Finding the words for it: how alexithymia can account for apparent deficits in the ability of an ASD group to describe their emotional responses to music

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ABSTRACT

It is common practice, when studying musically evoked emotions in listeners, to use a self-report format to measure their responses. This paper points out that the outcome of such studies will be affected by individual variability in participants' ability to verbalize their emotions (type-II alexithymia). It presents results from new research, comparing a sample of high-functioning adults with ASD to a matched control group on their emotional responses to a set of musical items. The study, which included both self-report and physiological measures of emotional responsiveness to music, as well as a separate measure of type-II alexithymia, demonstrates that an apparent reduction in emotional responsiveness to music in the ASD group can be accounted for by the higher mean level of alexithymia in that group. The implication of this, that the ASD group is essentially unimpaired in emotional responsiveness, is confirmed by the lack of group difference in the physiological responses to music. These findings suggest that future studies of musical emotions using self-report measures to compare groups whose mean alexithymia scores may differ, should not be interpreted as proving the existence of group differences in emotional responsiveness unless the alexithymia factor has also been taken into consideration.

1. INTRODUCTION

1.1 What is alexithymia?

Alexithymia literally means "being without words for emotions". In type II alexithymia, the category of interest here, the range of emotions experienced (ie the "affective dimension" of emotion) is normal, but the ability to access the language needed to verbalize them (the "cognitive dimension" of emotional experience) is impaired (Vorst & Bermond, 2001). Individuals with type II alexithymia may understand the meaning of words like jealousy and anger and may themselves experience these emotions, but they will typically be unable to discriminate between or name their own emotions as they arise, though they may be aware that they are feeling a negative emotion that they find disturbing.

Alexithymia is therefore characterized by a breakdown in the links between emotions and verbal abilities. Whilst such deficits are not uncommon in clinical populations (eg, Zahradnik et al., 2009), the ability to verbalise emotions shows considerable variability even among the general public, and as such, alexithymia is best viewed as a spectrum disorder.

1.2 Why is it important to consider alexithymia in a musical context?

Experimental tasks that require listeners to name their emotional responses to music, or to check boxes with prearranged lists of emotions (eg Zentner, Grandjean & Scherer, 2008), are measuring their ability to experience *and name* evoked emotions. One might call this variable cognitive emotional responsiveness to music, because a cognitive function – emotion verbalization – is an integral part of the process.

If this is viewed as a two stage process, with the experience evoked by the music comprising the first stage, and the naming of this experience comprising the second, the typical self-report paradigm measures the outcome of stage 1 followed by stage 2. A limitation, then, is that the subjective experience of emotion in response to music (stage 1) cannot be measured directly, and performance on stage 2 may be subject to individual variability, dependent on the individual's position on the spectrum of type II alexithymia.

The effect of this may not be important if the study compares groups or conditions which do not differ systematically on stage 2 performance, ie where alexithymia is not a confounding variable: in this case stage 2 merely introduces an additional source of random error. But if clinical populations are being compared with controls on sensitivity to musically evoked emotions using self-report, it is essential to measure and control for the influence of alexithymia on the results, otherwise the effects (if any) of the clinical condition on stage 1 will be inextricably confounded with the systematic error introduced by the effect of alexithymia on stage 2.

1.3 Why look at musically evoked emotions and autism?

Autism Spectrum Disorder (ASD) is a condition characterized by deficits in social and communication skills, together with a tendency to restricted and repetitive behaviour (DSM-IV-TR: American Psychiatric Association, 2000). Possible differences in the musical sensitivity of people with ASD may have implications for theories of how music originated, and how it generates emotional responses in the brain.

There are a number of plausible hypotheses put forward to account for the universal human appeal of music (for a summary, see Patel, 2008). One influential theory uses evolutionary principles to explain the liking for music as an adaptive change, driven by the role of music in facilitating social bonding (eg Huron, 2001). It has been suggested that as a consequence, the deficits in social skills seen in people with ASD will result in qualitative differences in their responses to music. In particular, it is predicted that they will not be emotionally responsive to music, or that they will have a low level of musical understanding or affinity with music (Huron, 2001; Levitin, 2006; Peretz, 2001). For short, I will refer to this claim as the autism music-difference hypothesis (AMDH). Thus, the argument goes, there is a logical link from the evolutionary theory of music, to a prediction that the AMDH will be correct.

Therefore, if the AMDH were false, this would tend to undermine the evidence for the evolutionary theory of music in this particular form. If, conversely, it were found that social deficits in individuals with ASD correlated strongly with differences in their responsiveness to music, this would tend to support the evolutionary theory. So it is a question of broad interest, extending beyond narrowly clinical considerations, whether, and how, people with ASD differ from the typically developing (TD) population in their reactions to music. We need to bear in mind, however, given the comments made above, that empirical data from self-report studies may need to be interpreted carefully in the light of the possible alexithymia confound, since alexithymia affects approximately 85% of individuals with ASD (Hill, Berthoz & Frith, 2004).

2. THE STORY SO FAR

2.1 Published studies: case not proven?

A number of less formal or less empirically based discussions of music and autism have cited the case of Temple Grandin, a distinguished professor at Colorado State University. Temple Grandin has autism, but has overcome the disability to the extent that she has made an outstanding contributions to the science of animal behaviour. She has stated (Levitin, 2006) that she has no emotional responsiveness towards, or interest in, music. It has been speculated by some writers that Grandin's lack of interest in music is likely to extend to the broader population of adults with ASD.

However, when we search for evidence to support these predictions in the peer-reviewed literature, we find that rigorous studies in this area have been surprisingly sparse. A search on Web of Science using the query music* AND autism* brings up only 138 papers, a proportion of which focus on musical savants, a subgroup which cannot be taken as representative of the ASD population as a whole. Given that a substantial number of the remainder are published in journals devoted to psychoanalysis, music therapy and, in one instance, homoeopathy, it can be appreciated that the number which report the results of scientifically-based comparisons of music perception in ASD and control groups is yet smaller.

The first papers to use standard quantitative experimental methodology and a group difference design to look at autism and music were published by Heaton and co-workers, initially in the late 1990s (eg Heaton, Hermelin & Pring, 1998) and subsequently throughout the 2000s. However, these focused on children rather than adults, and a number of them investigated perceptual processing or musical memory. The findings from these studies are therefore not directly relevant to questions of emotional responsiveness or musical understanding in high-functioning adults, and are thus unable to provide evidence either for or against the AMDH.

Excluding studies of children, individual case histories and savant studies, it appears that there have to date been just three peer-reviewed papers reporting empirical data clearly relevant to the AMDH, with participants comprising adults (including adolescents) with ASD. The first of these (Mottron, Peretz & Menard, 2000) tested local and global processing using a musical contour paradigm. The second (Bhatara et al., 2009), used silent and orchestrated versions of the social attribution task, in which participants are asked to give verbal descriptions of animated geometric shapes (Heider & Simmel, 1944). The final study was a qualitative investigation into the uses and experiences of music in adults with ASD (Allen, Hill & Heaton, 2009).

On a task which could be seen as a test of the AMDH, Bhatara et al. obtained a null result, in that orchestration of the visual stimuli revealed no significant differences in the responses of the participants with ASD and controls. Mottron et al., however, did find some evidence for the AMDH, though showing better performance by the ASD group. Their findings were consistent with empirical data showing enhanced discrimination of pitch in ASD (Bonnel et al., 2003; Heaton, 1998, 2005), and with the Enhanced Perceptual Functioning (EPF) model of autism (Mottron & Burack, 2001).

An early and influential cognitive theory of autism, the Weak Central Coherence theory (Frith & Happé, 1994) had proposed that autism is characterized by a global deficit. However, this theory appears inconsistent with one important finding from Mottron et al.'s study, namely that ASD participants were sensitive to musical contours, and that increased sensitivity to the "local" aspects of the musical stimuli (individual tones) did *not* co-occur alongside a global music processing deficit. Similar findings was reported in a study using musical intervals and contours in children with ASD (Heaton, 2005).

In the study by Allen et al. (2009), a qualitative methodology (Grounded Theory) using semi-structured interviews, examined the way a small sample (N = 12) of high functioning adults with ASD used and experienced music in their daily lives. The study compared the experiences of the participants with published investigations into the musical experiences of typically developing (TD) individuals (eg North, Hargreaves & Hargreaves, 2004), revealing many points of similarity. For example, both TD and ASD participants used music for mood management, as a means of emotional support, and for generating a feeling of group membership. However, there was a marked contrast in the way that the ASD participants described their affective reactions to music, and their self-reports focused on their internal arousal states (calmness, exhilaration etc), with less use of conventional emotion terms.

2.2 Absence of evidence, or evidence of absence?

This difference in verbal responses could be interpreted in various ways. For example, it might be suggested that they provide evidence for reduced or absent emotional responsiveness to music in the ASD sample. This could reflect an increased sensitivity to the perceptual properties of the music, as outlined in the EPF theory. Bowler (2007, p. 246) believes that “individuals with ASD seem to engage in less topdown processing when making perceptual judgements, that is to say, their reactions to the world are based on information that is closer to the properties of the incoming stimulus”. If, as Bowler suggests, ASD listeners are less likely to formulate complex top-down emotional interpretations of their reactions, this might produce language reflecting internal arousal states rather than emotion terms. Alternatively, and for the present purposes more relevantly, the results could reflect an inability to understand, or access, appropriate language to describe their emotions, ie type II alexithymia.

The question of whether individuals with ASD have a deficit in emotional responsiveness to music clearly cannot be resolved using conventional self-report methods alone, and the use of physiological measures, in combination with verbal reports, will be potentially more informative. One common measure of physiological responsiveness to music is galvanic skin response (GSR). As this measures activation of the autonomic nervous system (ANS) and is a reliable indicator of general emotional arousal, it can be used to test the AMDH in its most extreme form, that people with ASD will be emotionally unresponsive to music. Should the statistical analysis of GSR measures fail to distinguish ASD and control participants, the most parsimonious explanation for any observed deficits in musical outcomes relying on verbal report of emotional arousal may therefore be attributed to alexithymia rather than other deficits of a purely musical nature.

3. TESTING THE ALEXITHYMIA HYPOTHESIS

3.1 A new study: methods

The hypothesis, that differences in emotional responsiveness between ASD participants and controls reflect the presence of alexithymia in the former group, has now been tested in an experimental study carried out by the present author and co-workers (currently in course of publication). The study compared a sample of high-functioning adults with ASD (N = 23) and a group of TD controls (N = 24) matched on age, gender and BPVS vocabulary scores. Alexithymia was measured using the BVAQ-B scale (Vorst & Bermond, 2001), and autism diagnostic criteria were checked using a screening questionnaire, the AQ (Baron-Cohen et al., 2001). In order to control for any effects of prior musical expertise, a musical experience questionnaire was administered to all participants. GSR data were taken while participants listened to a sample of 12 short musical extracts previously piloted to represent happy, sad and ‘scary’ emotions (Quintin et al., 2010). In order to control for spurious effects due to group differences in low-level processing of sound, such as hyper-acusis, a control condition consisting of six duration-matched and decibel-matched sets of environmental sounds (BBC sound library) was included in the study.

The first active task that participants were given was to familiarise themselves with a check list of 28 words corresponding to possible affective responses to music, and to listen again in randomized order to six of the musical extracts, each time ticking any boxes for which that particular response was evoked by the music at any point (instructions emphasised the need to record only emotions evoked in the listener, not emotions perceived as present in the music: for clear explanations of the difference, see eg. Juslin & Västfjäll, 2008; Zentner et al., 2008). The word list comprised 14 items from the affective words used in the first, qualitative study using an ASD group (the words described arousal states: ‘calm’, ‘excited’, ‘tense’ etc), with the addition of a range of 14 words used by a control group in a pilot for the second study (words such as ‘happy’, ‘longing’, ‘hopeful’ etc).

It was assumed that the total number of emotion words that the person had ticked, over all six items of music (total = “wordcount”), was a measure of that person’s level of cognitive emotional responsiveness to music. It was predicted that the total mean wordcount for the autism group would be lower than for the control group, but that this difference would be completely mediated by the extent of their type II alexithymia, as measured by the BVAQ-B factors representing it.

It was further predicted that emotional responsiveness to music would be unimpaired in ASD participants, and that physiological (GSR) response measures would be responsible for a considerable proportion of the error variance in “wordcount”, and could be used as a covariate to increase the power of a multiple regression model for predicting wordcount on the basis of alexithymia scores. The (coded) data from the musical experience questionnaire were also included as a covariate in the analysis, on the basis that musically naïve and experienced listeners, whether ASD or TD, might demonstrate a marked difference in their liking for, and emotional reactivity towards, the classically-oriented musical items used in the study; the musical expertise variable could therefore account for some of the remaining error variance in the analysis.

A final task for participants was to complete a “Family Fortunes” assignment, where they had to match the remaining six musical items with six emotionally descriptive “word bundles” compiled by a control group during piloting. The aim of this condition was to see whether or not the ASD group might be able to circumvent their emotional identification difficulties by using cognitive strategies to work out the likely associations made by the TD pilot group, when cued with the alternatives in a forced choice task.

3.2 Results

As predicted, “wordcount” differed significantly between groups; TD participants checked an average total of 26 words for the six items of music, whereas this figure fell to 17 for the ASD group. The multiple regression analysis showed that group membership accounted for 12% of the variance in wordcount (measured as R^2). However, the ASD group also scored significantly higher on the questionnaire-based measure of alexithymia. The scale is in fact multi-factorial in structure, and not all factors are relevant: the one of greatest face validity here is BVAQ-B factor 3 (“poor insight”). This factor includes items such as “when I am fed up, it remains unclear to me whether I am sad or afraid or unhappy", clearly measuring the ability to identify one's internal feelings. When this factor (referred to below as "insight") and ASD membership are entered as independent variables in a multiple regression to predict "wordcount" as the dependent variable, the model accounts for 22% of the variance in wordcount, and insight is significant at $p = .024$. However the ASD group variable is no longer significant as an IV ($p = .065$), suggesting that this effect is substantially mediated by insight.

The situation is clearer when the noise variables of experience and GSR responsiveness are entered as covariates. The two groups did not differ in their means on these variables, so introducing them as covariates does not lead to a spurious confound with the group variable. In this case, the model accounts for an R^2 of 44% in wordcount, and all IVs are significant apart from ASD group membership. The exclusion of a single outlier in the solution (a control) gives a model with IVs of insight, experience and GSR response predicting wordcount, having an R^2 of 50% and an adjusted R^2 (an effect size measure which avoids bias due to overfitting) of 46%.

There were null results in both the profiles and "Family Fortunes" analyses. In other words, the ASD group showed no tendency, relative to the controls, to choose "internal arousal" over "normal emotion" words; nor did they perform any worse than controls in guessing which word bundles went with which items of music: in fact, with an average of 3.9 correct identifications out of 6, they were actually slightly, though not significantly, better than controls (averaging 3.3 correct).

3.3 Alexithymia & autism: the smoking gun?

The null result in the profiles test, though in conflict with the initial experimental hypothesis, is understandable when considered in the context of ASD group performance to be expected across cued versus non-cued word tasks. When the ASD group were asked, in the first study, to generate their own descriptions of their affective responses to music, they chose simple descriptions of arousal. However, when complex emotion words were made available in the check-box paradigm of the second study, the difficulty in accessing more complex emotion words was eliminated. At the same time, the problem of identifying an emotion word to correspond with their internal emotional state remained. This might allow us to account both for the significantly lower wordcount scores in the ASD group, and for the lack of difference in the profiles of words chosen. A similar explanation might account for the lack of deficit in ASD group performance on the Family Fortunes task. When cued with a set of emotion words, they may have been able to use a purely cognitive strategy for determining which word/music associations TD participants would make.

The finding that participants with ASD used fewer emotion words than typically developing controls appears robust (Cronbach's alpha, calculated by treating the words as separate test items, has a value of 0.88, showing good internal consistency). However, it has little to do with ASD group membership as such, and can be substantially accounted for by differences in type II alexithymia, in particular, scores on the "insight" factor from the BVAQ-B. Had we run the experiment employing the same experimental paradigm but omitting to include alexithymia measures in the analysis, the results might have been mistakenly interpreted as providing support for the view that individuals with ASD lack "musical understanding", "musical sensitivity" or some other important quality. However, as the analysis makes clear, the principal deficit demonstrated by the data was a reduced ability to link verbal labels and perceived emotions, and this appears unrelated to the ability to appreciate music, or to respond to music emotionally.

It should be noted that this analysis does *not* prove that the "insight" variable is the only determinant of ASD group sensitivity to emotion in music. There may well be other influences at play, which the sample sizes in this study were simply too small to detect. If, in the forced entry multiple regression, the unique contributions to variance in the "wordcount" DV are calculated separately for "insight" and the dichotomous group variable (ASD/controls), the squared part-correlations show that insight accounts for 11% of variance and group membership for 5%. It happens that in this study 5% is not significantly different from zero, but it may well be that there is some effect of ASD that is not mediated by alexithymia. In fact, a more extensive analysis, which includes a possible moderating role of experience on GSR response, suggests that there is indeed such an effect. It also tentatively identifies some of the AQ items concerned with cognitive empathy as accounting for this remaining variance. However, the analysis is both too lengthy and too speculative for inclusion here, and must await a subsequent, and fuller, account of the findings.

3.4 Conclusions

On a general point, the correlation between the insight factor and wordcount suggest that measurement of this factor from the BVAQ-B questionnaire is likely to account for an important source of individual variability, and thus improve the power and discrimination of self-report music/emotion paradigms even in studies dealing solely with TD participants.

The results of the second study lead to two observations relating to autism. Firstly, our findings indicate that the capacity for affective responses to music in ASD is largely preserved. This naturally suggests that music could be used as an integral part of a treatment program for alexithymia in high-functioning adults with autism, an approach set out in more detail in Allen and Heaton (2010).

Secondly, these results suggest that we should be mindful of the fact that paradigms which purport to test some perceptual or cognitive ability in clinical groups, such as ASD, should include precautions to ensure that inappropriate task demands do not compromise and confound measurement of the purported construct. Sensitivity to the emotional content of music is one area where alexithymia needs to be taken into consideration if emotional sensitivity is measured on the basis of self-report. More generally, experiments involving ASD participants should take full account of the range of difficulties potentially experienced by individuals with this disorder. In the absence of appropriate controls, over-elaborate experimental protocols imposed upon participants with dyspraxia or executive function issues may give rise to completely spurious experimental outcomes.

Finally, it is of interest that a recent neuroimaging study comparing ASD and control groups (Bird et al., 2010) provided compelling evidence that alexithymia is no mere hypothetical construct. They found, in a task measuring empathic responsiveness, that degree of alexithymia correlated strongly and negatively with activity in the left anterior insula (the anterior insula is already known to be important in empathic understanding: Singer et al., 2009), and that once alexithymia had been factored out, there were no differences in empathy between ASD and control groups. Bird et al. suggested that "empathy deficits observed in autism may be due to the large comorbidity between alexithymic traits and autism, rather than representing a necessary feature of the social impairments in autism".

The same comment might be made of the apparent deficits in musical emotional responsiveness in autism, demonstrated by the lower wordcount score in the ASD sample as described above. It appears that this deficit is not a necessary consequence of the social impairments characteristic of ASD; the underlying responsiveness, as measured using GSR, appears normal. As far as the issues discussed in §1.3 above are concerned, therefore, these data provide no support for the AMDH, nor, by implication, for evolutionary theories of music which require the AMDH as a necessary consequence.

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