Negative Valence Specific Deficit in Music Affect Perception in Alexithymia

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The pre-registration of this study can be viewed at <https://osf.io/3myru/wiki/home/> a link to stimulus and analysis script can be found at {OSF Link}

Abstract

Alexithymia is characterized by a lack of words for emotional experiences. It has also been implicated in deficits in emotion processing at a perceptual level. Most of this research has been conducted using emotion faces and words, thus neglecting other kinds of emotional stimuli, such as music, and using only short durations of stimulus presentation. Further, discrete emotion perception is also often the variable of interest rather than affect perception, which is a precursor to emotion construction. In this study, 162 participants listened to ten 15-s excerpts of film soundtracks that represented five target emotions (happy, sad, tender, angry, and fearful) and rated the valence and arousal ofeach. Participants also recalled all emotion words they knew as being expressed by music. Analyses revealed that alexithymia was not related to the number of emotion words recalled but valence-specific affect perception effects were found. Compared to those low in alexithymia, participants high in alexithymia made more positive ratings for music that was negatively valenced but were not different for positively valenced music. Likewise, people high in alexithymia rated arousal as more neutral for negatively but not positively valencedmusic. These results indicate less perceptual intensity for negative stimuli specifically, even when stimulus presentation allows for non-automatic processing. The results are taken to indicate a sustained direction of attention away from negative stimuli in alexithymia at an affective level with potential downstream effects for the perception and differentiation of negative emotions and emotional experiences.

Keywords: Alexithymia, Music, Theory of Constructed Emotion, Emotion

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Alexithymia—no words for emotion—is a sub-clinical personality trait that has been implicated in the reduced perception and experience of emotions (Donges, Kersting, & Suslow, 2014). Alexithymia is also related to reduced awareness of bodily sensations and it has therefore been proposed that people with high levels of alexithymia struggle to create mental representations of emotions (Ihme et al., 2014; Zamariola, Vlemincx, Corneille, & Luminet, 2018). This can be understood within the theory of constructed emotion, which posits that emotions are understood as clusters of similar instances grouped together by emotion words that allow for mental representations (Barrett, 2017a; Lindquist & Gendron, 2013; Lindquist, MacCormack, & Shablack, 2015).

The theory of constructed emotion (Barrett, 2006, 2017b, 2017a) maintains that emotions are constructed through a process of learning associations between affective states, social context, and knowledge about emotion concepts. Therefore, emotional experiences exist at a higher cognitive level than feeling or affective states, whereby affective states refer to perceptions or experiences of pleasantness (valence) and energy (arousal). Emotions are perceived by predicting the emotional state of the target based on what we know about emotion concepts—which are, of course, formed by our experiences (Barrett, 2017a). Therefore, the emotion perception deficits seen in alexithymia may stem from an earlier deficit in affect perception and a lack of integration of affective information with semantic representations.

Neurological studies provide support for this supposition. Patients with localized left anterior temporal lobe atrophy, and who therefore have limited conceptual knowledge, were able to perceive affect but were not able to sort emotional faces into discrete emotional categories (K. A. Lindquist, Gendron, Barrett, & Dickerson, 2014). However, the left temporal pole has not been implicated in neurological mapping studies of alexithymia whereas other areas relevant to affect processing have been (Goerlich-Dobre, Votinov, Habel, Pripfl, & Lamm, 2015; Ihme et al., 2013). A systematic review of neural activation during stimuli presentation has revealed that higher scores on alexithymia are related to increased cognitive demand (higher anterior cingulate gyrus activation), decreased attention to negative stimuli (reduced amygdala activation), and reduced activation of interoceptive networks during positive stimuli presentation (van der Velde et al., 2013). The majority of these studies have used facial emotion pictures as stimuli.

Although facial emotions are frequently processed in daily life, they are not the only way affect is experienced, perceived, or related to cognitive aspects of emotion construction. Emotion can also be expressed through speech vocalizations and more complex arrangements of music, with the ability to perceive these emotions developing in parallel (Vidas, Dingle, & Nelson, 2018). Unsurprisingly, alexithymia has been related to decreased sensitivity to both vocal and musical stimuli (Goerlich, Witteman, Aleman, & Martens, 2011; Goerlich-Dobre et al., 2014). However, these sound clips were only of a short duration (i.e., fractions of a second) and the effects of alexithymia may be accentuated by shorter stimuli duration (Parker, Prkachin, & Prkachin, 2005).

Using stimuli of a longer duration (specify?), Allen, Davis, and Hill (2013) adopted a two-stage model of musical emotions. Here, affective properties of music, such as valence, were theorized to be first processed before being appraised for emotional significance at a higher cognitive level (see also Peretz, 2010). Allen et al. found alexithymia to be related to reduced emotion labels associated with musical experiences but not related to differences in psychophysiological response. In a similar study, Taruffi, Allen, Downing, and Heaton (2017) found alexithymia to be related to reduced accuracy in emotion perception. However, these studies did not address affect perception, the proposed first stage of music emotion processing. Studies on visual stimuli have demonstrated, for example, that people high in alexithymia rate negative stimuli as more positive and positive stimuli as less positive than people low in alexithymia (Luminet, Rimé, Bagby, & Taylor, 2004; Vanman, Dawson, & Brennan, 1998). In other words, people with alexithymia consistently rated stimuli as more neutral.

This study aimed to expand the limited literature on musical emotions and alexithymia through the neurocognitive lens of the theory of constructed emotion. Consistent with proposed deficits in emotional perception in alexithymia, we expected people with alexithymia to apply fewer words to emotions in music. We further expected participants high in alexithymia to perceive musical valence and arousal as more neutral across five target emotions (happy, tender, sad, angry, fearful).

# Method

## Participants

One-hundred and two participants living in the United Kingdom were sampled from *Prolific* (http://prolifc.ac). Participants were aged 18 to 25 years (*M* = 21.52, *SD* = 1.94) and 91 were female. Participants were payed £1.25 for their participation (15 minutes at £5 an hour).

## Stimuli and Measures

**Musical Emotion Concepts.** In a text box, participants freely responded to the following prompt “In this box please write as many emotions as you can think of that are expressed in music”. Linguistic Inquiry Word Count software (Pennebaker, Boyd, Jordan, & Blackburn, 2015) was then used to count the number of words listed and the proportion of positive and negative emotion words. The proportion of positive and negative words was then converted to a count of positive and negative emotion words that was summed to give the total number of emotion words.

**Musical stimuli****.** Ten pieces of music, representing five emotions (happiness, tenderness, anger, fear, and sadness) were taken from the film soundtrack list provided by Eerola and Vuoskoski (2011). All pieces were 15 seconds in duration.

**Perceived affect.** Participants were given the instruction to rate the emotion of the music on two semantic differential scales. The first scale measured valence and was measured from -3 (negative) to 3 (positive) and the second measured arousal from -3 (low energy) to 3 (high energy). The valence and arousal perceived for each target emotion was the average valence and arousal score for the two songs representing the given target.

**Alexithymia.** Alexithymia was measured using the 20-item Toronto Alexithymia Scale (TAS-20; Bagby, Parker, & Taylor, 1994). The TAS-20 is widely used to measure alexithymia and demonstrated good internal consistency in the current sample, Cronbach’s alpha = .84.

## Procedure

After providing consent participants were asked to complete the measure of musical emotion concepts, 60 seconds was allowed for this before the page automatically advanced. They were then given the instructions to listen to each musical clip and make a rating of their perception of the affect in the song using sliders. Participants then listened to all ten songs in a randomized order. Participants then completed a battery of measures, including alexithymia and demographics1.

**Results**

Alexithymia (*M =* 54.31, *SD =* 11.91) did not relate to the total number of emotion words listed, *r* = -.05, *p* = .508. In light of this null result, the correlations between positive and negative emotion words and alexithymia were explored, also returning null results, *r*s < -.13, *p*s > .106. As significant values were not returned, exploratory tests of equivalence were undertaken using the two one-sided tests (TOST) method, whereby a significant results indicates a null-effect where the smallest effect size of interested is the correlation that the study had .8 power to find (± .228; Lakens, 2017). In this case, a relationship outside the smallest effect size of interest was found for the correlation between alexithymia and total number of emotion words as well as negative emotion words, *p*’s < .011. However, an inconclusive result was returned for the relationship between alexithymia and negative emotion words, *p* = .099.

Two mixed general linear models with participant set as a random effect were conducted used the *lme4* (Bates, Mächler, Bolker, & Walker, 2015) and *jtools* (Long, 2018) packages in R (R Core Team, 2018). Alexithymia and song category were entered as predictors in the model and descriptive statistics for ratings of each song category can be seen in table 1. Ratings of valence were assessed in the first model. As can be seen in figure 1, alexithymia scores were inconsistently related to ratings of valence across stimuli. For negatively valenced music, alexithymia was related to more neutral perceptions of valence (anger, *p* =, sad, *p = … ,* fearful*, p = )*, whereas no relationship was found between alexithymia and positively valencedmusic. Likewise, there was an inconsistent relationship between alexithymia and perceptions of arousal across musical emotions. As shown in figure 2, alexithymia related to greater arousal perception for sad music and lower arousal perception for angry and fearful music with no relation found for happy and tender music. Estimates for both models can be seen in Table 2.

**Discussion**

It has been argued that auditory features of music communicate affect with emotions being constructed around musical experiences and associations. Alexithymia has been related to difficulties in emotion conceptualization and affect perception. Therefore, this study considered both general frequency of words for emotions expressed in music and ratings of affect perceived in instrumental pieces of music.

Contrary to our first prediction, alexithymia was not related to the total number of words representing emotion expressed in music (Cespedes-Guevara & Eerola, 2018). This is contrary to past findings where participants high in alexithymia use fewer emotion words to describe their own autobiographical emotional experiences (Wagner & Lee, 2008; Wotschack & Klann-Delius, 2013). However, the lack of correlation found in this study regarding emotions expressed in music is consistent with Luminet et al. (2004), who found no relationship between alexithymia and the description of which part of a movie was most emotional for them. In both cases, it is possible for participants to be aware of emotions being present in a given medium and apply an emotion word without accurate perception having taken place. This is particularly possible as music and film are often spoken about in emotional terms, and are often used in conjunction for emotional effect (Cohen, 2010).

Further supporting this interpretation, Luminet, Vermeulen, Demaret, Taylor, and Bagby (2006) did not find alexithymia to be related to the overall recall of previously presented emotion words. However, specific relationships were still found in that study. While alexithymia was not related to negative recall, consistent with the null relationship found in the current study between alexithymia and negative emotion words, Luminet et al. (2006) did find relationships between alexithymia and positive word recall. In this case, participants high in alexithymia recalled being presented fewer positive words than participants low in alexithymia. This has parallels with the inconclusive finding in the current study, whereby it could not be said with confidence that alexithymia did not relate to a reduced knowledge of positive emotions being conveyed in music. Luminet et al. (2006) noted that participants high in alexithymia had lower rates of remembering specific associations or definitions of words recalled. Therefore, as awareness of emotions in music may not differ across levels of trait alexithymia, at least for negative emotions, this does not mean that knowledge of emotions in music is equitable across alexithymia. This is especially the case as for an emotion to be constructed the word conceptually representing the emotion must be related to and group previous specific instances of its occurrence (Lindquist & Gendron, 2013). Interestingly, for cases of positive emotions presenting emotional information in conjunction with an emotionally consistent music cue appears to aid the encoding of the word at a conceptual level (Vermeulen, Toussaint, & Luminet, 2010).

Although alexithymia was not not related to perceptions of valence for the positively valenced ( happy and tender) music, alexithymia did relate to reduced negative valence perception for sad, angry and fearful music. A valence specific pattern was also found for perceptions of arousal. Higher levels of alexithymia predicted arousal ratings for the negatively valenced songs but not positively valenced songs. Alexithymia predicted increased perceptions of arousal for sad music, which is a low arousal emotion, and decreased perceptions of arousal for the angry and fearful songs, which are high arousal emotions. Taken together, these findings indicate that affect perception for negatively valenced stimuli is muted by alexithymia while the same cannot be said about positively valenced stimuli.

These results are in direct contradiction to studies on affect experience in alexithymia, where a relationship between alexithymia and more neutral affect perception has been found irrespective of stimuli valence (Luminet et al., 2004; Vanman et al., 1998). Our results can be understood from an attention-based perspective, however. Participants high in alexithymia have been found to be more sensitive to negatively valenced stimuli and subsequently are not as engaged in its processing (Suslow, 1998; Suslow, Junghanns, Donges, & Arolt, 2001). This is consistent with neurobiological results of facial emotion processing where effects of alexithymia were particularly prevalent for negative stimuli and characterized by decreased activation of the amygdala (Donges & Suslow, 2017; van der Velde et al., 2013). The valence specific results of this study can be seen to highlight continued deployment of attention away from negatively valenced auditory stimuli over periods of time longer than previously studied.

The diversion of attention away from negatively valenced auditory stimuli can be understood in the context of emotion perception and processing, facilitated by the amygdala, leading to emotion elicitation (Barrett, Bliss-Moreau, Duncan, Rauch, & Wright, 2007; Juslin & Laukka, 2004). Diverting processing away from negative but not positive stimuli in alexithymia may occur as a protective strategy. People with high levels of alexithymia have a reduced ability to effectively regulate emotions and are subsequently less able manage any negative emotion that may follow negative emotion processing (Preece, Becerra, Robinson, Dandy, & Allan, 2018). However, negative affect is still present, and, in fact, higher in people with alexithymia and this appears to be influenced by directing attention away from affective experience (da Silva, Vasco, & Watson, 2017; Panayiotou et al., 2015)

The ability to differentiate negative emotional states is required to effectively regulate emotional states and greater differentiation has been related to experiencing more intense emotions (Barrett, Gross, Conner Christensen, & Benvenuto, 2001; Erbas, Ceulemans, Pe, Koval, & Kuppens, 2014; Kashdan, Barrett, & McKnight, 2015). The results of this study, however, indicate that higher levels of alexithymia are related to less intense negative affective perceptions, which likely influences subsequent experiences. As alexithymia was not found to influence positive affective perceptions, it does not appear that there is an overall perceptual deficit in alexithymia. This is consistent with the emerging attention-appraisal model of alexithymia, whereby people high in alexithymia divert attention away from negative stimuli which is related to downstream difficulties in appraising emotions (Preece, Becerra, Allan, Robinson, & Dandy, 2017). With this in mind, future studies should look to manipulate attentional focus during negative stimuli presentation to establish whether intensity of affective experience can be expanded. Such research looking to increase affective processing of negative stimuli would then provide grounds for deliberate efforts to expand emotion knowledge in alexithymia. This would in turn aid negative emotion differentiation, which has been shown to be reduced in alexithymia while positive emotion differentiation is not affected (Aaron, Snodgress, Blain, & Park, 2018).

The current study only tested musical emotion word recall; therefore, it is plausible that participants may have been recalling words that they had learned as relating to musical emotions without having a conceptual understanding of what is constituted by that emotional expression. Thus, it is not known how alexithymia relates to the understanding of emotional concepts, which are vital for perception and experience (Barrett, 2017a). Although our results have implications regarding discrete emotion categorization and differentiation, this study only measured affective responses and, by extension, perceptual intensity. A consequence of this is that affect intensity cannot be specifically related to differentiation ability. It is further likely that the depth of emotion concept knowledge would have an additive effect in predicting emotional differentiation. Therefore, future studies should investigate not just the size of the emotional lexicon but also the specificity of knowledge about each listed emotion as well as differential perception of emotions in addition to affect perception. Despite these limitations, the current study provides evidence for specific effects of negative valence and alexithymia on the perception of auditory stimuli, which are often experienced in everyday life but understudied in comparison to visual stimuli such as images and facial expressions, for example. Furthermore, this study has demonstrated that deficits in processing of stimuli extend to longer stimuli presentations, whereby previous studies have singled out temporal constraints as a factor that influences the processing ability of people with alexithymia.

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Footnotes

1Additional measures were taken for another project but were not analysed for the study reported in this paper.

Tables

Table 1:

Descriptive statistics of perception of valence and arousal for each music emotion category.

|  |  |  |
| --- | --- | --- |
|  | Valence | Arousal |
| Sad | -0.96 (*1.16*) | -1.23 (*1.13*) |
| Happy | 2.21 (*0.91*) | 2.14 (*0.88*) |
| Fearful | -1.47 (*1.09*) | 0.69 (*1.28*) |
| Tender | 0.75 (*1.10*) | -0.50 (*1.04*) |
| Angry | -1.00 (*1.13*) | 1.16 (*1.36*) |

*Note*: Data presented as Mean (*standard deviation*)

Table 1:

Simple slope estimates, *t* and *p* values of alexithymia for each musicalemotion

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sad | | | Happy | | | Fearful | | | Tender | | | Angry | | |
|  | Est. | *t* | *p* | Est. | *t* | *p* | Est. | *t* | *p* | Est. | *t* | *p* | Est. | *t* | *p* |
| Valence | **.03** | **3.76** | **< .001** | -.01 | -1.33 | .185 | **.02** | **2.75** | **.006** | < -.00 | 0.53 | .776 | **.02** | **2.44** | **.015** |
| Arousal | **.03** | **4.02** | **< .001** | < -.00 | -0.44 | .661 | **-.02** | **-2.29** | **.022** | < .00 | 0.53 | .600 | **-.03** | **-4.00** | **< .001** |

*Note: Significant results are bolded*

Figures



Figure 1. Relationship between alexithymia and ratings of valence for music representing each target emotion. Bands indicate 95% Confidence Interval.



Figure 2. Relationship between alexithymia and ratings of arousal for music representing each target emotion.

Bands indicate 95% Confidence Interval.