Descriptive statistics on self-reported emotional response for purposeful listening to music condition and no purposeful listening to music condition.

Condition	Statistic	Participant #1	Participant #2	Participant #3	Pooled raw data	Pooled standardized data
Purposeful listening to music	Mean	78.00*	78.13	65.00*	73.95*	0.65*
	S.D.	11.51	12.8	10.95	12.86	0.61
	<i>n</i>	5	8	6	19	19
No purposeful listening to music	Mean	50.56	59.71	37.5	48.26	-0.54
	S.D.	19.44	19.60	16.90	19.81	0.89
	<i>n</i>	9	6	8	23	23

Emotional response was measured on a scale of 0 – 100 scale of emotion intensity, 0 = none,

50 = moderately intense, 100 = extremely intense

* $p < .05$ for comparison of listening condition with its respective no listening condition.

Table 3

Descriptive statistics on observed emotional response for purposeful listening to music condition and no purposeful listening to music condition.

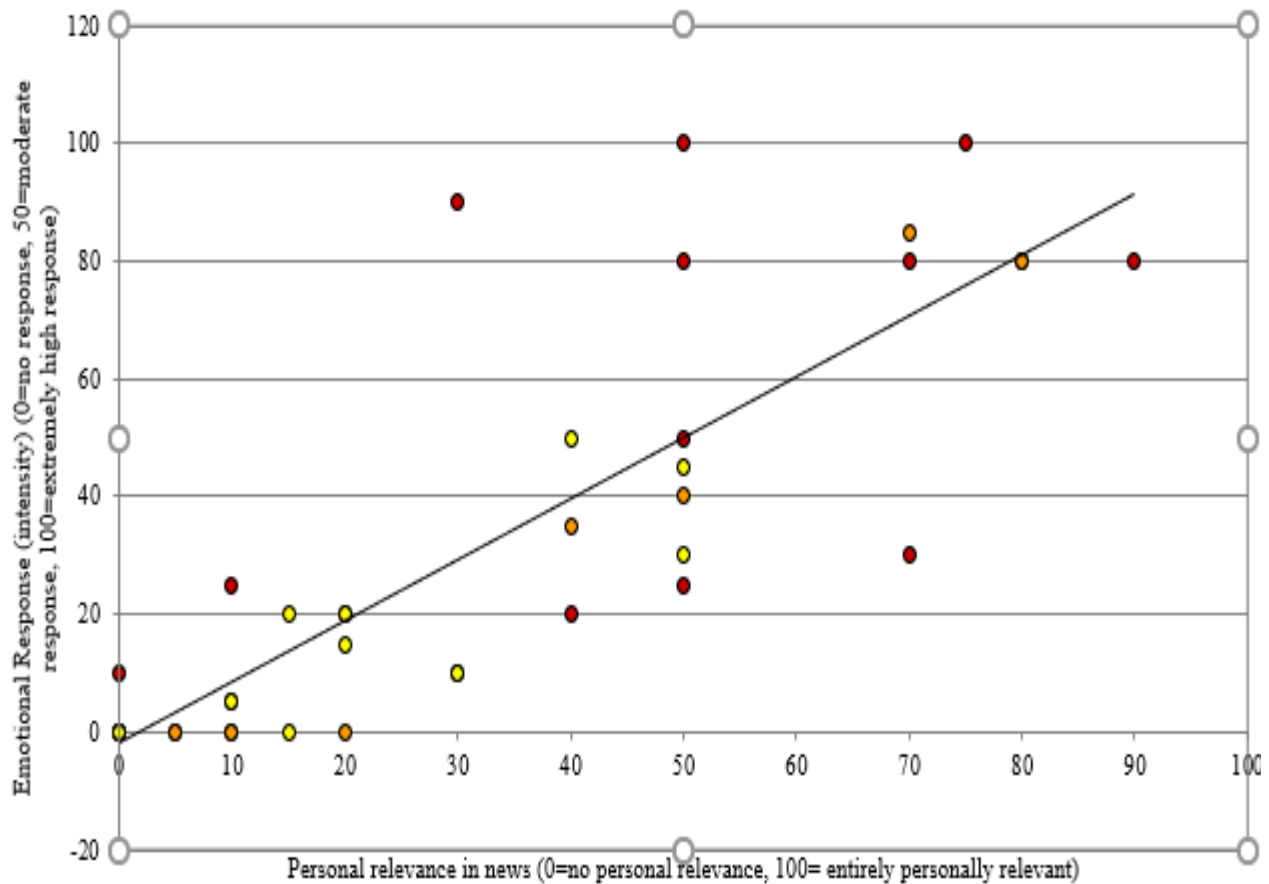
Condition	Statistic	Blind Participant #1	Blind Participant #2	Blind Participant #3	Pooled raw data	Pooled standardized data
[Purposeful listening to music]	Mean	55.00	72.13	73.33*	68.00	0.31
	S.D.	22.18	8.81	9.83	15.51	0.81
	<i>n</i>	5	8	6	19	19
[No purposeful listening to music]	Mean	66.67	59.17	48.75	58.48	-0.26
	S.D.	22.08	18.28	15.98	19.91	1.74
	<i>n</i>	9	6	8	23	23

Observed emotional response was measured on a scale of 0 – 100 scale of emotion intensity, 0 = none, 50 = moderately intense, 100 = extremely intense

* $p < .05$ for comparison of listening condition with its respective no listening condition.

Figure 1

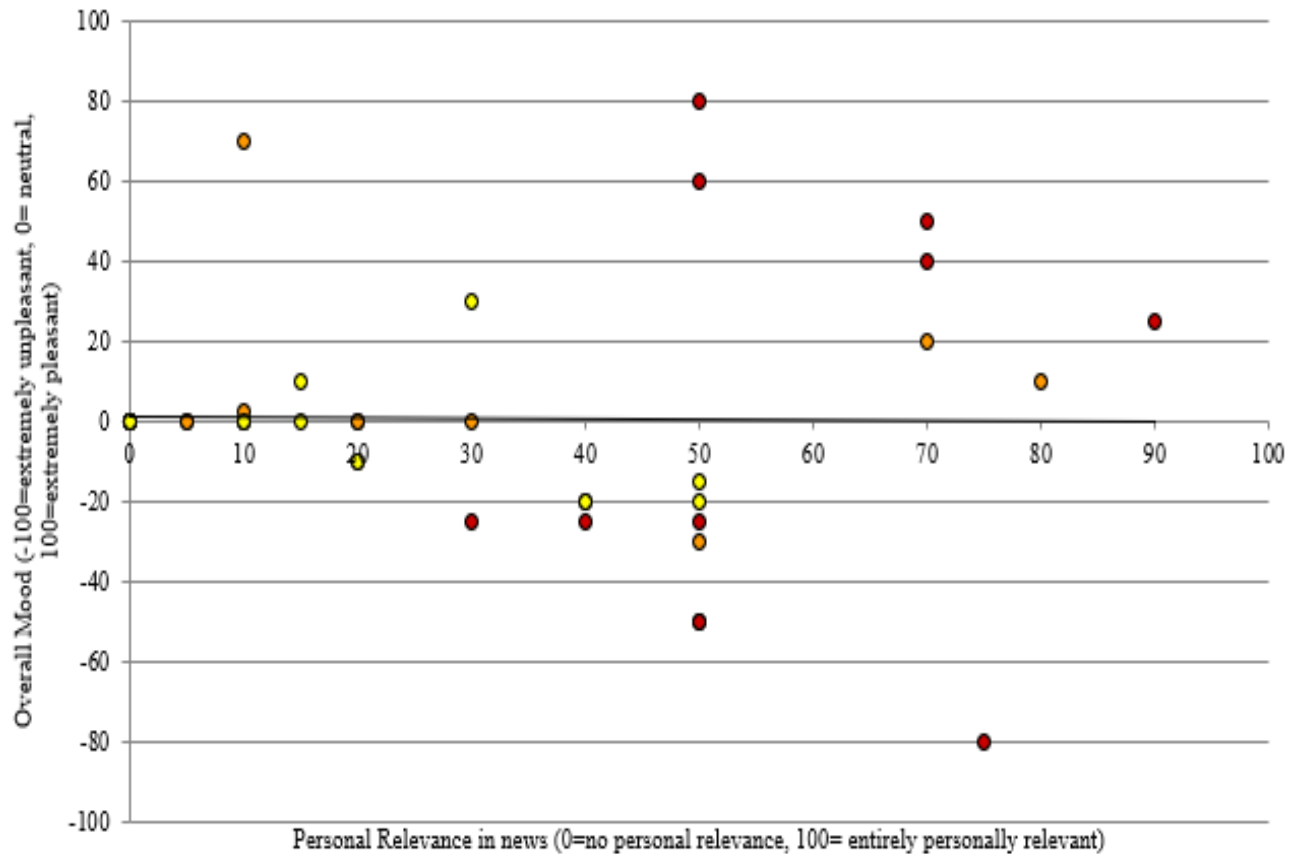
Scatterplot of personal relevance of news and emotional response using pooled raw data across participants



Marker color indicates participant: participant #1= red, participant #2= orange, and participant #3= yellow. Some data might not be visible in the figure due to overlapping markers.

Figure 2

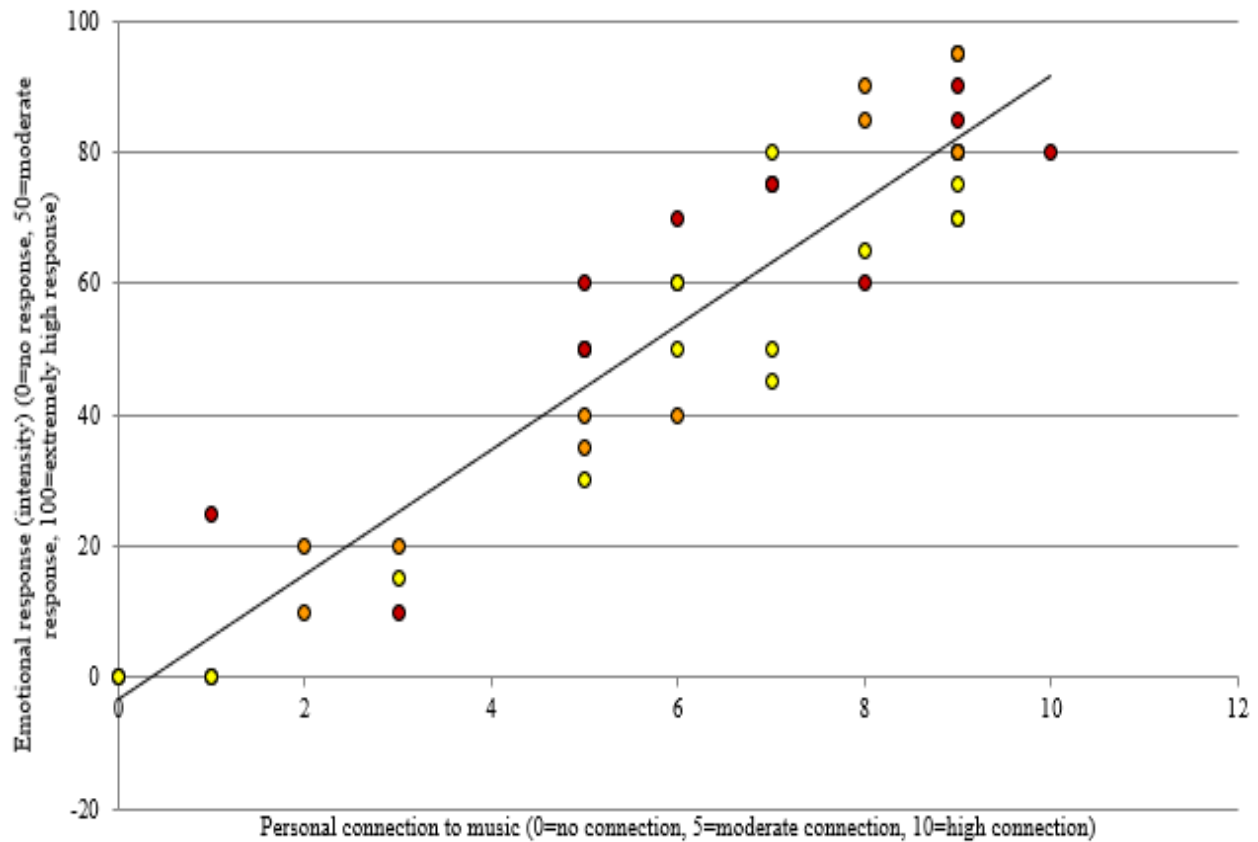
Scatterplot of personal relevance of news and overall mood using pooled raw data across participants



Marker color indicates participant: participant #1= red, participant #2= orange, and participant #3= yellow. Some data might not be visible in the figure due to overlapping markers.

Figure 3

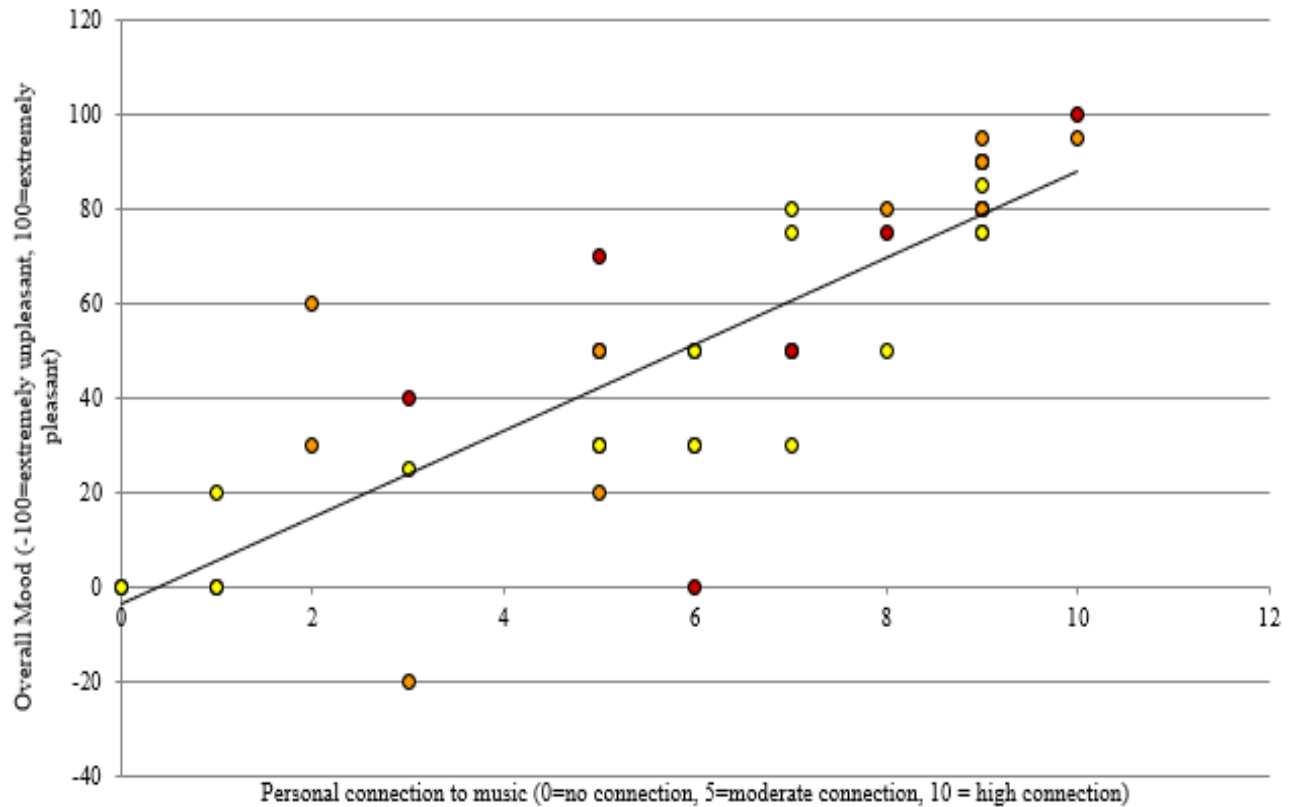
Scatterplot of personal connection to music and emotional response using pooled raw data across participants



Marker color indicates participant: participant #1= red, participant #2= orange, and participant #3= yellow. Some data might not be visible in the figure due to overlapping markers.

Figure 4

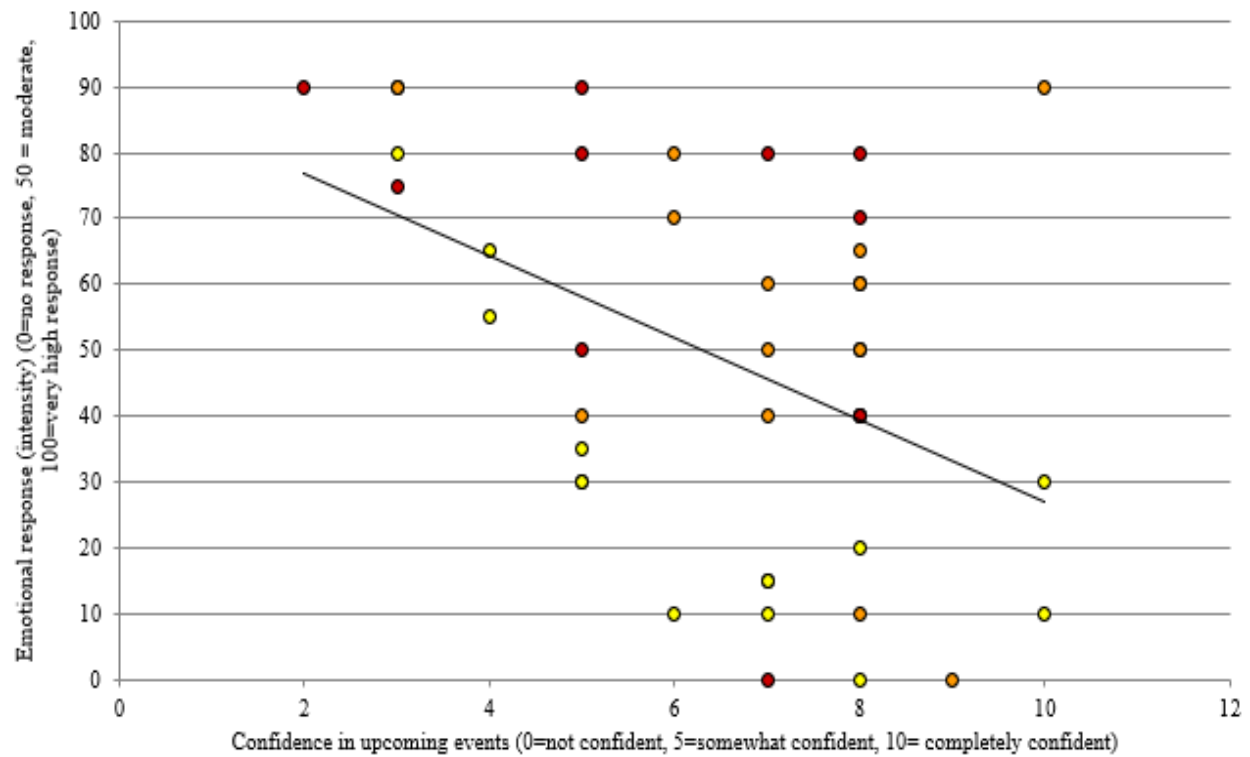
Scatterplot of personal connection to music and overall mood using raw pooled data across participants



Marker color indicates participant: participant #1= red, participant #2= orange, and participant #3= yellow. Some data might not be visible in the figure due to overlapping markers.

Figure 5

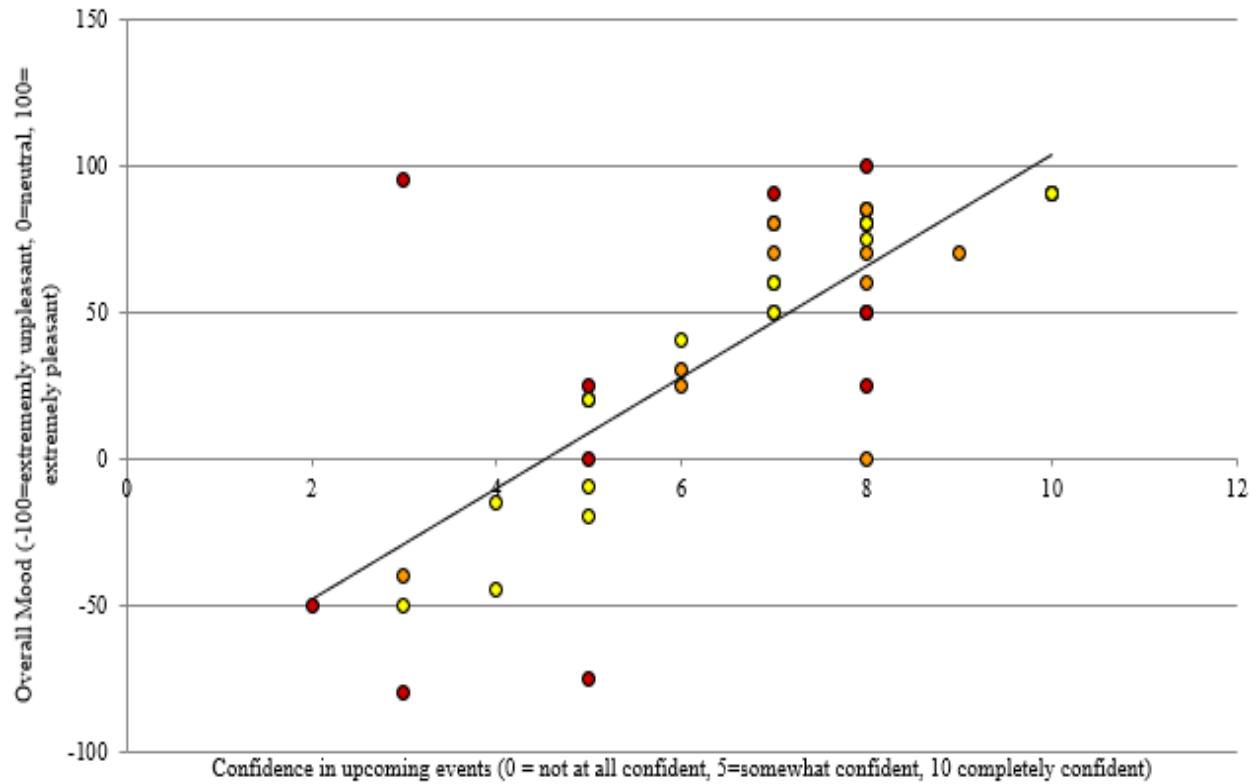
Scatterplot of confidence and emotional response using pooled raw data across participants



Marker color indicates participant: participant #1= red, participant #2= orange, and participant #3= yellow. Some data might not be visible in the figure due to overlapping markers.

Figure 6

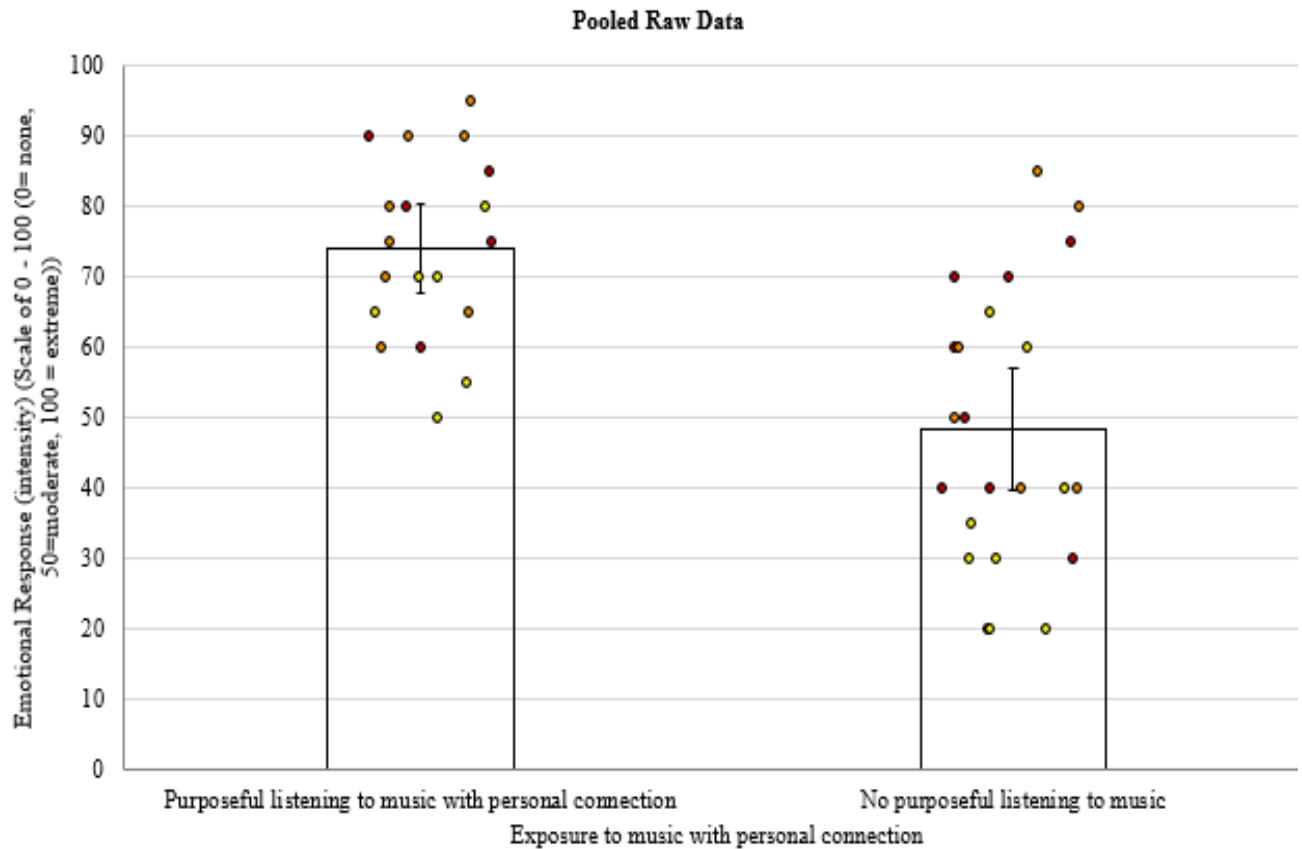
Scatterplot of confidence and overall mood using pooled raw data across participants



Marker color indicates participant: participant #1= red, participant #2= orange, and participant #3= yellow. Some data might not be visible in the figure due to overlapping markers.

Figure 7

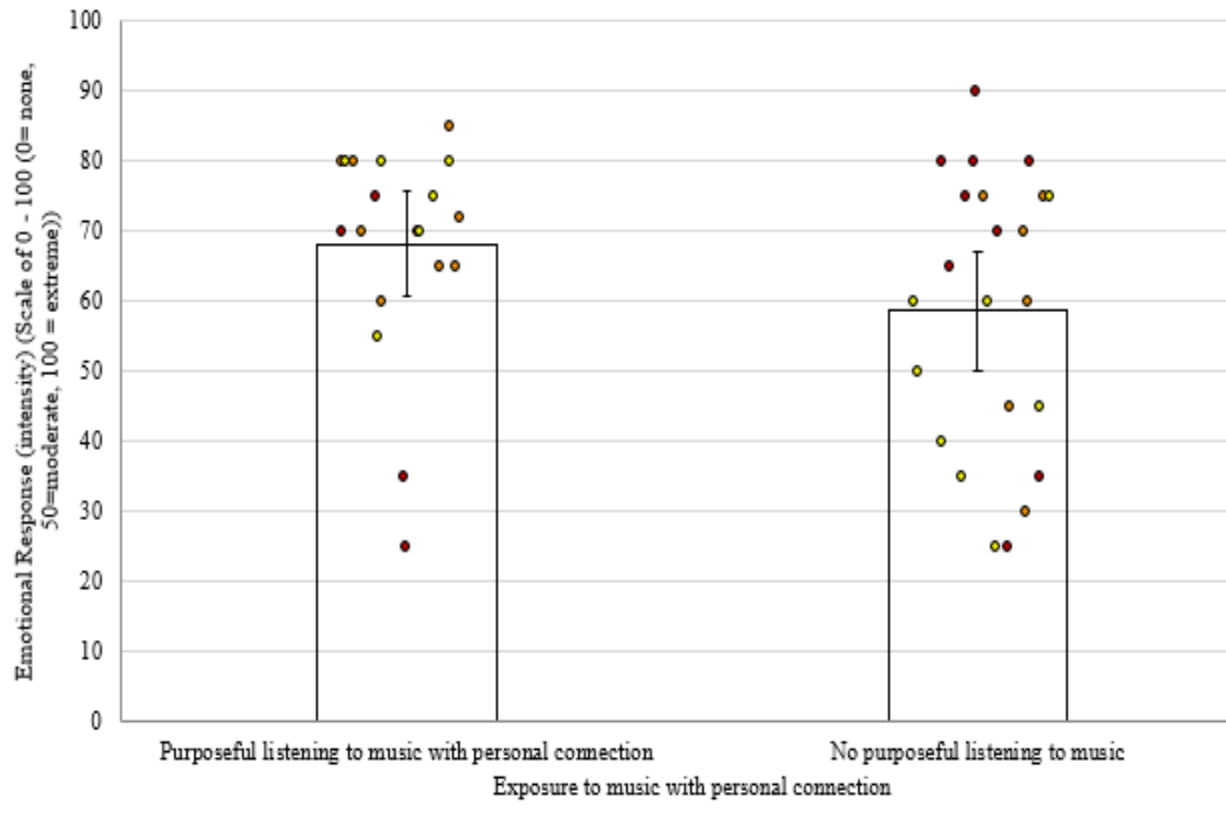
Bar graph of average self-reported emotional response across purposeful listening to music condition and no purposeful listening to music condition using pooled raw data from participants, with error bars showing $\pm 95\%$ confidence levels, and with an overlapping scatterplot of data from each participant.



Marker color indicates participant: participant #1= red, participant #2= orange, and participant #3= yellow.

Figure 8

Bar graph of average observed emotional response across purposeful listening to music condition and no purposeful listening to music condition using pooled raw data from blind participants, with error bars showing $\pm 95\%$ confidence levels, and with an overlapping scatterplot of data from each blind participant.



Marker color indicates participant: blind participant #1= red, blind participant #2= orange, and blind participant #3= yellow.

Appendix

The Shortened Unidirectional but Multifaceted version of the Profile Of Mood States (SUM-POMS) Scale

by Dr. Michael Pollock, Camosun Psychology

Part A. – Individual Negative & Positive Moods

Using the 0 to 100 range scale shown below, for each of the following moods indicate HOW MUCH YOU ARE FEELING THEM RIGHT NOW.

0	25	50	75	100
Not at all	A little	Moderately	Quite a lot	Extremely

Negative Moods

MOOD SCORE

Sadness _____

Adjectives: *Depressed, Unhappy, Blue, Hopeless, Miserable, Helpless, Worthless, and Sad*

Anxiety _____

Positive Moods

MOOD SCORE

Joy _____

Adjectives: *Elevated, Optimistic, Cheerful, Euphoric, and Joyful*

Contentment _____

Adjectives: *Tense, On Edge, Uneasy, Restless, Nervous, and Anxious*

Anger _____

Adjectives: *Peeved, Grouchy, Annoyed, Resentful, Bitter, Hostile, Furious, and Angry*

Tiredness _____

Adjectives: *Worn Out, Fatigued, Exhausted, Weary, Bushed, and Tired*

Confusion _____

Adjectives: *Unable to Concentrate, Bewildered, Forgetful, Uncertain About Things, and Confused*

Adjectives: *At Peace, Satisfied, Fulfilled, Relaxed, and Contented*

Love _____

Adjectives: *Fond, Adoring, Affectionate, Tender, Warm-hearted, and Loving*

Energy _____

Adjectives: *Lively, Active, Full of Pep, Vigorous, and Energetic*

Acuity _____

Adjectives: *Mentally Sharp, Focused, Clear Headed, Efficient, Perceptive, Insightful, and Acute*

Part B. – Overall Mood/Valence

Using the -100 to 100 range scale shown below, indicate OVERALL HOW YOU ARE
FEELING RIGHT NOW.

-100	-50	0	50	100
Extremely Unpleasant	Moderately Unpleasant	Neutral	Moderately Pleasant	Extremely Pleasant

Overall Mood Score: _____