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High emotional contagion and empathy are associated with enhanced detection of emotional authenticity in laughter

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Abstract

Nonverbal vocalizations such as laughter pervade social interactions, and the ability to accurately interpret them is an important skill. Previous research has probed the general mechanisms supporting vocal emotional processing, but the factors that determine individual differences in this ability remain poorly understood. Here we ask if the propensity to resonate with others' emotions – as measured by trait levels of emotional contagion and empathy – relates to the ability to perceive different types of laughter. We focus on emotional authenticity detection in spontaneous and voluntary laughs: spontaneous laughs reflect a less controlled and genuinely felt emotion, and voluntary laughs reflect a more deliberate communicative act (e.g., polite agreement). One hundred nineteen participants evaluated the authenticity and contagiousness of spontaneous and voluntary laughs, and completed two self-report measures of resonance with others' emotions: the Emotional Contagion Scale, and the Empathic Concern scale of the Interpersonal Reactivity Index. We found that higher scores on these measures predict enhanced ability to detect laughter authenticity. We further observed that perceived contagion responses during listening to laughter significantly relate to authenticity detection. These findings suggest that resonating with others' emotions provides a mechanism for processing complex aspects of vocal emotional information.

Keywords

affective empathy; emotional authenticity; emotional contagion; laughter; emotional vocalizations

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Voices are a major source of emotional information in social interactions. Like facial expressions, vocalizations such as laughter, screams or crying offer a window into the intentions and emotions of others. These nonverbal cues are rapidly detected (Sauter &

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Eimer, 2010), communicate a range of positive and negative emotions (e.g., Lima, Alves, Scott, & Castro, 2014; Sauter, Eisner, Calder, & Scott, 2010), and are cross-culturally recognized (Sauter, Eisner, Ekman, & Scott, 2010). Nonverbal vocalizations are highly variable, and there is an increasing interest in understanding how different forms of the same expression may reflect distinct socio-emotional processes. Studies on laughter, a pervasive emotional expression, have emphasized a distinction between spontaneous and voluntary laughter (e.g., Gervais & Wilson, 2005; McKeown, Sneddon, & Curran, 2015; Scott, Lavan, Chen, & McGettigan, 2014). Spontaneous laughter is less controlled, reflects a genuinely felt emotion, includes 'hard-to-fake' features, and is typically a reaction to outside events. Voluntary laughter, on the other hand, is part of more deliberate communicative acts, reflecting a signal that can be flexibly used to convey appreciation, polite agreement, or to deceive others during interactions. McGettigan et al. (2015) identified cortical sensitivities to the emotional authenticity of laughter: spontaneous laughter elicits greater responses than voluntary laughter in bilateral superior temporal gyri; and voluntary laughter elicits greater responses in anterior medial prefrontal and anterior cingulate cortices, suggesting that less genuine laughter might implicate a more active engagement of mentalizing processes. Acoustic and perceptual differences have also been delineated (Lavan, Scott, & McGettigan, 2015). Spontaneous laughter is often higher in pitch, longer in duration, and shows spectral characteristics that differ from voluntary laughter; voluntary laughter, on the other hand, is more nasal than spontaneous laughter. Perceptually, spontaneous laughter is perceived as more authentic than voluntary laughter, and as more positive and higher in arousal.

Being able to accurately detect the authenticity of laughter is an important social skill. However, the psychosocial factors that determine this ability remain unknown. Factors such as musical training (Lima & Castro, 2011), cultural background (Pell, Monetta, Paulmann, & Kotz, 2009), and social power (Uskul, Paulmann, & Weick, 2016) are associated with the ability to recognize emotion categories in speech prosody. Here we ask for the first time if trait levels of emotional contagion and emotional empathy, i.e., individual differences in dispositional tendencies to resonate with others' emotions (e.g., Banissy, Kanai, Walsh, & Rees, 2012; Lishner, Cooeter, & Zald, 2008), are associated with the detection of laughter authenticity.

Although no studies have addressed this question to date, an association between emotion resonance mechanisms and the perception of emotional vocalizations has been suggested by neuroimaging and transcranial magnetic stimulation studies. Warren et al. (2006) found that passively listening to emotional vocalizations engages the lateral premotor cortices, inferior frontal gyrus, anterior insula, and the pre-supplementary motor area, regions that overlapped with those recruited during the production of orofacial movements. This suggests that motor information is automatically activated during the perception of vocal expressions, a sensorimotor effect that might facilitate resonance with others' emotions. Banissy et al. (2010) further showed that stimulation to the postcentral gyrus and lateral premotor cortex impairs the ability to discriminate vocal emotions, suggesting that sensorimotor activity also contributes to performance in behavioural tasks. Consistent with this, Bestelmeyer, Maurage, Rouger, Latinus, and Belin (2014) found that activity in sensorimotor regions reflects greater perceptual differentiation between vocal expressions, even after regressing out the acoustic features of the expressions; and McGettigan et al. (2015) found that greater neural responses

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in sensorimotor regions during passive listening to laughter predicted better performance in a post-scanner authenticity discrimination task. Thus, the systems that support the generation of our own emotional expressions are activated by others' vocal expressions, and this might facilitate two inter-related processes: contagion/resonance responses (Warren et al., 2006), arguably related to shared interpersonal states and empathy (e.g., Banissy & Ward, 2007), and the interpretation of the meaning of vocal expressions. This is in line with sensorimotor simulation accounts of emotion recognition, which have been examined in detail in the context of facial expression recognition, including the detection of smile authenticity (e.g. Korb, With, Niedenthal, Kaiser, & Grandjean, 2014; Maringer, Krumhuber, Fischer, & Niedenthal, 2011; Manera, Grandi, & Colle, 2013; Rychlowska et al., 2014; Wood, Rychlowska, Korb, & Niedenthal, 2016).

If emotion resonance mechanisms contribute to the interpretation of others' vocal expressions, it is plausible to hypothesize that higher trait levels of resonance are associated with a better ability to detect laughter authenticity: individuals with higher dispositional tendencies to resonate with others' emotions could spontaneously experience enhanced contagion/resonance during laughter perception, and this could facilitate authenticity detection. To test this hypothesis, we asked one hundred nineteen participants to evaluate the authenticity and contagiousness of spontaneous and voluntary laughs, and measured their traits levels of resonance using two well-established self-report indices: the Emotional Contagion Scale (ECS; Doherty, 1997), and the Empathic Concern scale of the Interpersonal Reactivity Index (IRI), which focuses on others' oriented affective reactions (Davis, 1980, 1983). These self-report measures have been shown to correlate with brain activity and structural features of sensorimotor systems (Banissy et al., 2012; Hooker, Verosky, Germine, Knight, & D'Esposito, 2010; Lamm, Batson, & Decety, 2007; Schulte-Ruther, Markowitsch, Fink, & Piefke, 2007), as well as with emotional mimicry as evidenced by facial electromyography (Hietanen, Surakka, & Linnankoski, 1998; Sun, Wang, Wang, & Luo, 2015). ECS scores have also been shown to correlate with the ability to detect the emotional authenticity of smiling faces (Manera et al., 2013).

We predicted that individuals scoring higher on the ECS and on the Empathic Concern IRI scale would be better at discriminating the authenticity of spontaneous and voluntary laughs. Additionally, if sensorimotor resonance during listening to laughter facilitates authenticity detection, we might also expect to see an association between perceived laughter contagiousness and authenticity evaluations. We also examined if the hypothesized associations hold for men and women alike, as sex differences have been observed in some studies on vocal emotions (e.g., McKeown et al., 2015; but see, e.g., Lima et al., 2014), as well as for ECS (Doherty, 1997; Rueff-Lopes & Caetano, 2012) and IRI scores (Davis, 1980; Limpo et al., 2010).

Methods

Participants

One hundred nineteen participants took part in this study (M_{age} = 39.53 years; SD = 21.61; range = 18–79 years; 83 women). They were all native Portuguese speakers, with an average of 15 years of education (SD = 2.68; range = 10–25 years). Fifteen of them had some degree of musical training (M_{years} = 5.67; *SD* = 2.77; range = 3–12). Exclusion criteria included psychiatric and neurological illnesses, intake of psychotropic medications, and brain damage. Testing involved a single experimental session, and participants received course credits or a small financial compensation for their time. Written informed consent was obtained.

Because we included participants from a wide age range, they were tested for potential hearing and cognitive losses. In a hearing test based on pure-tone audiometry, participants' better ear average thresholds ranged from -1.67 to 40 dB hearing level (*M* = 10.56, *SD* = 9.06; frequency range, 500–4000 Hz). As thresholds ≤ 25 dB are considered clinically normal (Hall & Mueller, 1997; Peelle, Troiani, Grossman, & Wingfield, 2011), all but six participants had normal hearing, and these had what would be considered a possible mild hearing loss (they were 60+ years old). These participants were not excluded from the analyses, as their potential hearing loss was mild and we individually adjusted the volume of the experimental stimuli to a comfortable hearing level. In the Montreal Cognitive Assessment test (MoCA; www.MoCAtest.org; Portuguese version, Freitas, Simões, Santana, Martins & Nasreddine, 2013), that screens for cognitive impairment, all participants scored ≥ 21 out of 30 (*M* = 27.39, *SD* = 1.59, range = 23–30), which is within the normative range for the Portuguese population (Freitas, Simões, Alves, & Santana, 2011).

Emotional Contagion Scale

The ECS is a uni-dimensional self-report questionnaire that assesses the propensity to resonate with others' emotions (Doherty, 1997; Portuguese version, Rueff-Lopes & Caetano, 2012). It consists of 15 items covering contagion for five emotions: love, happiness, sadness, anger, and fear. Examples are: 'I cry at sad movies' and 'When someone smiles warmly at me, I smile back and feel warm inside'. Participants indicate their agreement with each item on a scale from 1 ('never') to 5 ('always'). The original and the Portuguese ECS have appropriate psychometric properties, including high internal consistency, convergent and discriminant validity, and test-retest reliability (Doherty, 1997; Rueff-Lopes & Caetano, 2012).

Interpersonal Reactivity Index

The IRI is a multi-dimensional self-report questionnaire of empathy (Davis, 1980, 1983; Portuguese version, Limpo, Alves, & Castro, 2010). It consists of 28 items, divided into four scales: Perspective Taking; Fantasy; Personal Distress; and Empathic Concern (7 items per subscale). While Perspective Taking and Fantasy measure cognitive empathy, Personal Distress and Empathic Concern measure affective empathy. Participants responded to the four scales, but we emphasized results on affective empathy, namely on the Empathic Concern scale, that measures trait levels of affective reactions to others' emotions (Personal Distress is self-oriented and related to aversive emotional responses). Examples of items are: 'I am often quite touched by things that I see happen' and 'I often have tender, concerned feelings for people less fortunate than me'. Participants respond to each item on a scale from 0 ('does not describe me well') to 4 ('describes me very well'). Like the ECS, the original and Portuguese IRI have appropriate psychometric properties (Davis, 1983; Limpo et al., 2010).

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Laughter Perception

The laughter stimuli consisted of 18 voluntary and 18 spontaneous laughs, generated by seven speakers (four women) in an anechoic chamber at University College London. Their affective and acoustic characteristics are summarized in Table 1. An amusement induction situation was used to elicit spontaneous laughter: each speaker was shown video clips, which they identified as amusing and that would easily make them laugh aloud (McGettigan et al., 2015). To record voluntary laughter, the same speakers deliberately produced laughter in the absence of external emotional stimulation, i.e., they did not experience feelings of amusement, but were asked to make the expression sound natural and credible. We piloted a large number of laughs on 40 participants (who did not take part in the main study; M_{age} = 23.6; SD = 4.8), and selected the final set used here so that spontaneous and voluntary laughs were discernible in perceived authenticity, but not significantly different regarding other affective attributes, namely valence and arousal, as well as duration (Table 1). Acoustically, spontaneous and voluntary laughs differed regarding several pitch attributes (Table 1), a result consistent with previous findings (Lavan et al., 2015; McGettigan et al., 2015). The number of laughs produced by women and men was similar across conditions: voluntary laughs, 9 produced by women and 9 by men; spontaneous laughter, 11 produced by women and 7 by men (Fisher's exact test, p = .738). The laughs were intermixed with 18 distractor vocalizations consisting of acted expressions of sadness, pleasure, relief, and achievement (Lima, Castro & Scott, 2013). These stimuli were included so that participants would be less likely to detect that the manipulation concerned laughter authenticity; they were not included in the analysis.

The 36 laughs and 18 distractors were randomized and presented twice to each participant, as separate tasks, for authenticity and contagion evaluations. The order of the tasks was counter-balanced. For authenticity, participants evaluated how much the vocalizations expressed a genuine emotion on a scale from 1 ('the person is acting out the expression') to 7 ('the person is genuinely feeling the emotion'). For contagion, participants evaluated how contagious each vocalization was perceived to be, from 1 ('it does not make me feel like mimicking or feeling the emotion') to 7 ('it makes me feel like mimicking or feeling the emotion'). The stimuli were presented via headphones, and stimulus presentation and data collection was controlled using SuperLab 5 (www.superlab.com).

The laughter perception tasks were administered after participants completed the hearing and cognitive background tests, and the ECS and IRI questionnaires. As part of two separate studies, the same participants also completed an artificial language learning experiment and three additional laughter-related tasks (perceived arousal, emotion and control). These results will be reported elsewhere.

Results

Trait levels of emotional contagion and empathy

The average scores obtained on the ECS (M = 3.70; scale 1-5) and on the Empathic Concern IRI scale (M = 2.43; scale 0-4) are consistent with the published norms for these measures (Davis, 1983; Doherty, 1997; Limpo et al., 2010; Rueff-Lopes & Caetano, 2012).

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Importantly, there were large inter-individual differences: on the ECS, scores ranged between 1.87 and 4.73 (*SD* = 0.50); and on the Empathic Concern scale they ranged between 0.83 and 3.67 (*SD* = 0.57). In line with previous studies, scores on the ECS and on the Empathic Concern scale were positively correlated, as indicated by the estimate of the Pearson product-moment correlation coefficient, $r(118) = .54$, $p < .001$ (Doherty, 1997).

Also in line with previous studies, women (*M* = 3.81, *SD* = 0.42, range = 2.53–4.73) scored higher than men (*M* = 3.45, *SD* = 0.57, range = 1.87–4.40) on the ECS (independent samples t-test, $t[117] = 3.87$, $p < .001$; equal variances assumed, Levene's test, $p = .20$) (Doherty, 1997; Rueff-Lopes & Caetano, 2012). Similarly, on the Empathic Concern scale, women (*M* = 2.51, *SD* = 0.55, range = 0.83–3.67) also scored higher than men (*M* = 2.23, *SD* = 0.59, range = 0.83–3.33; $t[117] = 2.49$, $p = .01$; Levene's test, $p = .44$) (Davis, 1980; Limpo et al., 2010). No significant relationships were found between ECS, Empathic Concern and general cognitive abilities, as measured by the MoCA test (ECS, $r[118] = .03$, $p = .78$; Empathic Concern, $r[118] = .14$, $p = .14$).

Average scores on the remaining IRI scales were: 2.39 for Personal Distress (*SD* = 0.57; range = 0.83–4); 3.11 for Perspective Taking (*SD* = 0.48; range = 1.83–4) and 2.19 for Fantasy (*SD* = 0.61; range = 0.83–3.50).

Perceived authenticity and contagiousness of laughter

Participants evaluated spontaneous laughs as more authentic (*M* = 4.69, *SD* = 0.67, range = 2.33–6.22) than voluntary laughs (*M* = 3.66, *SD* = 0.77, range = 1.78–5.78), indicating that they were able to detect laughter authenticity (paired sample t-test, $t[118] = 18.71$, $p < .001$). Differences were also found for contagion responses: spontaneous laughs were evaluated as more contagious (*M* = 4.55, *SD* = 0.76, range = 2.50–6.22) than voluntary laughs (*M* = 3.76, *SD* = 0.85, range = 1.39–6; $t[118] = 16.30$, $p < .001$).

Relationship between emotional contagion, empathy, and detection of laughter authenticity

To obtain an index of authenticity detection abilities, we computed a difference score for each participant by subtracting average authenticity ratings provided to voluntary laughs from average authenticity ratings provided to spontaneous laughs (*M* = 1.02, *SD* = 0.60, range = -0.39 – 2.56). Higher scores indicate a better ability to discriminate laughter authenticity. A similar index was computed for laughter contagiousness, reflecting how fine-grained contagion responses were (*M* = 0.79, *SD* = 0.53, range = -0.56 – 2.33). Authenticity detection was similar for men (*M* = 1.08, *SD* = 0.61, range = -.039–2.50) and women (*M* = 1.00, *SD* = 0.59, range = -0.33 –2.56; independent samples t-test, $t[117] = -.65$, $p = .52$; Levene's test, $p = .84$)[1]. Regarding the contagion index, men (*M* = 0.96, *SD* = 0.61, range = -0.11–2.33) scored slightly higher than women (*M* = 0.72, *SD* = 0.48, range = 0.56-1.83; $t[117] = -2.32$, $p = .02$; Levene's test, $p = .24$). No significant relationships were found

[1]Follow-up analyses showed that authenticity detection was also similar for laughs produced by male (*M* = 1.25, *SD* = 0.84, range = -.86–5.19) and female speakers (*M* = 1.09, *SD* = 0.74, range = -.61–3.51; paired sample t-test, $t[118] = 1.69$, $p = .09$).

between responses to laughter and the MoCA test (authenticity index, $r[118] = .10$, $p = .26$; contagion index, $r[118] = -.11$, $p = .25$).

To test the hypothesis that trait levels of emotional contagion and empathy modulate authenticity detection abilities, the index of authenticity detection was submitted to two linear regressions, one with ECS scores and the other one with Empathic Concern scores as regressors. Higher scores in both ECS ($F[1,117] = 11.64$, $p = .001$, $R^2 = .09$) and Empathic Concern ($F[1,117] = 14.30$, $p < .001$, $R^2 = .11$) significantly predicted a better ability to discriminate the authenticity of spontaneous and voluntary laughs; around 10% of individual variation in authenticity detection was accounted for by the propensity to resonate with others' emotions[2]. These associations are illustrated in Figure 1 (a-b). Importantly, we calculated Cook's distance values and confirmed that these effects are not explained by extreme data points on the regression models: all values were below the critical value $F[0.5,1,118] = 0.46$ (Aguinis, Gottfredson, & Joo, 2013) (Cook's distance range = 0–0.10 for ECS, and 0–.10 for Empathic Concern). In follow-up analyses, we also confirmed that these effects cannot be explained by variability related to age, hearing thresholds, and years of musical training: the results remained unaltered when the regression models were conducted on residual values, after having removed the effects of these factors (ECS, $F[1,117] = 27.42$, $p < .001$, $R^2 = .19$; Empathic Concern, $F[1,117] = 14.10$, $p < .001$, $R^2 = .11$). Additionally, the associations are significant both for men and women, as indicated by separate regression analyses per group of participants (men: ECS, $F[1,35] = 8.83$, $p = .01$, $R^2 = .21$; Empathic Concern, $F[1,35] = 7.07$, $p = .01$, $R^2 = .17$; women: ECS, $F[1,82] = 6.92$, $p = .01$, $R^2 = .08$; Empathic Concern, $F[1,82] = 9.05$, $p = .003$, $R^2 = .11$).

Similar analyses on the remaining IRI subscales were not significant, i.e., no associations between IRI scores and authenticity detection were found beyond the hypothesized one for the Empathic Concern subscale (Personal Distress, $F[1,117] = 2.79$, $p = .10$, $R^2 = .02$; Fantasy $F[1,117] = 1.03$, $p = .31$, $R^2 = .01$; Perspective Taking, $F[1,117] = 2.74$, $p = .10$, $R^2 = .02$).

Finally, we examined whether perceived contagion responses during listening to laughter related to authenticity detection: the regression model was significant ($F[1,117] = 30.60$, $p < .001$, $R^2 = .21$), indicating that 21% of variation in authenticity detection was accounted for by perceived laughter contagiousness. This association was significant for men ($F[1,35] = 13.89$, $p = .001$, $R^2 = .29$) and women ($F[1,82] = 16.39$, $p < .001$, $R^2 = .17$).

Discussion

In this study, we showed for the first time that individual differences in dispositional tendencies to resonate with others' emotions predict the ability to infer the emotional authenticity of nonverbal vocalizations. Individuals who report higher traits levels of

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[2]Separate regression models were conducted for ECS and Empathic Concern scores, as the two measures are correlated and were included in the study as two indices of the same construct, trait levels of resonance. When they were entered into a single multiple regression model (enter method), a significant effect was found ($F[116] = 8.69$, $p < .001$), with an R^2 of .13. Empathic Concern was a significant predictor (Beta = .237, $t[116] = 2.31$, $p = .02$), but ECS failed to reach significance (Beta = .174, $t[116] = 1.69$, $p = .09$). This suggests that, in addition to the overlapping variance across the two measures, there might be a unique contribution of Empathic Concern scores to the association with authenticity detection in laughter.

emotional contagion and empathy are generally better at discriminating the authenticity of spontaneous and voluntary laughs. We have additionally shown that contagion responses during listening to laughter were associated with better authenticity discrimination. All the associations were observed for men and women alike.

These findings contribute to current debates on the socio-emotional determinants of laughter (Scott et al., 2014), and on the roles of sensorimotor resonance and shared interpersonal representations in vocal emotional processing. Previous neuroimaging work suggests that activity in sensorimotor systems provides a mechanism for mirroring the vocal emotional expressions of others, and that this might facilitate emotional responses in interactions (Warren et al., 2006), as well as the interpretation of the meaning of those expressions (Banissy et al., 2010; Bestelmeyer et al., 2014; McGettigan et al., 2015). Here we provide new evidence for the potential key role of resonance with others' expressions in emotional understanding, by focussing on a rarely studied aspect of voices – emotional authenticity –, and by capitalizing on an individual differences approach. Across two different measures (ECS and IRI Empathic Concern scale), we establish not only the involvement of emotional resonance in emotional evaluations, but also that individual variation in dispositional/trait levels of emotional resonance is diagnostic of vocal processing abilities. Our results thus extend to trait-related measures the finding by McGettigan et al. (2015) that neural responses to laughter in sensorimotor sites predict laughter authenticity detection in a post-scanner behavioural task. They are also consistent with evidence from work on facial expression recognition, both from studies on the recognition of specific emotion categories and from studies on smile authenticity detection (Korb et al., 2014; Manera et al., 2013; Maringer et al, 2011; Rychlowska et al., 2014; Wood et al., 2016). Notably, the association between laughter perception and IRI scores was selective to the Empathic Concern scale. This emphasizes the specificity of this association, and the multifaceted nature of interpersonal reactivity. It suggests that authenticity detection in laughter might be particularly related to trait affective resonance with others' emotions, and not to all aspects of interpersonal reactivity and empathy.

Finding that authenticity detection is not only associated with trait levels of emotional resonance (self-report measures), but also with subjective contagion responses during listening to laughter further suggests that emotional resonance mechanisms are closely linked with socio-emotional inferences about vocalizations. However, in what concerns to the association between Empathic Concern and authenticity detection, we cannot exclude that other factors beyond emotional resonance might have played a role as well. In a structural neuroimaging study, Banissy et al. (2012) identified associations between Empathic Concern and morphological differences, not only in sensorimotor areas, but also in the anterior cingulate, which has been associated with mentalizing (e.g., Apps, Green, & Ramnani, 2013). Consistent with this, neural responses to laughter in this region predict laughter authenticity perception (McGettigan et al., 2015). The possible role of mentalizing processes in the relationship between trait empathy and authenticity detection will need to be addressed in future work.

The findings of the current study raise other interesting questions for future research. First, it will be interesting to ask if the association between trait emotion resonance and vocal emotional processing uncovered here extends to vocal expressions beyond laughter (e.g., crying), and to abilities beyond authenticity detection (e.g., recognition of specific emotion categories). The focus on laughter here builds on the growing interest in positive expressions in emotion research (e.g., Sauter, 2017), and on the growing literature on authenticity detection in this vocalization, that allows for the generation of testable hypothesis and for the confident use of well-controlled stimulus sets (e.g., Bryant & Atkipis, 2014; Lavan et al., 2015; Lima et al., 2016; McGettigan et al., 2015; McKeown et al., 2015;). Extending this to other vocalizations will benefit from methodological and theoretical developments in the field, that are only now starting to emerge (Anikin & Lima, 2017; Sauter & Fischer, 2017). Second, our results suggest that emotion resonance during listening to vocalizations relates to higher socio-emotional processing and empathy, i.e., positive associations were observed, a finding consistent with previous studies (e.g., Hooker et al., 2010; McGettigan et a., 2015; Sun et al., 2015). Notwithstanding, the direction of the relationship between sensorimotor systems and empathy remains an open issue (e.g., Banissy et al., 2012), and it will be interesting to further explore this, for instance by examining whether higher sensorimotor activity might also reflect compensation for decreased empathy in some instances. Finally, the offline self-report measures that we used here provide a suitable tool to examine trait levels of resonance, which would be difficult to capture otherwise, and they have been shown to index sensorimotor and contagion processes (e.g., Banissy et al., 2012; Hooker, Verosky, Germine, Knight, & D'Esposito, 2010; Lamm, Batson, & Decety, 2007; Schulte-Ruther, Markowitsch, Fink, & Piefke, 2007). However, one concern regards the potential confounding effects of general cognitive abilities (e.g. working memory, attention), that could potentially affect how participants complete these measures (e.g., Rankin, Kramer, & Miller, 2005). Our results are unlikely to be reducible to such unspecific effects, though: we found no associations between the self-report measures and general cognitive performance. Also, only the Empathic Concern scale of the IRI correlated with authenticity detection, while the others did not. It seems difficult to explain such a specific association in terms of a general cognitive performance effect. Notwithstanding, in future work it will be relevant to combine self-report measures with other indices of sensorimotor activity, such as facial electromyography (e.g., Rychlowska et al., 2014; Sun et al., 2015) or brain responses (e.g., McGettigan et al., 2015), which will objectively probe situational sensorimotor responses, and thus extend the current findings, focussed on more stable dispositional tendencies.

To conclude, the current study identified for the first time a link between higher trait levels of emotional contagion and empathy and enhanced ability to detect laughter authenticity. This adds to the growing literature on individual differences in vocal emotions (e.g., Lima & Castro, 2011; McGettigan et al., 2015; Pell et al., 2009; Uskul et al., 2016), and points to the key contribution of sensorimotor mechanisms in the processing of complex aspects of vocal emotional information.

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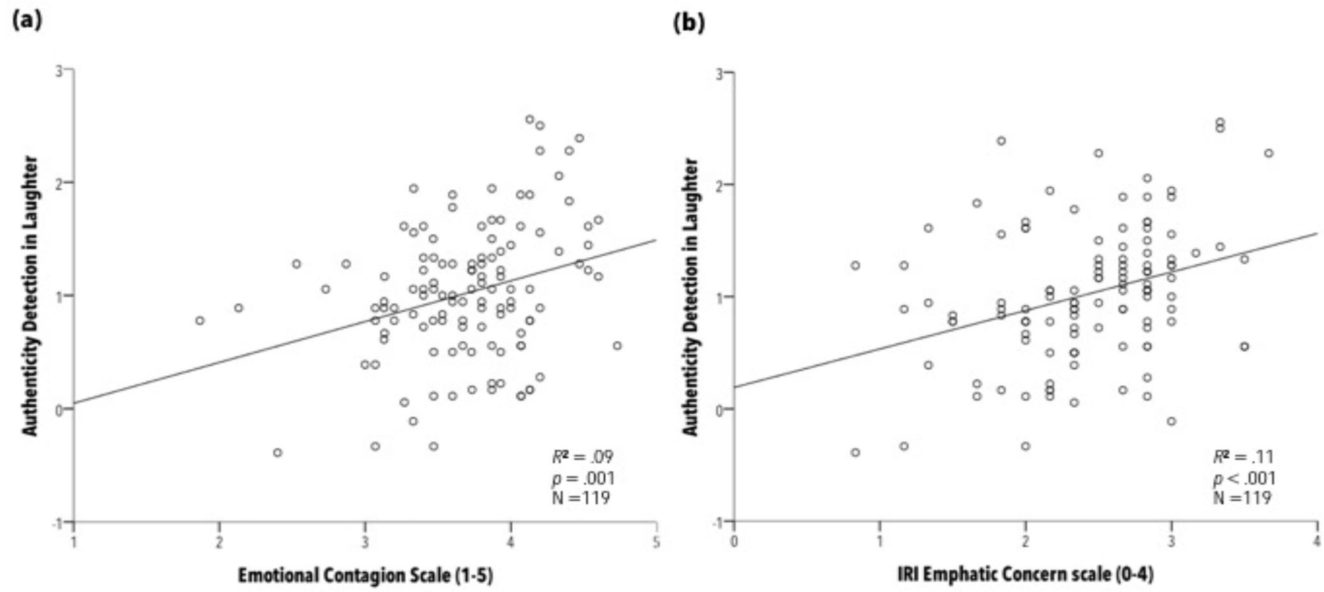

Figure 1.

Scatterplots illustrating the relationship between detection of laughter authenticity and scores on the Emotional Contagion Scale (a) and on the Empathic Concern scale of the Interpersonal Reactivity Index (b).

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Table 1

Affective and acoustic features of voluntary and spontaneous laughs

	Spontaneous Laughter		Voluntary Laughter			
Feature	***M***	***SD***	***M***	***SD***	***t*(34)**	***p***
Authenticity (1-7)	4.67	0.81	3.62	0.92	3.65	**.001**
Arousal (1-7)	4.97	0.64	4.52	0.75	1.94	.061
Valence (1-7)	5.58	0.60	5.23	0.47	1.96	.058
Total duration (sec)	2.44	0.26	2.36	0.36	0.71	.481
F0 mean (Hz)	451.70	91.17	272.08	64.91	6.81	**< .001**
F0 variability (Hz)	144.48	45.42	108.20	54.53	2.17	**.037**
F0 minimum (Hz)	225.69	95.87	137.84	50.03	3.45	**.002**
F0 maximum (Hz)	815.41	115.37	546.36	195.48	5.03	**< .001**
F0 range (Hz)	589.72	155.38	408.52	194.82	3.09	**.004**
Spectral centre of gravity (Hz)	858.93	219.76	767.22	296.06	1.15	.258
Intensity variability (dB)	13.91	2.06	14.02	2.31	.026	.884
HNR (dB)	6.10	2.20	6.80	3.42	1.47	.469

Note. F0 = Fundamental Frequency. *t* values correspond to the statistic of independent samples t-tests (two-tailed). Significant differences are highlighted in bold. On a scale from 1 to 7, higher values indicate higher authenticity, higher arousal, and more positive valence.