DOES EMOTION PERCEPTION IN MUSIC AND SPEECH PROSODY SHOW A NEGATIVE BIAS? A NEURAL OSCILLATION INVESTIGATION

by

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ABSTRACT

Previous research has shown that the emotional perception of language and the emotional perception of music show some neural relation. Studies focusing on emotional musical primes and the emotional interpretation of spoken words, visually presented words, and complex photos have found evidence of negative bias. Negative bias is the tendency to "attend to, learn from, and use negative information far more than positive information" (Vaish et al., 2008, p.383). In the present study, we utilized electroencephalogram oscillatory activity to determine the presence of negativity bias when assigning emotion to speech prosody after an emotional musical prime. We analyzed data from a study in which EEG oscillations and frontal asymmetry of participants were recorded while they were presented with pairs of emotional musical prime stimuli and target nonsense words spoken with either happy or sad intonation. These pairs were either matched or mismatched in emotional valence. Participants were asked to ignore the musical prime and judge only the emotional valence of the speaker's voice in the target nonsense words. Mean EEG alpha band power, frontal alpha asymmetry, and individual alpha peak frequencies were measured. These measures were examined to determine attention devoted to negative stimuli and whether these attentional changes were indicative of negative bias.

Results showed a significant decrease in mean alpha power when happy target words followed a sad musical prime, but no significant decrease when sad target words followed a happy musical prime. This provides evidence of negative bias in the processing of the emotion of music and language.

Keywords: alpha oscillation, EEG, negative bias, emotion, music, language

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CHAPTER I

Introduction

Music and language are primary methods of relaying meaningful and emotional information in all cultures (Patel, 2008). Over three decades of research suggests that the way information is deciphered in these two communication systems relies on partially overlapping neural responses (Brown, Martinez, & Parsons, 2006). Similarly, semantic analysis of words has been shown to be equally affected by linguistic and musical primes (Koelsch et al., 2004). Research points to overlapping neurocognitive systems for emotional processing as well. For instance, analysis of the emotional valence of musical and spoken phrases is reflected by similar early brain responses (Juslin & Laukka, 2003). In fact, the timbre of musical instruments has even been shown to convey emotion in a manner that mimics the emotional prosody of speech (Liu, Xu, Alter, & Tuomainen, 2018).

These findings reveal the multitude of similarities between music and speech when it comes to conveying emotional information. In this study, we further investigated emotional processing in music and language by examining how music emotion influences the subsequent processing of spoken language words spoken with either a positive or negative affect.

Music, Speech and Emotion

Linguistic processing was once thought to take place in its own totally separate and proprietary regions of the brain (Zatorre, Evans, Meyer, & Gjedde, 1992). Recent studies have shown that this idea of exclusive processing areas is indeed untrue. On the contrary, musical and linguistic processing occur simultaneously in several brain regions, including those that delineate general emotional context (Pinheiro, Vasconcelos, Dias, Arrais, & Gonçalves, 2015).

Koelsch (2010) showed that listening to music affects both the limbic and paralimbic structures in the brain. These structures, which include the hippocampus, the amygdala, the orbitofrontal cortex, and more, are integral in the function of general emotional processing, not just the processing attributed to music. In fact, listening to immensely pleasurable music actually stimulates dopaminergic activity in the nucleus accumbens, which also accompanies the consumption of enjoyable food, sex, and drugs (Blood & Zatorre, 2001).

More recent neuroscientific findings on the processing of syntax have shown that emotions induced specifically by hearing music are only partially contained to brain areas unique to music processing. More specifically, when an emotion is unexpected, as in the case of determining that the emotion of a target differs from the emotion of a prime, the processing takes place, in large part, outside of those brain regions specific to music processing (Marin & Bhattacharya, 2010). Individuals with impaired musical pitch perception also demonstrate a deficit in speech intelligibility (Liu, Jiang, Wang, Xu, & Patel, 2015).

In a 2013 study, Lense, Gordon, Key, & Dykens found that the emotional processing of musical excerpts showed a priming effect on the perception of emotions of facial expressions seen after hearing the music. The emotional context of the music affected the participants' perception of the emotions expressed on the faces they were subsequently shown, even after having been told to ignore the music and focus only on the facial expressions.

The use of sounds with pleasant or unpleasant valence as primes has also been shown to produce a cross modal priming effect on the emotional processing of target words (Scherer & Larsen, 2011). In this study as well as many others, the influence of negative emotional primes outweighed the influence of positive emotional primes. This reflects the framework for negative bias.

Negative Bias Hypothesis

The expression of emotion in speech enables a communicator to relay important information without necessarily speaking that information aloud. The information conveyed by the emotion of the speech can alert the recipients to behave in a certain manner. If, for instance, the emotion is fear, those receiving the communication are alerted to the potential imminent danger. If the emotion is playful, the recipient prepares to either reciprocate or deflect the oncoming actions (Juslin & Laukka, 2003).

Baumeister et al. (2001) proposed that it is likely beneficial for humans and animals to devote more of their attention to negative information because it signals a need for change. In support of this hypothesis, it has been shown that the brain regions associated with the emotional processing of both negative and positive music have found that negative emotional responses are particularly likely to activate brain regions associated with memory and attention (Blood, Zatorre, Bermudez, & Evans, 1999). The case for negative bias may be most strongly posed as a matter of evolutionary necessity. Negative sounds, experiences, and events signal humans that there may be something dangerous, or at the least, threatening at hand. This typically requires some type of action or change on the part of the individual processing this negativity.

While there is converging evidence supporting the negative bias hypothesis, it is important to note that there also exists a positivity bias. This is defined as faster processing of stimuli with positive emotional connotation (Leppänen, Tenhunen, & Hietanen, 2003). Evidence in favor of the positivity bias has been found when participants are asked to classify the emotion of facial features (Leppänen & Hietanen, 2003), as well as when they are asked to categorize the emotion of words (Stenberg, Wiking, & Dahl, 1998). Recent findings suggest that this discrepancy reflect individual differences. For instance, it has been found that individuals with more advanced cognitive abilities and emotion regulation demonstrate a positive, rather than a negative, bias when tested on positively and negatively emotive words (Taroyan, Butnicu, Ypsilanti, & Overton, 2020).

Present Study

Because they require an inverse measure, alpha oscillations produce an event-related decrease in band power, meaning that more activity is represented by a reduction in alpha band power (Klimesch, 2018). In this study, we conducted pairwise comparisons of sad music followed by happy prosody and happy music followed by happy prosody and of happy music followed by sad prosody and sad music followed by sad prosody. We compared the measured levels of alpha band power. The attention required to correctly identify the emotion of stimuli following either a happy or sad musical prime is reflected in reduced alpha band power. This served as our measure for negative bias.

Previous studies have shown the general alpha power of neural activity to correlate directly with the emotional processing of music (Lense et al., 2013), but there has not been much research conducted regarding the hemispheric differences in alpha when processing the emotion of music or language.

However, studies have shown that, within the frontal cortex of the brain, the right hemisphere is associated with the behavioral inhibition and vigilant attention that occurs during negative affective states which necessitate withdrawal (Reznik & Allen, 2017). This includes fear, potential threats associated with the detection of another person's sadness, or other situations that would call for the inhibition of behavior on the part of the person processing this emotional information.

Though insufficient research has been conducted on the role of frontal EEG asymmetry to date, it is believed to either play the role of a moderator or a mediator in emotional response (Coan & Allen, 2004). This study measured frontal asymmetry in the instance of activation, which occurs when a change in EEG activity is elicited as a response to stimuli (Reznik & Allen, 2017).

In their 2004 study on asymmetrical frontal EEG activity, Coan and Allen state that left frontal activity "indicates a propensity to approach or engage a stimulus, while relatively greater right frontal activity indicates a propensity to withdraw or disengage from a stimulus." As it relates to this study, the propensity to withdraw or disengage associated with great right frontal activity is likely to be found in cases wherein the stimulus has negative affect (Harmon-Jones & Gable, 2017). The present study examined the levels of frontal EEG activity in the right and left hemispheres of participants when the paired stimuli are emotionally mismatched with the negative stimulus serving as the target.

Alpha band oscillations average a frequency of approximately 10 Hz (Tumyalis & Aftanas, 2014). Previous studies on individual alpha frequencies, or IAFs, have pointed out a few notable differences between high and low individual alpha frequencies. People with higher than average resting individual alpha frequencies have more activity of positive emotions and can more easily access memories of positive events, whereas people with lower than average resting IAFs have more difficulty activating positive emotion (Tumyalis & Aftanas, 2014).

Individual alpha peak frequencies also vary depending on the emotion being processed. When processing emotions such as fear and sadness, individual alpha peak frequency declines compared to resting IAF, but when processing happiness, individual alpha peak frequency increases (Kostyunina & Kulikov, 1996).

In the present study, we analyzed data collected for a previous study (Steele, 2019) in which EEG was recorded to measure participants' responses to pairs of auditory stimuli in four conditions: Happy music followed by a word with happy prosody (HMHP), sad music followed by a word with happy prosody (SMHP), happy music followed by a word with sad prosody (HMSP), and sad music followed by a word with sad prosody (SMSP). Planned comparisons were conducted between the two contrasting conditions wherein the target stimulus has happy prosody (HMHP v. SMHP) and between the two contrasting sad prosody conditions (HMSP v. SMSP).

Based on previous findings and the lack of research in some areas, the hypotheses of the present study are as follows:

I. a) If a negative bias is detected, alpha power will decrease for happy targets following sad primes, but not for sad targets following happy musical primes because it will require greater attention to identify a happy target after devoting attention to a sad prime.

b) If no negative bias is detected, alpha power will be significantly lower for mismatching than matching conditions, regardless of the emotional valence of the musical prime.

II. a) If a negative bias is detected, frontal alpha asymmetry will be observed when a happy target word follows a sad musical prime, but not when a sad target word follows a happy musical prime.

b) If no negative bias is detected, right frontal alpha asymmetry is expected to be larger in both mismatching conditions compared to the matching conditions.

III. a) If a negative bias is detected, individual alpha peak frequencies will decrease when a happy target follows a sad prime compared to when it follows a happy prime, while no difference is expected for sad targets.

b) If no negative bias is detected, happy targets will show a lower IAPF following a sad musical prime, while sad targets will show an increase in IAPF following a happy musical prime.

CHAPTER II

Method

Participants

Analysis was conducted on data collected in twenty undergraduate college students during the fall 2020 (Steele, 2019). All participants were right-handed, native English speakers (*M* age = 19.67 years, *SD* = 2.23 years, 10 females). The study was approved by the Institutional Review Board at Middle Tennessee State University, and written consent was obtained from each participant prior to the start of the experiment (See Appendix A). Participants were recruited from the MTSU Psychology Research Pool and received course credit for their participation in the study.

Stimuli

A total of 32 musical excerpts from classical pieces served as affective primes. The musical excerpts were adapted from a previous study in which they were rated for emotional valence and arousal (Peretz, Gagnon, & Bouchard, 1998). Half of the excerpts (n = 16) were rated as happy and half (n = 16) were rated as sad.

A total of 128 nonsense words served as the target stimuli. The words were created using the software Wuggy (http://crr.ugent.be/programs-data/wuggy). A female, native English speaker with training in vocal performance recorded two versions of each word: one version spoken with a happy prosody and another version spoken with a sad prosody.

Four experimental conditions were created by manipulating independently the emotional valences of the prime musical excerpt and target word prosody: (a) happy music/happy prosody (HMHP); (b) happy music/sad prosody (HMSP); (c) sad music/sad prosody (SMSP); and (d) sad music/happy prosody (SMHP). To prevent any potential repetition effect, four lists of stimuli were created using a Latin square design so that each word appeared only once for each participant, but in all conditions across all participants.

Procedure

At the start of the experimental session, participants were provided with instructions regarding the EEG procedure and asked to avoid eye blinks and movement during stimulus presentation. Participants were asked to ignore the musical prime and indicate whether the target pseudoword sounded happy or sad by pressing one of two buttons on a response pad. The mapping between the buttons and emotional valence was counterbalanced across participants. The duration of each musical prime was 500 ms, followed by an interstimulus interval of 250ms and the target pseudoword. As soon as the target started being played, participants had 2000ms to give a response. Each participant was presented with 32 stimuli per condition. The entire experimental session lasted about 90 minutes.

EEG Data Acquisition and Processing

The EEG was recorded continuously from 32 Ag/AgCl electrodes embedded in a GSN Hydrocel net (EGI, Eugene, OR) placed on the scalp with Cz at the vertex, connected to a NegAmps 400 amplifier, and using NetStation 5 on a Mac Pro computer. Data was referenced online to Cz, and acquired at a frequency of 1000Hz. Electrode impedances were kept below 50kOhm.

The continuous EEG data was processed using Matlab version R2020a and EEGLAB toolbox version 2019.1 (Delorme & Makeig, 2004). Data was down sampled to 250 Hz to save computational time and slow drift artefacts were removed using a 1 Hz high-pass filter. Bad electrodes with excessive noise, flat signal or abnormal trends were removed and interpolated using spherical spline interpolation. The EEG was referenced to the average of the signal from all electrodes. High amplitude non-stereotypical artefacts (e.g., muscle artefacts) were removed using the artefact subspace reconstruction algorithm implemented in the clean-rawdata extension for EEGLAB. Stereotypical artefacts (eye blinks and eye movements) were removed using independent component analysis (ICA). Finally, the clean EEG data was segmented into 1100-ms epochs from -100 ms to +1000 ms relative to the onset of the musical prime and target pseudowords.

Data Analysis

The power spectrum of the EEG associated with musical primes and target pseudowords were separately computed with Matlab's fast Fourier transformation function using a Hanning window of 1 s width and 50% overlap. Alpha power (μV^2) was calculated in the 8-12.5 Hz range and log10-transformed for normalization. FAA was calculated by subtracting the normalized alpha power at electrode F3 (frontal left) from the normalized alpha power at electrode F4 (frontal right). For each participant, IAPF was defined as the highest local maximum within the alpha band over occipital electrode sites; The average of electrodes O1 and O2 was chosen based on several previous studies showing that alpha power is the strongest over the parieto-occipital region of the scalp, thus allowing a more precise determination of the alpha peak (Lozano-Soldevilla, 2018).

All statistical analyses were conducted using the software package IBM SPSS Statistics. For each alpha measure (mean alpha power, FAA, IAPF), pair-wise comparisons were conducted between matching and mismatching conditions for target pseudowords with the same emotional prosody (i.e., happy music-happy prosody versus sad music-happy prosody, and sad music-sad prosody versus happy music-sad prosody).

CHAPTER III

Results

One participant's EEG data were excluded from further analysis due to excessive noise and artefacts, resulting in a low number of available cleaned EEG epochs. Paired *t*-tests were conducted for the EEG results of the final 21 participants. The frontal alpha asymmetry, individual alpha peak frequencies, and mean alpha band power were measured for each condition. Each EEG alpha measure was then compared between matching and mismatching conditions using pairwise *t*-tests.

Mean Alpha Band Power

Figure 1 shows the mean alpha band power across participants for each condition. Mean alpha power was hypothesized to decrease for happy targets following sad primes (SMHP vs HMHP), but not for sad targets following happy musical primes (i.e., HMSP vs SMSP) in the case of negative bias. There was indeed a significant difference between the conditions of happy targets following sad primes and happy targets following happy primes. A paired-samples *t*-test indicated that mean alpha band power was significantly lower when a sad musical prime was followed by a word with happy prosody ($M = 5.15$, $SD = 0.744$) than when a happy musical prime was followed by a word with happy prosody ($M = 5.21$, $SD = 0.749$), $t(20) = -2.25$, $p = .036$, $d = 0.49$. This difference shows a moderate effect size (see Figure 2, left panel). A paired-samples *t*-test indicated that mean alpha band power was not significantly different when a sad musical prime was followed by a word with sad prosody ($M = 5.19$, $SD = 0.739$) than when a happy musical prime was followed by a word with sad prosody ($M = 5.17$, $SD = 0.788$), $t(20) = 0.89$, $p = .387$, $d = 0.19$ (See Figure 2, right panel).

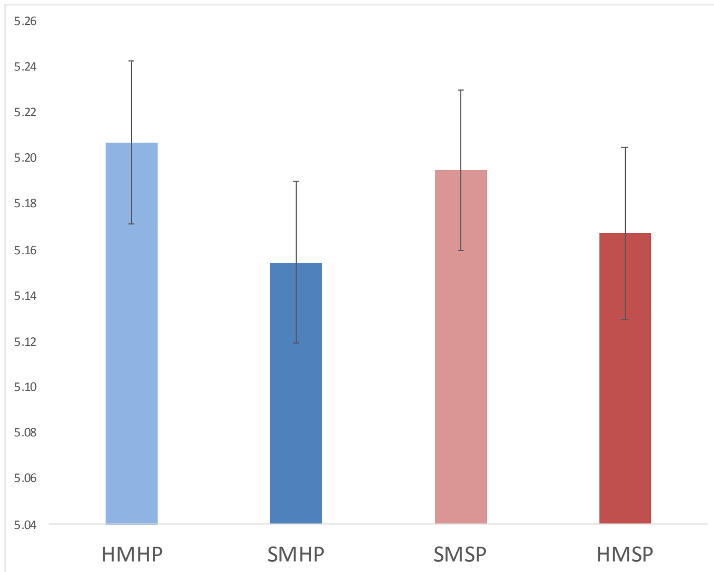

Figure 1. Mean power in the alpha band (8-12 Hz) in each experimental condition.

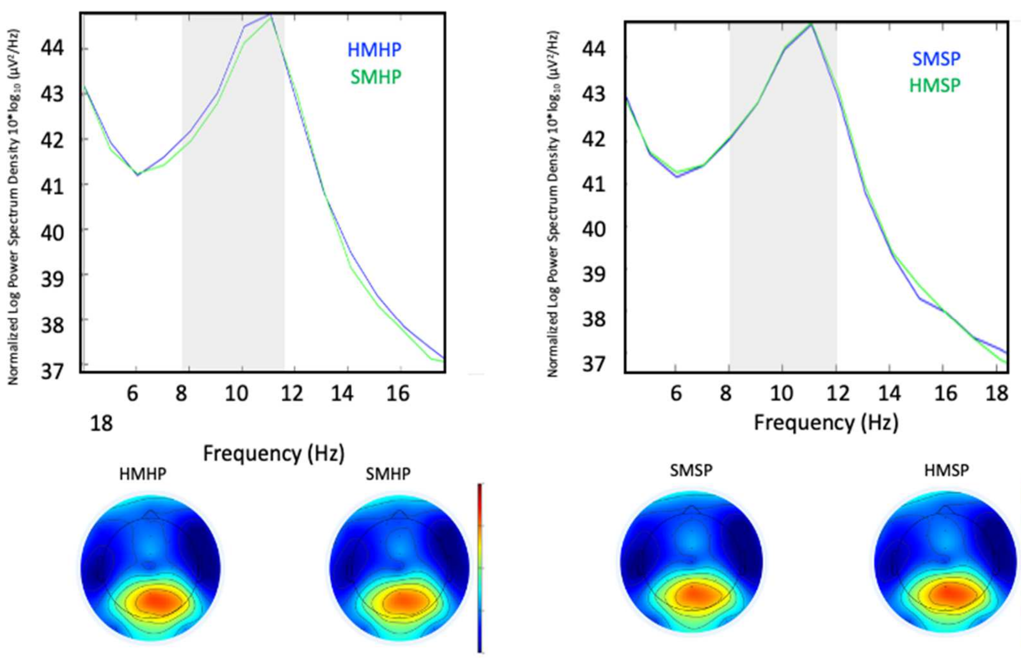

Figure 2. Comparison of the Mean alpha band for HMHP and SMHP conditions (left panel) and for SMSP and HMSP conditions (right panel). The top panel presents a comparison of the spectrum for the matching (blue) and mismatching (green) condition. The gray rectangle indicates the alpha band. The bottom panel show the topographic map of the mean alpha power for each condition.

Frontal Alpha Asymmetry

The average frontal alpha asymmetry for each experimental condition is presented in figure 3. Frontal alpha asymmetry was hypothesized to be present when a happy target word follows a sad musical prime, but not when a sad target word follows a happy musical prime. Neither of the pairwise comparisons of FAA was significant. A paired-samples *t*-test indicated that frontal alpha asymmetry levels were not significantly different when a sad musical prime was followed by a word with happy prosody (M = -0.024, SD = 0.372) than when a happy musical prime was followed by a word with happy prosody (M = -0.027, SD = 0.377), $t(20) = 0.09$, $p = .927$, $d = 0.02$. A paired-samples *t*-test indicated that frontal alpha asymmetry levels were not significantly different when a sad musical prime was followed by a word with sad prosody (M = -0.022, SD = 0.38) than when a happy musical prime was followed by a word with sad prosody (M = -0.017, SD = 0.397), $t(20) = -0.15$, $p = .883$, $d = 0.03$.

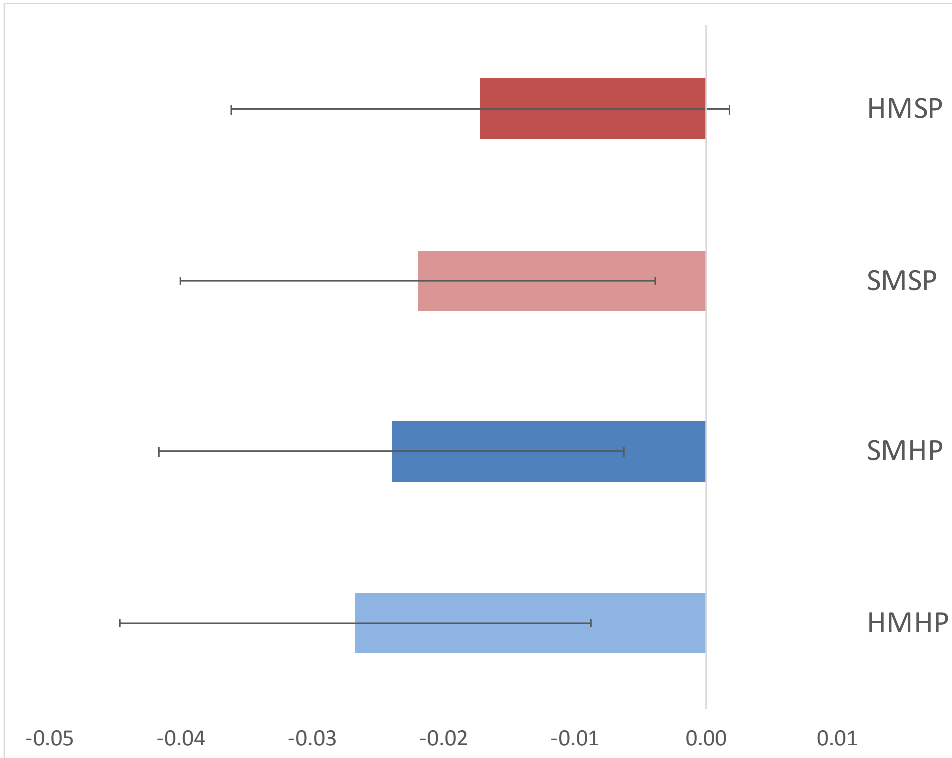

Figure 3. Mean FAA in each experimental condition.
A negative value indicates a left-lateralized frontal activity.

Individual Alpha Peak Frequencies

The average individual alpha peak frequency is shown in figure 4. Individual alpha peak frequencies were hypothesized to decrease when a happy target follows a sad prime compared to when it follows a happy prime with no difference expected for sad targets. Neither of the pairwise comparisons of IAPF was significant. A paired-samples *t*-test indicated that individual alpha peak frequencies were not significantly different when a sad musical prime was followed by a word with happy prosody (M = 10.36, SD = 0.382) than when a happy musical prime was followed by a word with happy prosody (M = 10.33, SD = 0.338), $t(20)$ = 0.87, p = .393, d = 0.19. A paired-samples *t*-test indicated that individual alpha peak frequencies were not significantly different when a sad musical prime was followed by a word with sad prosody (*M* = 10.35, *SD* = 0.355) than when a happy musical prime was followed by a word with sad prosody (*M* = 10.35, *SD* = 0.412), *t*(20) = -0.02, *p* = .984, *d* = 0.004.

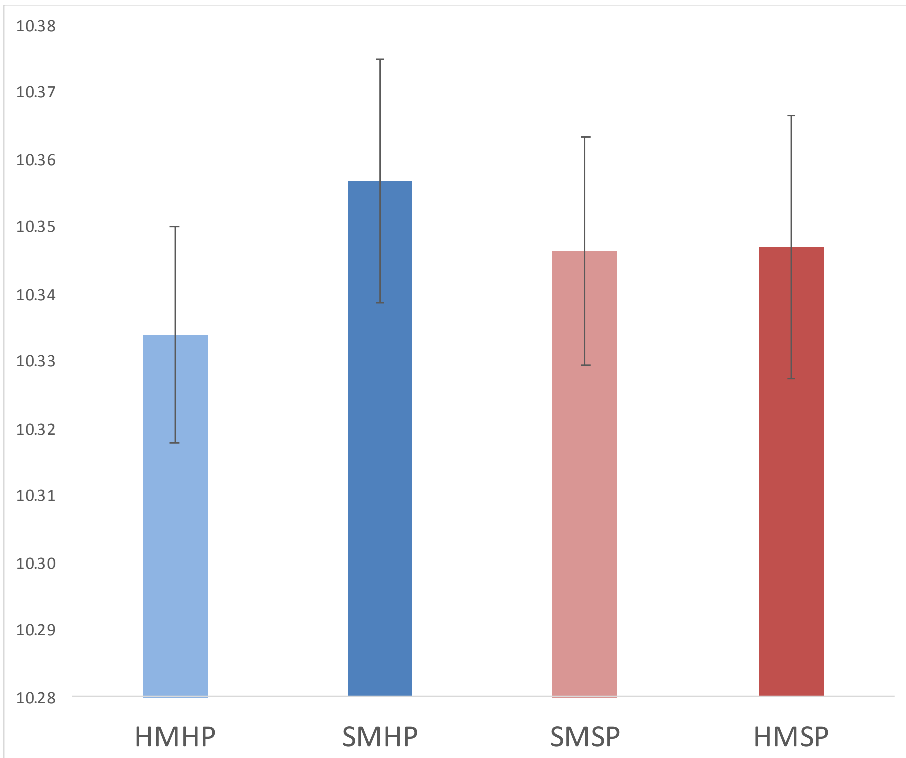

Figure 4. Mean individual alpha peak frequency in each experimental condition.

CHAPTER IV

Discussion

The main goal of this study was to look for evidence of the existence of negative bias in processing the emotion of music and language. In this study, negative bias was determined by an increase in attention associated with correctly identifying an emotionally mismatched stimulus when it follows a sad prime. The main finding of this study was the significant decrease in mean alpha band power when a happy target word followed a sad prime compared to a happy target word following a happy prime.

Mean alpha power showed that there is an increased focus of attention when a sad emotional prime is followed by a mismatching happy emotional stimulus. Because there was no difference between a sad target word following a sad musical prime and a sad target word following a happy musical prime, we can conclude that the difference was not equal for both mismatched conditions. The only difference occurred when there was mismatched emotion and a sad musical prime. Therefore, this significant difference in mean alpha power involving a sad musical prime and a happy prosody target provide evidence of a negative bias (Carretié et al., 2001).

The decrease in mean alpha power is associated with an increased focus of attention expected with a change in emotional valence after being primed with a sad stimulus (Klimesch, 2018). Because this decrease only follows the sad musical prime when attention must be shifted to a mismatched emotional target, it supports the theory of a negative bias in processing the emotion of music and language. The happy musical primes did not result in any significant changes, so there is no evidence of a positive bias in the results of this study.

Limitations and Future Directions

Frontal alpha asymmetry proved to be an insufficient measure of a negative bias in this study. This could be due to the small sample size used in this study. The left frontal alpha asymmetry is lower for conditions in which the target word has a sad prosody, regardless of the prime emotion. However, the left FAA is lowest when a sad target word follows a happy musical prime. The reduction in left FAA is trending toward right FAA in both sad prosody conditions. Because right frontal alpha asymmetry is associated with negative emotion, more participants may result in a significant peak in right frontal FAA in conditions involving sad target words, which would be in line with the original hypothesis regarding FAA (Harmon-Jones & Gable, 2017).

Individual alpha peak frequencies were also inconclusive regarding attention. This measure may not have been as powerful because the IAPF were averaged across all participants. Had these frequencies been compared to the mean alpha power for each participant individually, rather than the average alpha power, the results of the IAPF measure may have been more impactful (Kostyunina & Kulikov, 1996).

Both frontal alpha asymmetry and individual alpha peak frequency may be more subject to individual differences than accounted for in this study (Tumyalis & Aftanas, 2014). It is possible that both of these measures are highly impacted by individual differences. For the purposes of this study, these individual differences include measures such as empathy, musical training, and musical aptitude. Future research would benefit from including measures of these individual differences and accounting for them in the final results (Taroyan et al., 2020).

If the results for these two measures are replicated even with the addition of individual differences and a larger sample size, we could ascertain that frontal alpha asymmetry and individual alpha peak frequencies are not associated with the processing of the emotion of music and language. They may be better suited as measures not related to the processing of emotion, but perhaps to decision-making as it correlates to the emotion of a situation (Coan & Allen, 2004).

For this study, mean alpha waves were measured across the entire band ranging from 8 to 12 Hertz. To improve the specificity and also improve the accuracy of mean alpha power and individual alpha peak frequencies, this study could be conducted in the future using two different categories of alpha band frequencies. The band could be split up into low bands, which consist of those in the 8 to 10 Hertz range, and high bands, which consist of those in the 10 to 12 Hertz range.

Future research regarding mean alpha power and attention would also benefit from first measuring participants' individual alpha peak frequencies. From this point, low band alpha ranges could be set to -2 Hz from this number for each participant, and high band ranges could be set to +2 Hz. This would likely show more substantial differences than averaging the mean alpha power and the individual alpha peak frequencies, as well as the difference between the two measures.

The existence of negative bias could affect real-world decision making and the manner in which people approach perceived risks on a daily basis. If negative bias influences the way people interpret information, feedback, and emotional cues, it could also impact their self-worth. We could further investigate how to counteract these effects in order to make people more confident and productive in the workplace or the classroom.

If independent measures of IAPF show that some individuals have more difficulty processing negative emotions and some positive emotions, there could be clinical implications. Measuring an individual's resting alpha rate and comparing it to their peak frequency may reveal a predisposition to negative or positive emotion. Therapists could develop specific strategies for treating both of these types of individuals. This could impact the prescription and overall use of drugs such as antidepressants as well. Another useful direction for future research would be to compare the evidence of negative bias in a sample such as ours with a median age of 19.67 years to studies who have found evidence of a positivity bias in older adults and search for factors that may have contributed to this shift over time.

In conclusion, the significant decrease in mean alpha power shows that there is an increase in attention required to correctly identify a happy target stimulus when it follows a sad prime. This supports the negative bias theory in the processing of the emotion of music and language. However, there is still much more research that needs to be conducted in order to determine the extent of the role of negative bias in processing emotion.

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APPENDICES

Appendix A

IRB

INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129
FWA: 00005331/IRB Regn. 0003571

MIDDLE TENNESSEE STATE UNIVERSITY

IRBN001 - EXPEDITED PROTOCOL APPROVAL NOTICE

Tuesday, November 10, 2020

Protocol Title	***Relationship between music prosody and emotion***
Protocol ID	**19-2193**
Principal Investigator	**Jessica Steele** (Student)
Faculty Advisor	Cyrille Magne
Co-Investigators	Rachel Winesberry
Investigator Email(s)	*jrs2bw@mtmail.mtsu.edu; cyrille.magne@mtsu.edu*
Department	Psychology
Funding	**NONE**

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU IRB through the **EXPEDITED** mechanism under 45 CFR 46.110 and 21 CFR 56.110 within a PRIMARY category *(4) Collection of data through noninvasive procedures* and a SECONDARY category *(7) Research on individual or group characteristics or behavior*. A summary of the IRB action on this protocol is given below:

IRB Action	**APPROVED for ONE YEAR**		
Date of Expiration	**3/31/2021**	*Date of Approval*: 3/21/19	*Recent Amendment*: 11/2/20
Sample Size	ONE HUNDRED (100)		
Participant Pool	*Target Population:* Primary Classification: **General Adults (18 or older)** Specific Classification: **MTSU Students**		
Type of Interaction	☒ Analysis ☐ Virtual/Remote/Online interaction ☐ **In person or physical interaction – Mandatory COVID-19 Management**		
Exceptions	Use of MTSU SONA is permitted		
Restrictions	**1. Mandatory SIGNED Informed Consent.** **2. Other than the exceptions above, identifiable data/artifacts, such as, audio/video data, photographs, handwriting samples, personal address, driving records, social security number, and etc., MUST NOT be collected. Recorded identifiable information must be deidentified as described in the protocol.** **3. Mandatory Final report (refer last page).** **4. The protocol details must not be included in the compensation receipt.** **5. CDC guidelines and MTSU safe practice must be followed**		
Approved Templates	*IRB Templates:* Informed Consent and Recruitment Script *Non-MTSU Templates:* NONE		
Research Inducement	Course Credit		
Comments	The format of this template has been updated (11/09/2020)		

IRBN001 (Stu) Version 2.0 Rev 08/07/2020

Post-approval Requirements

The PI and FA must read and abide by the post-approval conditions (Refer "*Quick Links*" in the bottom):

- ***Reporting Adverse Events:*** The PI must report research-related adversities suffered by the participants, deviations from the protocol, misconduct, and etc., within 48 hours from when they were discovered.
- ***Final Report:*** The FA is responsible for submitting a final report to close-out this protocol before **9/30/2021** **(Refer to the Continuing Review section below)**; REMINDERS WILLNOT BE SENT. **Failure to close-out or request for a continuing review may result in penalties** including cancellation of the data collected using this protocol and/or withholding student diploma.
- ***Protocol Amendments***: An IRB approval must be obtained for all types of amendments, such as: addition/removal of subject population or investigating team; sample size increases; changes to the research sites (appropriate permission letter(s) may be needed); alternation to funding; and etc. The proposed amendments must be requested by the FA in an addendum request form. The proposed changes must be consistent with the approval category and they must comply with expedited review requirements
- ***Research Participant Compensation:*** Compensation for research participation must be awarded as proposed in Chapter 6 of the Expedited protocol. The documentation of the monetary compensation must Appendix J and MUST NOT include protocol details when reporting to the MTSU Business Office.
- ***COVID-19:*** Regardless whether this study poses a threat to the participants or not, refer to the COVID-19 Management section for important information for the FA.

Continuing Review (Follow the Schedule Below)

This protocol can be continued for up to THREE years by requesting a continuing review before **3/31/2021**. Refer to the following schedule to plan your annual progress report; **REMINDERS WILL NOT BE SENT**. Failure to obtain an approval for continuation will result in cancellation of this protocol..

Reporting Period	Continuing Review	
First year report	**11/10/2020 IRBCR2021-076** CR Date: 11/09/2020; Progress Report: 11/02/2020; Status: The CR determined the protocol may continue with restrictions Comments: This protocol was originally approved for in person interaction. Due to COVID-19, the protocol must be updated to include a COVID-19 Management Plan. This CR only authorizes data analysis of this protocol. No fresh data collcection is permitted at this stage.	
Reporting Period	**Requisition Deadline**	**IRB Comments**
Second year report	6/30/2022	NOT COMPLETED
Final report	6/30/2023	NOT COMPLETED

Post-approval Protocol Amendments:

The current MTSU IRB policies allow the investigators to implement minor and significant amendments that would fit within this approval category. ***Only TWO procedural amendments will be entertained per year*** *(changes like addition/removal of research personnel are not restricted by this rule).*

Date	Amendment(s)	IRB Comments
09/05/2019	Student worker Rachel Winesberry (rmw5w - CITI8339473) is added as a co-investigator.	IRBA2020-044
11/02/2020	Jennifer Johnson (jlj8x@mtmail.mtsu.edu - CITI5743701) is added to the protocol as a co-investigator.	IRBCR2021-076

Other Post-approval Actions:

The following actions are done subsequent to the approval of this protocol on request by the PI/FA or on recommendation by the IRB or by both.

Date	IRB Action(s)	IRB Comments
NONE	NONE	NONE

COVID-19 Management:

The PI must follow social distancing guidelines and other practices to avoid viral exposure to the participants and other workers when physical contact with the subjects is made during the study.

- The study must be stopped if a participant or an investigator should test positive for COVID-19 within 14 days of the research interaction. This must be reported to the IRB as an "adverse event."

- The MTSU's "Return-to-work" questionnaire found in Pipeline must be filled by the investigators on the day of the research interaction prior to physical contact.
- PPE must be worn if the participant would be within 6 feet from the each other or with an investigator.
- Physical surfaces that will come in contact with the participants must be sanitized between use
- **FA's Responsibility:** The FA is given the administrative authority to make emergency changes to protect the wellbeing of the participants and student researchers during the COVID-19 pandemic. However, the FA must notify the IRB after such changes have been made. The IRB will audit the changes at a later date and the FA will be instructed to carryout remedial measures if needed.

Data Management & Storage:
All research-related records (signed consent forms, investigator training and etc.) must be retained by the PI or the faculty advisor (if the PI is a student) at the secure location mentioned in the protocol application. The data must be stored for at least three (3) years after the study is closed. Additional Tennessee State data retention requirement may apply (*refer "Quick Links" for MTSU policy 129 below*). The data may be destroyed in a manner that maintains confidentiality and anonymity of the research subjects.

The MTSU IRB reserves the right to modify/update the approval criteria or change/cancel the terms listed in this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Quick Links:
- Post-approval Responsibilities: http://www.mtsu.edu/irb/FAQ/PostApprovalResponsibilities.php
- Expedited Procedures: https://mtsu.edu/irb/ExpeditedProcedures.php
- MTSU Policy 129: Records retention & Disposal: https://www.mtsu.edu/policies/general/129.php

Appendix B

List of target pseudowords

bloam
claft
corld
drair
drewn
falp
firsh
flipe
frice
garch
glast
grood
jeve
learm
nunge
paith
phic
plesh
plour
preet
quaz
ryke
scrog
slerk
sluce
splum
strob
thaid
thide
treme
trood
wrast
blumb
clearn
crylt
drarp
drin
fauze
flear
floag
froad
gelle
glorn
gures
joype
murm
nunts
pauve
pidge
plich
prall
prepe
quilp
saist
septh
sless
smins
spoan
swong
thark
thike
tremp
tumph
yasht
barsh
burve
cloop
delsh
dreet
drock
felce
fleft
frath
froll
glaim
gloud
gwarf
knort
mynch
nyst
pebe
pizz
plin
prang
pumph
realp
salph
shish
sloup
smows
spump
tarce
theck
thirp
trome
twear
bley
chull
clyke
dempt
drell
fadge
filbe
flide
fraws
frool
glamp
graim
hilms
knove
nipes
oorph
phafe
pleck
plorn
praph
puzz
reash
scaid
shrow
slour
speen
strit
tearl
thept
thirt
tront
weith