Uses and Functions of Music in Congenital Amusia

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The goal of this study was to ascertain whether deficits in music perception impact upon music appreciation. Likert ratings were gathered from congenital amusics and matched controls concerning the degree to which individuals incorporate music in their everyday lives, are able to achieve certain psychological states through music, and feel positively about music imposed upon them. Those with amusia reported incorporating music into everyday activities to a lesser degree than controls. They also reported experiencing fewer changes in psychological states when listening to music and felt more negatively about imposed music compared to controls. However, the scores of some amusic individuals fell within the control range on these questionnaires, providing some evidence for a developmental dissociation between music perception (impaired) and music appreciation (normal). Potential reasons for this dissociation are discussed.

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Music is enjoyed in the 'stream of everyday life' (Konecni, 1982) and it is within this context that we can learn how and why the non-specialist listener uses music. Studies of everyday music listening have emphasized the active role of the listener, who consciously and deliberately uses music to achieve or enhance certain, predominantly affective, psychological states (DeNora, 1999, 2000; Sloboda, 1999). The extent to which music can mediate these psychological changes will depend on an interaction between the listener, the music, and the music listening situation (North & Hargreaves, 1997). However, within this triad of factors, the ability to discern physical and structural characteristics of music is incontrovertibly important (Scherer & Zentner, 2001). The question therefore arises whether music perceptual deficits, such as in those seen in amusia, limit the extent to which music can be appreciated.

Individuals with congenital amusia have a true perceptual agnosia. These individuals cannot recognize familiar tunes or tell two tunes apart (Peretz, Champod, & Hyde, 2003). They should be distinguished from those individuals who self label as tone deaf yet have no demonstrable perceptual deficits (Cuddy, Balkwill, Peretz, & Holden, 2005). While much amusia research has focused on the perception of music and its components (Foxton, Dean, Gee, Peretz, & Griffiths, 2004; Hyde & Peretz, 2004; Peretz et al., 2002), the question of how these perceptual impairments impact upon the appreciation of music has not been systematically addressed.

While one may predict that faulty perception of music will limit its appreciation, degraded perceptual input is not always a bar to appreciation, as in the case of some deaf individuals (Chorost, 2005). Music is a multidimensional stimulus and even if amusic individuals are relatively insensitive to pitch, the perception of other aspects of music, such as rhythm or timbre, may allow them to generate expectancies that are crucial for mediating the affective dimension of music listening (Huron, 2006).

Indeed, congenitally amusic individuals are able to differentiate between excerpts of music that normal listeners identify as happy or sad, suggesting that they have preserved sensitivity to at least one of the structural features (tempo) that is conventionally used to convey affective tone (Ayotte, Peretz, & Hyde, 2002). However, the identification of an emotion within a piece of music should be distinguished from the actual experience of an emotional state evoked or mediated through musical listening (Sloboda, 1991). In the present paper, we address the experiential aspects of music listening, asking whether individuals with congenital amusia report employing and experiencing music in a similar way to non-amusic individuals of a similar age and music training background.

Three questionnaires were developed. Questionnaire 1 ('Uses of Music') investigated the 'how' of music listening in amusics and matched controls. Research on everyday music listening has shown that people use music purposely and deliberately in many everyday

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situations; while performing household chores, driving, cycling or running, working or reading, or having a bath (Juslin & Laukka, 2004; North & Hargreaves, 2004; Sloboda, O'Neill, & Ivaldi, 2001). Questionnaire 1 therefore asked individuals to report how likely they were to employ music in some of these common everyday situations. We hypothesized that those with amusia would report incorporating music into these everyday activities to a lesser extent than controls.

Questionnaire 2 ('Functions of Music') investigated the 'why' of music listening in the two groups. Previous literature has shown that music is often used in order to consciously and deliberately achieve psychological (mainly affective) goals: to motivate, excite, or calm, to match or induce particular moods, to trigger memories of past events, to help release strong emotions, and as a source of comfort or healing (DeNora, 1999; 2000; Juslin & Laukka, 2004; Sloboda, 1999). Questionnaire 2 therefore asked individuals to report whether they had experienced various commonly reported psychological states through music. We hypothesized that those with amusia would report experiencing fewer psychological states in response to music listening, compared with controls.

In contrast to the positive reactions listeners experience to music of their own choice, reactions to imposed music, such as music experienced in bars, restaurants, and shops are often negative, or at best ambivalent (Sloboda, 1999). Such reactions are often evoked because this 'imposed' music may not be deemed a good fit to the context in which it is played and/or is incongruent with the listener's identity and personal preferences (North & Hargreaves, 1997). Questionnaire 3, ('Attitudes to Imposed Music') was therefore designed to investigate how amusic individuals feel about music that is outside of their control. We hypothesized that both amusic and control groups would feel negatively towards imposed music but for different reasons—predominantly due to a degraded perceptual input for the amusics and primarily due to a lack of control or contextual fit for the controls.

Method

Participant Characterization

Participants were identified as amusic on the basis of their scores on a standard music perception battery, the Montreal Battery of Evaluation of Amusia (MBEA, Peretz et al., 2003). This battery comprises six subtests designed to assess distinct aspects of music perception. Each subtest requires participants to listen to 30 pairs of novel musical phrases and report whether they are the same or different. An online version of one of these six subtests (scale) was used to screen for potential amusics (www.delosis.com/listening/home.html).

Participants who had taken the online scale test at least twice and achieved a mean score that was two standard deviations below the mean score of a normative sample of 160 adults (Peretz et al., 2003) were invited to the laboratory for face to face testing on four of the six subtests: scale, contour, interval, and rhythm. Previous studies of amusia have demonstrated consistent findings of pitch-related deficits in amusia, while the presence of rhythmic deficits appears to be more varied (Ayotte et al., 2002; Peretz et al., 2003). We therefore calculated, for each individual, a score that was a composite of all three pitch subtest scores. Individuals were classified as amusic if their composite score fell below 65 out of 90, placing them two standard deviations below the composite mean score of the normative sample (Peretz et al., 2003).

Seventy percent of the participants who were invited to the laboratory based on their score on the online scale subtest achieved a composite score below 65 during face to face testing on the scale, contour, and interval subtests combined. Within the group of those individuals classified as amusic, a comparison of the scores obtained during the online and subsequent face to face testing of the scale subtest revealed a significant positive relationship, $r\,(19) = .71$, $p = .001$.

All participants classified as amusic additionally reported lifelong difficulties with music during a screening interview. For instance, participants variously mentioned their difficulties with singing in tune (as remarked upon by friends/family), their inability to recognize familiar tunes or summon them from memory, and their difficulty in spotting notes that are 'out of key.' Several also remarked upon additional problems with clapping or dancing in time.

Each amusic individual was matched to a control participant of the same gender and of similar age and music training background, who scored in the normal range across the scale, contour, interval, and rhythm subtests of the MBEA. Both groups comprised 7 males and 14 females, ranging in age from 31 to 69 years ($M = 50.6$, $SD = 9.4$). Table 1 details the demographic details and performance on the four MBEA subtests of the amusic sample. Table 2 summarizes the characteristics of the amusic and control groups.

General Feeling about Music and Hours of Listening

As a simple gauge of the extent to which participants liked or disliked music, participants were asked, 'How do you feel about music in general?' with the following

TABLE 1. Amusic Participants' Demographic Details and Individual MBEA Subtest Scores.

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21
Demographics																					
Gender	F	M	M	F	M	M	M	F	F	F	F	F	M	F	M	F	F	F	F	F	F
Age	54	34	46	55	54	36	65	55	45	45	51	69	55	59	31	50	56	61	54	44	49
Education	16	13	11	17.5	16	16	16	19	14	18	21	17	20	16	16	11	17	11	20	17	17
Music-Training	0	2	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	.5	3	0	6
Music Battery																					
Scale	16	14	21	19	18	18	19	16	18	17	23	20	15	17	20	19	20	14	19	17	17
Contour	14	15	18	19	21	19	16	20	20	19	16	21	17	19	22	23	20	15	23	19	20
Interval	16	14	18	16	16	17	18	17	15	18	17	19	17	15	19	17	20	20	18	14	19
Composite	46	43	57	54	55	54	53	53	53	54	56	60	49	51	61	59	60	49	60	50	56
Rhythm	24	18	24	21	20	21	23	25	19	19	23	27	21	29	25	26	22	18	27	24	18

F = female; M = male. Age, education, and music training are expressed in years. MBEA = Montreal Battery of Evaluation of Amusia. Composite = aggregate of scores on pitch-related MBEA sub-tests (scale, contour, interval).

TABLE 2. Participants' Characteristics and Scores on the MBEA.

	Amusics (*SD*)	Controls (*SD*)	*U*
Demographic Characteristics			
Gender	7 M, 14 F	7 M, 14 F	—
Age	51.0 (9.6)	50.2 (9.4)	220
Education	16.2 (2.9)	16.6 (2.6)	194
Music Training	0.7 (1.5)	0.9 (1.8)	209
Music Battery (MBEA)			
Scale	18.0 (2.3)	26.6 (1.8)	0***
Contour	18.9 (2.6)	26.9 (1.5)	0***
Interval	17.1 (1.8)	26.4 (2.3)	0***
Composite	54.0 (4.8)	80.0 (4.7)	0***
Rhythm	22.6 (3.3)	27.1 (1.8)	51***

F = female; M = male; *SD* = standard deviation. MBEA = Montreal Battery of Evaluation of Amusia. Composite = aggregate score on scale, contour and interval MBEA subtests.
U = computed value of Mann-Whitney tests comparing the two groups; ***$p < .001$ level, one-tailed.

response options: 'I love music,' 'I like music,' 'I am indifferent to music,' 'I dislike music,' and 'I hate music.' In addition, they were asked how many hours per week they spend listening to music of their own choice, including instances where music was used as background accompaniment to another activity.

Questionnaires

Three Likert scale questionnaires were developed, each consisting of 10 items. Questionnaire 1 ('Uses of Music') and Questionnaire 2 ('Functions of Music') both drew on findings from previous studies of everyday music listening (Sloboda, 1999; Sloboda et al., 2001) in untrained Western listeners. Questionnaire 1, 'Uses of Music,' asked participants to indicate how likely they were to include music of their choice during a variety of everyday situations, with the following response options: 'very likely,' 'likely,' 'unsure,' 'unlikely,' and 'very unlikely.' Example situations included studying or working at home, exercising, or having a bath.

Questionnaire 2, 'Functions of Music,' asked participants to indicate whether they had experienced certain psychological changes while listening to music, using a scale of 'strongly agree,' 'agree,' 'unsure,' 'disagree,' and 'strongly disagree.' Examples included effects of music on arousal or emotional state.

Questionnaire 3, 'Attitudes to Imposed Music,' investigated participants' feelings concerning music over which they have no control (North & Hargreaves, 1997). Participants were asked to rate how the presence of imposed music would affect their experience of certain situations, from the following options: 'very positively,' 'positively,' 'indifferently,' 'negatively,' and 'very negatively.' Examples included the presence of piped music in elevators, in shops, or while eating out with friends. Response options were reversed for different items and every second item was reverse worded to guard against any potential effects of response bias. All questionnaires had an optional response box for participants to elaborate on their response with written comments.

Procedure

The three questionnaires were administered to participants. Written instructions for the questionnaires encouraged participants to conceptualize music in its broadest form and to refer to situations in general when responding. The instructions also addressed the possibility that some participants may not have experienced a given situation included in the questionnaires and asked participants to give a response corresponding to how they imagine they would feel in such a situation.

Data Recording

For each questionnaire item, the response (e.g., very likely, likely, unsure, unlikely, very unlikely) was converted to a numerical score, from 1 to 5, where 1 reflected the most negative response (very unlikely) and 5, the most positive response (very likely). Missing data (0.3% of the total) were substituted using the mean score for that item from the relevant participant group (Tabachnick & Fidell, 2001). Total scores were derived for each questionnaire by summing the scores for each of the ten items, yielding a range of scores between

10 and 50. Higher total scores reflected an increased likelihood of including music during everyday activities (Questionnaire 1), an increased ability to employ music to achieve certain psychological states (Questionnaire 2), and a more positive attitude towards imposed music (Questionnaire 3). Lower scores reflected the reverse. For each questionnaire, total scores for each participant were entered into SPSS (version 14) and were used as the basis for the between group comparison.

Results

General Feelings about Music and Hours of Listening

A Mann Whitney *U* one-tailed test revealed a significant difference between groups for the response to the question: 'How do you feel about music in general?' While 100% of control participants reported liking or loving music, only 43% of the amusic participants felt similarly, $U = 41$, $p < .001$, $r = -.73$.[1] A significant difference between groups was also found for the number of hours of listening to music. On average, control participants listened to 9 hours of music per week, compared with amusic participants who listened to 3 hours of music per week, $U = 91$, $p < .001$, $r = -.51$. These between group differences represent large effect sizes (Field, 2005).

Questionnaire Reliability

Each of the developed questionnaires was demonstrated to have a high internal consistency. Cronbach's alpha values for the three questionnaires were: .88 (Questionnaire 1: 'Uses of Music'), .93 (Questionnaire 2: 'Functions of Music'), and .85 (Questionnaire 3: 'Attitudes to Imposed Music').

Comparison of Questionnaire Scores Between Groups

Mann Whitney *U* tests were used to compare total scores for the amusic and control groups for each questionnaire (alpha level of .05), and to compare scores for each of the items within the three questionnaires (alpha level of .005, following Bonferroni corrections for multiple testing). Mann Whitney *U* exact significance values are reported in all cases (as opposed to asymptotic values), as recommended for smaller sample sizes (Field, 2005). Higher descriptive scores indicate more frequent use of music in everyday situations (Questionnaire 1), increased experience of changes in psychological states mediated via music (Questionnaire 2) and a higher tolerance of imposed music (Questionnaire 3). One-tailed tests were used where we had a directional hypothesis about group differences (Questionnaires 1 and 2) and a two-tailed test was used where we did not (Questionnaire 3).

Questionnaire 1: 'Uses of Music'

Figure 1 shows the distribution of total scores on Questionnaire 1 for both groups. A Mann Whitney *U* one-tailed test revealed a significant difference between groups. Amusic participants, as a group, were less likely to incorporate music during a selection of everyday activities compared with control participants, $U = 99$, $p = .001$, $r = -.47$. The effect size was medium.

Table 3 shows the results for each of the ten items on this questionnaire. Overall, the amusic participants, as a group, report incorporating music less while reading as a leisure activity, when studying or working at home, while performing household chores, while driving or traveling, at bedtime, and during a romantic evening. The between group differences for these items represent medium to large effect sizes.

While both amusic and control participants reported that they would include music during everyday activities

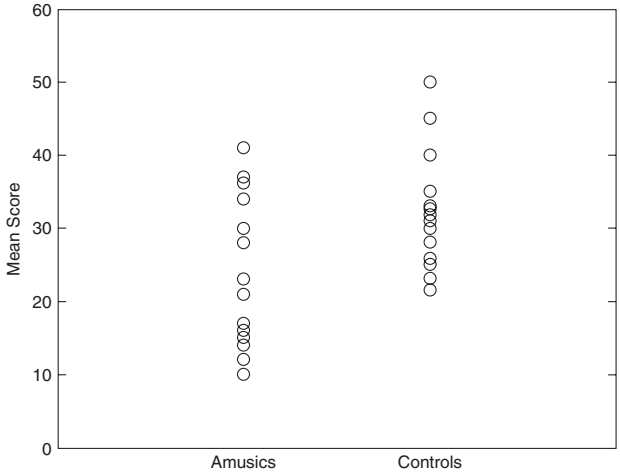

FIGURE 1. Distribution of total scores for Questionnaire 1: 'Uses of Music.'

[1] *r* represents an effect size estimate derived by converting test statistics into *z*-scores and dividing by the square root of the sample size (Rosenthal, 1991).

TABLE 3. Questionnaire 1: Inclusion of Music in Certain Everyday Situations.

	Amusics ($n = 21$)			Controls ($n = 21$)			Statistics	
	Likely	Unsure	Unlikely	Likely	Unsure	Unlikely	U	r
Bath	33%	10%	57%	48%	5%	48%	192	−.12
Exercising	33%	5%	62%	62%	0%	38%	146	−.30
Reading	10%	0%	91%	33%	10%	57%	117*	−.43
Study/Work	24%	5%	71%	48%	19%	33%	102*	−.47
Chores	33%	5%	62%	91%	5%	5%	86*	−.54
Driving	43%	5%	52%	86%	5%	10%	110*	−.46
Getting up	10%	5%	86%	33%	0%	67%	129	−.38
Bedtime	5%	0%	95%	24%	10%	67%	112*	−.45
Romance	48%	14%	38%	81%	5%	14%	119*	−.41
Walk	14%	0%	86%	29%	5%	67%	134	−.37

For presentation purposes, responses for 'very likely'/'likely' and 'very unlikely'/'unlikely' have been summated.
U = computed value of Mann-Whitney test; r = effect size estimate; *$p < .005$, one-tailed (Bonferroni-corrected).

if the task was relatively undemanding, such as while performing household chores or on a long journey, a number of amusic participants ultimately preferred complete absence of music. For example, one commented, '*I often listen to radio 4* (a speech-based channel) *whilst doing house work—no music programmes though!*' The reported use of music to set the ambience and mood for a romantic evening also differed greatly between controls and amusics (81% of controls were likely to use music in this way compared with 48% of amusics). Of the amusics who did report using music in this way, many reported that it was solely for the enjoyment of their partner, '*I am thinking of the other person and how to make it enjoyable for them.*'

Questionnaire 2: 'Functions of Music'

Figure 2 shows the distribution of total scores on Questionnaire 2 for both groups. A Mann Whitney U one-tailed test revealed a significant difference between groups. Amusic participants, as a group, reported fewer psychological changes associated with listening to music compared with control participants, $U = 25$, $p < .001$, $r = -.76$. The effect size was large.

Table 4 shows the results for each of the ten items on this questionnaire. Significant between group differences were found for all but one item, which concerned the ability of music to evoke nostalgic memories of past times. However, the between group comparison for this item was close to significance, $U = 131$, $p = .006$, $r = -.41$. Effect sizes were medium to large.

When amusic participants did report experiencing psychological changes in response to music, this was often specifically described in relation to the lyrics or cultural associations present in the music, rather than to the music itself. This was especially true for the item relating to nostalgia. For example, one amusic commented, '*The lyrics of songs from my teens can sometimes do this [evoke nostalgic memories]. [However] I cannot "hear" them but have to read them.*'

The comments from some amusic participants concerning effects of music on arousal are also revealing. For example, in response to the item, 'Certain music can sometimes motivate or excite me,' one amusic wrote, '*Excite me to irritability and annoyance.*' In response to the item, 'I have never experienced tingles/goose pimples/shivers from any kind of music,' the same amusic participant wrote, '*[I have experienced]*

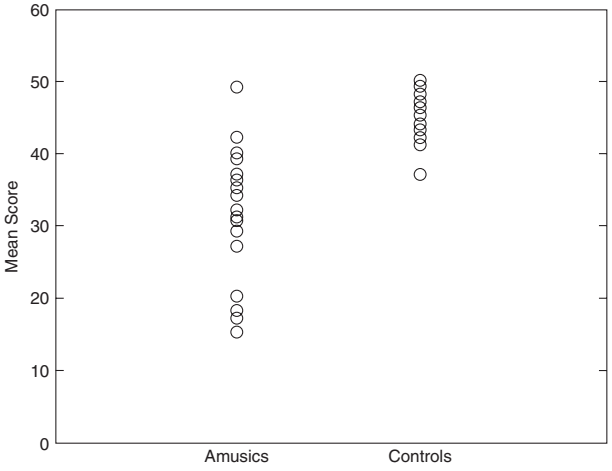

FIGURE 2. Distribution of total scores for Questionnaire 2: 'Functions of Music.'

TABLE 4. Questionnaire 2: Ability of Music to Induce Certain Psychological Changes.

	Amusics ($n = 21$)			Controls ($n = 21$)			Statistics	
	Agree	Unsure	Disagree	Agree	Unsure	Disagree	*U*	*r*
Nostalgia	86%	10%	5%	100%	0%	0%	131	−.41
Shivers	43%	14%	43%	91%	0%	10%	78*	−.61
Match mood	57%	14%	29%	100%	0%	0%	81*	−.60
Catharsis	38%	14%	48%	100%	0%	0%	65*	−.67
Relax	52%	0%	48%	100%	0%	0%	70*	−.62
Uplift	33%	5%	62%	100%	0%	0%	49*	−.69
Sadden	48%	10%	43%	95%	0%	5%	111*	−.45
Comfort	29%	10%	62%	95%	0%	5%	89*	−.54
Motivate	48%	10%	43%	100%	0%	0%	87*	−.55
Spiritual	24%	24%	52%	72%	10%	19%	114*	−.43

For presentation purposes, responses for 'very likely'/'likely' and 'very unlikely'/'unlikely' have been summated.
U = computed value of Mann-Whitney test; *r* = effect size estimate; *$p < .005$, one-tailed (Bonferroni-corrected).

just a sort of irritable rage. Now I wonder what others feel and think I may be missing out on something.'

Questionnaire 3: 'Attitudes to Imposed Music'

Figure 3 shows the distribution of total scores on Questionnaire 3 for both groups. A Mann Whitney *U* two-tailed test revealed a significant difference between groups. Amusic participants, as a group, regarded imposed music more negatively compared with control participants, $U = 134$, $p = < .05$, $r = -.34$. The effect size was medium.

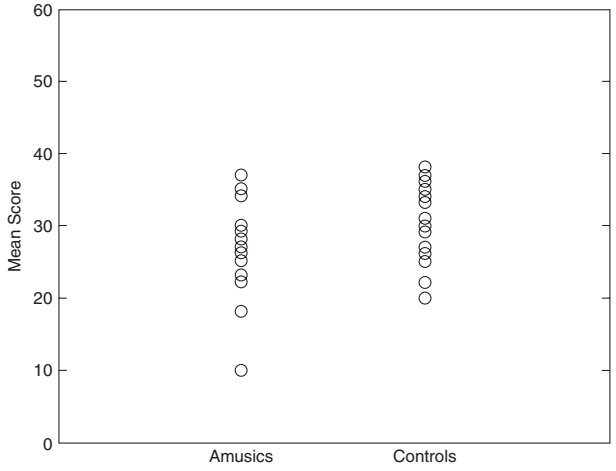

FIGURE 3. Distribution of total scores for Questionnaire 3: 'Attitudes to Imposed Music.'

Table 5 shows the results for each of the ten items on this questionnaire. Significant between group differences were found for one item only—an item asking how the presence of imposed music would be regarded in a communal area within the home. Half of the control group, in contrast to none of the amusic group, rated the presence of imposed music within the home positively.

As expected, comments from participants of both groups often revealed a dislike of music in public places. However, responses from the amusic participants were, in general, particularly negative, even for social situations where music is frequently acknowledged to have an important role. For instance, in response to the item, 'You are at a party or occasion (e.g., wedding). How would the presence of music which is outside your control, affect your enjoyment of the occasion?' only a third as many amusic individuals as controls rated the presence of music positively. One amusic commented, '*I would find it very hard to stay in the room . . . I find it makes my ears and head hurt and so avoid these situations at all cost. In fact if I have to go to such an event I get very anxious weeks beforehand and try to work out coping strategies which all usually involve can I avoid the event or how soon can I leave. I am not a social mixing type of person probably because of this.*'

One situation in which imposed music was judged positively by both amusic and control participants was listening to the street musician or 'busker.' Although no significant between group differences were found with regard to this item, 48% of amusics compared with 67% of control participants, rated street music positively, representing the item with the most positive rating for the amusic group.

TABLE 5. Questionnaire 3: Impact of Imposed Music on Enjoyment of Certain Situations.

	Amusics ($n = 21$)			Controls ($n = 21$)			Statistics	
	Positive	Indifferent	Negative	Positive	Indifferent	Negative	U	r
Party	19%	52%	29%	62%	10%	29%	148	−.29
Eating Out	19%	48%	33%	33%	43%	24%	176	−.18
Cinema	38%	52%	10%	76%	24%	0%	120	−.42
Elevator	5%	52%	43%	5%	38%	57%	207	−.06
Doctors	14%	38%	48%	33%	43%	24%	146	−.30
Shopping	10%	38%	52%	10%	43%	48%	202	−.08
Living area	0%	29%	71%	48%	24%	29%	92*	−.52
Buskers	48%	24%	29%	67%	33%	0%	167	−.23
Phone	14%	29%	57%	10%	24%	67%	193	−.11
Transport	10%	14%	76%	5%	29%	67%	193	−.12

For presentation purposes, responses for 'very likely'/'likely' and 'very unlikely'/'unlikely' have been summated.
U = computed value of Mann-Whitney test; r = effect size estimate; * $p < .005$, one-tailed (Bonferroni-corrected).

Correlations Between Variables

Spearman Rho correlations were employed to assess the relationships between variables. For the control group, there was a significant correlation between 'hours spent listening to music' and scores on Questionnaire 1 ('Uses of Music'), $r_s(19) = .57$, $p < .01$ and between 'hours spent listening to music' and gender, with women listening to more music than men, $r_s(19) = .45$, $p < .05$. There was also a significant correlation between scores on the MBEA rhythm subtest and Questionnaire 1, $r_s(19) = .53$, $p < .05$.

For the amusic group, several variables correlated significantly with age: 'Hours spent listening to music,' $r_s(19) = -.69$, $p < .001$, scores on Questionnaire 1, $r_s(19) = -.72$, $p < .001$, and scores on Questionnaire 2 ('Functions of Music'), $r_s(19) = -.70$, $p < .001$. The variable 'hours spent listening to music' correlated significantly with scores on Questionnaire 1, $r_s(19) = .63$, $p < .005$ and Questionnaire 2, $r_s(19) = .49$, $p < .05$. The extent to which participants reported liking music correlated significantly with scores on Questionnaire 1, $r_s(19) = .74$, $p < .001$, scores on Questionnaire 2, $r_s(19) = .69$, $p < .001$, and scores on Questionnaire 3 ('Attitudes to Imposed Music'), $r_s(19) = .61$, $p < .005$. Scores on Questionnaire 1 and Questionnaire 2 correlated significantly, $r_s(19) = .85$, $p < .001$, as did scores on Questionnaire 2 and Questionnaire 3, $r_s(19) = .59$, $p = .005$.

Subgroups Within the Amusia Group

On the basis of the preceding analysis, it is evident that while the amusics scored lower as a group on all three questionnaires, some amusics scored in the same range as the control participants. This suggests the presence of a subgroup of amusic individuals who are able to use music in similar contexts and for similar psychological functions as non-amusic listeners despite abnormal performance on the MBEA. In order to explore whether any demographic or performance variables might account for these differences in self-reported music appreciation, we divided the amusic group into two subgroups, according to how they scored on Questionnaires 1 and 2. Subgroup 1 comprised those amusics who scored within the control range on both questionnaires ($n = 5$) and subgroup 2 comprised those amusics who scored outside the control range on both questionnaires ($n = 11$). Table 6 summarizes the demographic characteristics and MBEA scores of the two subgroups.

A statistical comparison revealed that the subgroups differed significantly in age and in the number of hours reported voluntary music listening per week. Those in subgroup 2 were significantly older and listened to significantly less music per week than the individuals in subgroup 1. No other variables differed significantly between the two subgroups.

Discussion

The results were consistent with prior research demonstrating that, for non-amusic listeners at least, music is often used as an accompaniment to other activities (Juslin & Laukka, 2004; North & Hargreaves, 2004; Sloboda et al., 2001). In line with these previous studies, activities such as performing household chores, driving (91% and 86%, respectively), romantic occasions (81%), and exercise (64%) were reported to be the most likely activities to be accompanied by music. The reported functions of music for non-amusic listeners

TABLE 6. Demographic Characteristics and Scores on MBEA Subtests of Amusic Subgroups.

	Subgroup 1 (*SD*)	Subgroup 2 (*SD*)	*U*
Demographic Characteristics			
Gender	2 M, 3 F	3 M, 8 F	24
Age (years)	41.2 (7.6)	57.6 (5.4)	0***
Education (years)	16.8 (0.8)	17.1 (2.8)	26
Music Training (years)	1.2 (2.7)	0.4 (0.8)	27
Hours Music Listening	8.1 (10.1)	0.6 (1.2)	10*
Reported Liking of Music	40 %	18%	13
Music Battery (MBEA)			
Composite	55.0 (4.0)	54.1 (4.8)	24
Rhythm test	21.4 (3.0)	23.2 (3.3)	20

SD = standard deviation. F = female; M = male; Hours listening to music is reported as the amount of voluntary listening per week. MBEA = Montreal Battery of Evaluation of Amusia. *U* = computed value of Mann-Whitney test; * $p < .05$, *** $p < .0001$ (both two-tailed).

also echoed previous findings, demonstrating that music is frequently used to achieve psychological goals: to evoke memories, to match or modulate subjective moods, to increase arousal levels, and to aid relaxation (Juslin & Laukka, 2004; Sloboda et al., 2001). Indeed, participants in the control group identified so strongly with these suggested functions of music that for eight of the ten items, 95% or more participants rated them positively.

Amusic participants were, in general, less positive about music compared with controls. While all control participants reported 'liking' or 'loving' music, this was true for less than half the amusics. This was also reflected in a significant difference in the number of hours per week spent listening to music, with control participants listening, on average, to more than three times as much music as the amusic listeners. The scores on the three questionnaires largely supported our predictions: amusic participants, as a group, reported employing music considerably less in everyday situations and experiencing fewer psychological changes in response to music. In addition, amusic participants reported feeling more negatively about imposed music than control participants. The effect size for this difference was smaller than for the other two questionnaires, reflecting the fact that, as predicted, many control participants also felt negatively about the presence of music in public places. With regard to imposed music, only one item—referring to the presence of music in a communal area within the home—revealed a significant difference between groups. It may be that the presence of another's choice of music within the home is particularly difficult for some amusic individuals because, even if they are relatively used to encountering music in public places, the home is one place where they might expect to be able to exercise control over their listening environment.

Although previous research has demonstrated that those with congenital amusia are able to recognize affective content present in music excerpts (Ayotte et al., 2002), the majority of our amusic group reported an impoverished experience of affective states when listening to music. This finding underlines the distinction between recognizing and experiencing emotion in music (Kivy, 1989). Nevertheless, a subgroup of amusic individuals ($n = 5$) scored within the control range on Questionnaires 1 and 2, suggesting that they employ music in similar contexts and for similar reasons as do non-amusic listeners, in spite of their evident music perceptual impairments. This dissociation between perception (impaired) and appreciation (normal) has been previously shown in clinical cases (Lechevalier, Rossa, Eustache, Schupp, Boner, & Bazin, 1984; Peretz & Gagnon, 1999; Peretz, Gagnon, & Bouchard, 1998) but, to our knowledge, has not before been demonstrated in congenital cases of amusia.

An examination of the characteristics of those amusic individuals scoring in the same range as the controls for Questionnaires 1 and 2 versus those amusics scoring below the range of the controls on both questionnaires revealed that neither performance on the MBEA pitch-related or rhythm tests, nor music training background could account for this difference. The only variables that were significantly different between the two subgroups were age and number of hours of voluntary music listening per week. Those amusics scoring below the range of controls' scores on Questionnaire 1 ('Uses of Music') and Questionnaire 2 ('Functions of Music') were significantly older and listened to significantly less music per week compared to those scoring within the same range as the controls. Indeed, across the amusic group as a whole, there was a significant negative

correlation between age and number of hours of voluntary music listening per week that was not evident in the control group.

The reason why older amusic individuals spend less time listening to music and report fewer psychological changes in response to music listening is not clear. One possibility is that the younger amusics may be less inclined to admit to an indifference towards music for reasons of social desirability and impression management. However, this is not supported by previous research suggesting that social desirability and impression management increase with age (Eysenck & Eysenck, 1975; Ray, 1988). One plausible explanation for the effect of age in the amusic group may be that the younger amusics score in the normal range on Questionnaires 1 and 2 because of factors that are extrinsic to their appreciation of the music per se. Music listening is crucial for the formation of self identity in early adulthood (Green, 1999). The inextricable link between music and social identity allows for the possibility that, in young adulthood, music may be employed partly on the basis of factors that are not intrinsic to the music per se, but rather the social and cultural associations that music carries. With increasing age, when the role of music in establishing or maintaining social identity is likely to be reduced, individuals may employ music in everyday situations based upon their evaluation of the music in its own right. By this reasoning, amusic individuals may have a lower self-reported appreciation for music than non-amusics throughout the life span, but a potential indifference to music may be masked in the younger amusics due to the influence of sociocultural factors. In underlining the myriad of potential factors that may influence music appreciation, such an account emphasizes the need to investigate experiential effects of contextualized music listening as a complement to laboratory based studies of music perception.

Conclusion

The current study documents the reported uses and functions of music in a group of congenitally amusic adults. The findings suggest that music perceptual deficits can, but do not always, limit music appreciation. A subgroup of amusics reported levels of musical engagement and appreciation that were within the same range as the control participants. The suggestion of a dissociation between perception (impaired) and appreciation (normal) found in the current study provides a clear motivation for future research that will combine the self-report method with additional objective empirical approaches such as the measurement of physiological responses. These future research objectives will further explore the interdependence—or otherwise—of what we hear and how we feel.

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