Research Article

Psychological Science
2018, Vol. 29(9) 1515–1525

DOI: 10.1177/0956797618778235
www.psychologicalscience.org/PS

The Perception of Spontaneous and Volitional Laughter Across 21 Societies

Gregory A. Bryant[1,2], Daniel M. T. Fessler[2,3], Riccardo Fusaroli[4,5], Edward Clint[2,3], Dorsa Amir[6], Brenda Chávez[7], Kaleda K. Denton[8], Cinthya Díaz[7], Lealaiauloto Togiaso Duran[3], Jana Fanćovićová[9], Michal Fux[10], Erni Farida Ginting[11,12], Youssef Hasan[13], Anning Hu[14], Shanmukh V. Kamble[15], Tatsuya Kameda[16], Kiri Kuroda[16], Norman P. Li[17], Francesca R. Luberti[18], Raha Peyravi[19], Pavol Prokop[9,20], Katinka J. P. Quintelier[21], Hyun Jung Shin[22], Stefan Stieger[23,24], Lawrence S. Sugiyama[25], Ellis A. van den Hende[26], Hugo Viciana-Asensio[27], Saliha Elif Yildizhan[28], Jose C. Yong[17], Tessa Yuditha[11,29], and Yi Zhou[14]

[1]Department of Communication, University of California, Los Angeles; [2]UCLA Center for Behavior, Evolution, and Culture, University of California, Los Angeles; [3]Department of Anthropology, University of California, Los Angeles; [4]Interacting Minds Center, Aarhus University; [5]Department of Communication and Culture, Aarhus University; [6]Department of Anthropology, Yale University; [7]Department of Psychology, Pontificia Universidad Catolica del Peru; [8]Department of Ecology and Evolutionary Biology, University of California, Los Angeles; [9]Department of Biology, University of Trnava; [10]Department of Biblical and Ancient Studies, University of South Africa; [11]Jakarta Field Station, Max Planck Institute for Evolutionary Anthropology, Jakarta, Indonesia; [12]Faculty of Literature, Al Azhar Indonesia University; [13]Department of Social Sciences, Qatar University; [14]Department of Sociology, Fudan University; [15]Department of Psychology, Karnatak University; [16]Department of Social Psychology, University of Tokyo; [17]School of Social Sciences, Singapore Management University; [18]Evolution and Ecology Research Centre, University of New South Wales; [19]Department of Anthropology, Binghamton University; [20]Institute of Zoology, Slovak Academy of Sciences; [21]School of Business and Economics, Vrije Universiteit Amsterdam; [22]Department of Psychology, Pusan National University; [23]School of Psychology, University of Vienna; [24]Department of Psychology, Karl-Landsteiner University of Health Sciences; [25]Department of Anthropology, University of Oregon; [26]Department of Product Innovation and Management, Delft University of Technology; [27]Institute for Advanced Social Studies (IESA), CSIC, Córdoba, Spain; [28]Department of Biostatistics and Medical Informatics, Acıbadem Mehmet Ali Aydinlar University; and [29]Department of Education, Atma Jaya Catholic University

Abstract

Laughter is a nonverbal vocalization occurring in every known culture, ubiquitous across all forms of human social interaction. Here, we examined whether listeners around the world, irrespective of their own native language and culture, can distinguish between spontaneous laughter and volitional laughter—laugh types likely generated by different vocal-production systems. Using a set of 36 recorded laughs produced by female English speakers in tests involving 884 participants from 21 societies across six regions of the world, we asked listeners to determine whether each laugh was real or fake, and listeners differentiated between the two laugh types with an accuracy of 56% to 69%. Acoustic analysis revealed that sound features associated with arousal in vocal production predicted listeners' judgments fairly uniformly across societies. These results demonstrate high consistency across cultures in laughter judgments, underscoring the potential importance of nonverbal vocal communicative phenomena in human affiliation and cooperation.

Keywords

laughter, vocal communication, cross-cultural, emotion, speech, open data

Received 10/13/17; Revision accepted 4/17/18

Corresponding Author:
Gregory A. Bryant, University of California, Los Angeles, Department of Communication, 2225 Rolfe Hall, Los Angeles, CA 90095-1563
E-mail: gabryant@ucla.edu

Human social interaction relies on a complex suite of verbal and nonverbal communicative behaviors. Unlike language, across taxa, many nonverbal expressive behaviors have clear parallels in other species. Comparative analyses have revealed homologies in play vocalizations across mammals; in humans, this manifests as spontaneous laughter (Davila-Ross, Owren, & Zimmermann, 2009; Gervais & Wilson, 2005; Provine, 2000; Vettin & Todt, 2005). Consistent with this characterization of human laughter as a biologically evolved species-typical feature, laughter appears in every culture, evincing remarkable consistency in form (Provine, 2000). The functions of laughter are also plausibly universal. However, this is more difficult to determine, as laughter occurs embedded within a variety of social contexts, resulting in many laugh types. A growing research corpus potentially addresses questions of function by examining the contexts in which laughter is generated as well as laughter's social consequences (e.g., Otten, Mann, van Berkum, & Jonas, 2017; Scott, Lavan, Chen, & McGettigan, 2014). In contrast, much less is known about how laughter is perceived. Research has explored distinctions between spontaneous and volitional laughter (Bryant & Aktipis, 2014; Lavan, Scott, & McGettigan, 2016; McGettigan et al., 2013), judgments of affiliation in colaughter (Bryant et al., 2016), and how perceivers ascribe social functions to laughter (Wood, Martin, & Niedenthal, 2017). The phylogeny of laughter suggests an avenue through which, by investigating perceptions of laughter, one of the earliest functions of laughter can be explored. The human homologue of mammalian play vocalizations may have maintained the ancestral function of this trait, namely, to uniquely signal affiliation. If so, then listeners should be able to distinguish this signal from other forms of laughter—and, critically, this ability should be a species-typical trait, independent of the many facets of communication that differ across cultures.

Laughter is a family of vocalizations linked by a particular pattern of rhythmic respiratory and laryngeal activity (Bachorowski, Smoski, & Owren, 2001; Luschei, Ramig, Finnegan, Bakker, & Smith, 2006)—vocalizations that, with some notable exceptions (Provine, 2000), are often tied to feelings of mirth or joy. Laughs typically have a burstlike onset in which repeated oscillations of the glottis generate a series of bursts that decay over time in both energy and frequency (Provine & Yong, 1991). However, repetition is not essential, as a laugh can consist of only one burst as well. There is often, but not always, an associated perceived pitch in the bursts, resulting from the fundamental frequency (F_0) of vocal-fold vibration regimes during glottal oscillatory cycles. Laughter production in normal conversation exhibits systematic features, including constrained vowel and loudness patterning, consistent affective properties, and a rule-governed relationship between laugh bursts and speech (Bryant, 2011; Provine, 1993, 2000; Ruch & Ekman, 2001; Szameitat et al., 2009; Vettin & Todt, 2004).

In other mammals, play vocalizations are derived from ritualized breathing during rough-and-tumble play (Gervais & Wilson, 2005; Knutson, Burgdorf, & Panksepp, 1998; Provine, 2000). Although the rhythmic respiratory and laryngeal activity of human laughter constitute clear homologous aspects, human laughter differs from other primate play vocalizations in its higher proportion of voiced components—that is, more tonal, harmonically structured features attributable to vocal fold vibration (Davila-Ross et al., 2009). Intriguingly, voicing in laughter appears to be associated both with positive valence (Bachorowski & Owren, 2001) and with judgments of laughter as "fake" (Bryant & Aktipis, 2014). Such findings reveal the limited extent of knowledge regarding the relationships between physical properties of laughs and listeners' percepts. Although laughter's links to phylogenetically ancient play vocalizations indicate that some such perceptions should be independent of language, to date, only limited research has been conducted on laughter perception across cultures. Sauter, Eisner, Ekman, and Scott (2010) identified laughter as the most recognizable emotional vocalization across two disparate cultures (British and Himba). Bryant et al. (2016) found that listeners across 24 societies could detect friendship status on the basis of brief decontextualized clips of colaughter. These results reveal high perceptual sensitivity to this ubiquitous and ancient behavior.

Emotional vocal signals in humans are generated from a conserved production system shared by most social mammals (U. Jürgens, 2002). Humans also produce articulated speech using a largely distinct neural system (Ackermann, Hage, & Ziegler, 2014; Simonyan, 2014). Speech affords the imitation of a variety of sounds, including signals generated by the vocal emotion system such as laughter, crying, and pain shrieks. Nonverbal acted emotional vocalizations are acoustically distinct from their authentic counterparts, and the difference is perceptible (Anikin & Lima, 2018). However, cross-cultural findings are mixed, with some research reporting relatively low accuracy rates in discriminating play-acted vocal emotions from authentic expressions, as well as interactions between culture and emotion categories (R. Jürgens, Drolet, Pirow, Scheiner, & Fischer, 2013). Vocal emotion expressions are influenced by the vagal system, which extends to the recurrent laryngeal nerve (Ludlow, 2013). Thus, arousal in speakers can have direct effects on the vocal apparatus, including increased vocal fold tension, subglottal air pressure, and glottal adduction rate, along with possible irregular vibration regimes of vocal fold tissue. Consequently, arousal in laughter is characterized by higher pitch, increased loudness, faster burst rate, and greater nontonal noise. The evolutionary introduction of volitional forms of expression that emulate genuine emotional signals created an arms race, pitting production dynamics against perceptual sensitivity: Vocalizers attempt to manipulate listeners by emitting sounds that falsely appear to reveal emotional states; in turn, listeners benefit from the ability to discriminate between honest indicators of vocalizers' emotional states and facsimiles thereof. We should therefore expect perceptual systems to strive to track relevant features to enhance the accuracy of social judgments.

We tested the above thesis by exploring cross-cultural recognition of dual vocal-production pathways in human laughter. Paralleling work on so-called Duchenne smiles (Gervais & Wilson, 2005), many proposed taxonomies of laughter distinguish between genuine and deliberate forms; this maps onto the aforementioned emotion-speech production distinction. Colingual listeners can discriminate between these basic laughter types (Bryant & Aktipis, 2014; Lavan, Rankin, Lorking, Scott, & McGettigan, 2017; Lavan et al., 2016; McGettigan et al., 2013), and neuroimaging work shows that these laugh types differentially activate brain regions during both production and perception (Lavan et al., 2017; McGettigan et al., 2013; Szameitat et al., 2010). Reflecting their respective production systems, spontaneous laughter and volitional laughter have different acoustic features. Spontaneous laughs have higher values on acoustic correlates of physical arousal, such as F_0, and shorter burst duration but also lower relative loudness, potentially because of the prolonged, regulated energy of volitional laughter produced by the speech system; they also often have fewer voiced elements, including a higher rate of intervoicing intervals (IVIs; Bryant & Aktipis, 2014; Lavan et al., 2016), which contributes to sound qualities that make them more similar to nonhuman animal vocalizations than volitional laughs (Bryant & Aktipis, 2014). The rate of IVI measures the proportion of the calls across a laugh not associated with voicing (i.e., nontonal), a ratio likely reflecting the extent of differential breath-control deployment during production. The percentage of unvoiced components per call is positively associated with colingual listeners' judgments of the laughs being real (Bryant & Aktipis, 2014; Wood et al., 2017) as well as with listeners' inability to distinguish slowed versions of spontaneous human laughs from nonhuman animal calls (Bryant & Aktipis, 2014).

Research to date suggests that laughs produced by the two production systems are distinct. Because this reflects the activity of two different species-typical vocalization mechanisms, and selection will have consistently favored the ability to distinguish between the two types of laughter, we expected that this distinction would be universally recognizable. The strongest test of this prediction examines listeners who vary substantially in their degree of linguistic and cultural similarity to the laughers. Because language and other aspects of culture shape many features of verbal performance (Henrich, Heine, & Norenzayan, 2010), if the ability to distinguish between the two types of laughs is evident across a broad spectrum of commonality or difference between producer and receiver, then this capacity for discrimination likely constitutes a biologically evolved, species-typical trait.

We explored whether listeners from around the world (see Fig. 1) were able to distinguish between the two laugh types as produced by English speakers. We predicted that participants would reliably identify the laugh types and, as found in earlier work (Bryant & Aktipis, 2014), that acoustic features associated with spontaneous production (e.g., arousal-linked features such as higher F_0 and higher rate of IVI) would predict their judgments.

Method

Participants

Given previous work on listeners' discrimination of laughter types, we predicted a medium-sized effect. An average sample size per study site of 40 participants at a significance level (p) of less than .05 would be sufficient to detect an effect size (Cohen's d) of 0.25 with 88% power (R package *pwr*; Champely et al., 2017). We recruited 884 participants (500 women, 384 men; age: M = 26.6 years, SD = 7.0) from 21 different societies across six regions of the world (for full demographic information, see the Supplemental Material available online). Participant recruitment varied across study sites, but all were asked to volunteer, and no participants were paid.

Laughter stimuli

The stimulus set, used in a previous study (Bryant & Aktipis, 2014), consisted of 36 audio recordings of laughs. Eighteen spontaneous laughs were taken from 13 natural conversations between pairs of female young adult American English speakers who were friends at the time of the conversation; recordings were made in a laboratory (16-bit amplitude resolution, 44.1-kHz sampling rate, uncompressed WAV files; Sony DTC recorder, Sony ECM-77B microphones; Bryant, 2010).

Fig. 1. Map showing the 21 study sites.

Complementing this set, 18 volitional laughs, produced in response to the impromptu request "now laugh" during the course of an unrelated project, were collected from a different set of 18 female young adult American English speakers; these also were recorded in a laboratory (16-bit amplitude resolution, 44.1-kHz sampling rate, uncompressed WAV files; MicroTrack recorder, M-Audio, Cumberland, RI). The laughs were duration matched and amplitude normalized. For a full description of the stimulus set, see Bryant and Aktipis (2014).

Procedure

The 36 laughter samples were presented in random order using SuperLab 4.0 (Cedrus, San Pedro, CA) experiment software. For study sites in which a language other than English was used in conducting the experiment (16 of 21), the instructions were translated beforehand by the respective investigators or by native-language translators recruited by them for this purpose. Customized versions of the experiment were then created for each of the study sites using the translated instructions and a run-only version of the software. For study sites in which literacy was limited or absent, the experimenter read the instructions aloud to each participant in turn. Before each experiment and after obtaining informed consent, participants were told that they would be listening to recordings of women laughing and that, after each trial, they would be asked to determine whether the laugh was real or fake. Specifically, participants were told,

> In some of the recordings, the women were asked to laugh but were not given any other reason for laughing (we call these fake laughs). Other recordings are of women laughing naturally while talking to a friend (we call these real laughs).

Participants performed 1 practice trial and then completed the full experiment consisting of 36 trials. The study was approved for all sites by the University of California, Los Angeles Institutional Review Board. For the complete text of instructions and questions used in the experiment, see the Supplemental Material.

Results

Judgment task

To evaluate listener accuracy, we used a model-comparison approach in which variables were entered into generalized linear mixed models, and effects on model fit were measured using the Akaike information criterion. The data were modeled using the *glmer* procedure of the *lme4* package (Bates, Maechler, Bolker, & Walker, 2018) in the statistical platform R (R Core Team, 2014). The best-fitting model was a generalized linear mixed model using the Laplace approximation,

Table 1. Results From the Best-Fitting Model of Judgment Accuracy of Spontaneous and Volitional Laughter

Factor	Variance	*SD*	Estimate	*SE*	*z*	$p(>\|z\|)$
Random effects						
Participant	0.03005	0.1733				
Laugh trial	1.53619	1.2394				
Society × Laugh Condition	0.08939	0.2990				
Fixed effects						
Intercept			0.6252	0.2389	2.617	0.009*
Laugh condition			0.1908	0.2188	0.872	0.383

*$p < .01$.

with fixed effects of laugh condition (spontaneous or volitional) and random effects of participant, laugh trial, and an interaction between societies sampled and laugh condition (see Table 1). Accuracy (percentage correct) was the dependent measure. Across all participants, the overall rate of correct judgments was 64% ($SD = 0.48$, range = 56–69), a performance significantly better than chance ($z = 3.50$, $p < .001$), and spontaneous and volitional laughs were recognized overall at similar rates ($z = 0.872$, $p = .38$). There were no significant sex differences in listeners' judgments. Figure 2 shows the rates of correct judgments for each study site.

The best-fitting model included an interaction between societies sampled and laugh condition, with participants from some study sites showing a tendency to respond with "fake" more often than "real," and other participant groups showing the reverse pattern. Signal detection analysis was used to separate sensitivity from response bias in the task. Receiver-operating-characteristic (ROC) curves for each society were drawn using the *pROC* package in R (Robin et al., 2011; see Fig. 3). See Table S6 in the Supplemental Material for all signal detection values, including area-under-the-curve (AUC) values associated with the ROC figure.

An exploratory analysis of the possible impacts of six estimated demographic variables (English fluency, mass media exposure, mass media exposure in English, education, community size, and economic mode; see the Supplemental Material) on participants' response patterns revealed that societies' economic mode was most associated with a tendency to judge laughs as being real. Economic mode refers to a rough categorization based on principal economic activities and market integration. For example, the Shuar in Ecuador live in small villages and have minimal dependence on market exchanges, whereas highly industrialized societies such as the United States have maximal dependence on market exchanges. Figure S2 in the Supplemental Material reveals an overall pattern of increased responses of "real" in societies with greater industrialization and more reliance on skilled professionals. For all model comparisons and complete demographic analysis, see Table S7 in the Supplemental Material.

Acoustic analysis

Acoustic features, including the frequency and temporal dynamics of voiced and unvoiced segments, were automatically extracted from the individual laugh segments, following a procedure analogous to that used by Bryant et al. (2016). The acoustic features were used to statistically reconstruct (a) the distinction between spontaneous and volitional laughs and (b) the rate at which participants judged each laugh as real (i.e., spontaneous). We used a 5-fold cross-validated process wherein a Lasso algorithm (Tibshirani, 1996) first individuated key features (see Table S4 in the Supplemental Material); then, these were assessed in multiple logistic (for judgments of real vs. fake) and linear (for judgment rate) regressions. Because cross-validation is a stochastic process, we repeated the process 100 times to ensure stability of the results. We report cross-validated performance of the model (adjusted R^2 for linear regression and ROC curve for logistic regression), including 95% confidence intervals (CIs) on the repetitions and beta coefficients for the same models fitted on the full data set.

The acoustic-based model reliably predicted participants' judgments, employing coefficient of variation of intensity ($\beta = 0.5$, $SE = 0.09$, $p < .001$), mean pitch ($\beta = 0.41$, $SE = 0.09$, $p < .001$), and the mean absolute deviation of harmonics-to-noise ratio ($\beta = -0.46$, $SE = 0.09$, $p < .001$). The model could explain 63.9% of the variance (R^2; 95% CI = [55.5, 69.8]). Figure 4 displays the cross-validated model predictions (*x*-axis) against the actual mean judgments reported by participants (*y*-axis).

We were also able to reliably discriminate spontaneous from volitional laughs independent of participants' judgments, employing the rate of IVI ($\beta = 2.14$, $SE = 0.89$, $p = .016$), harmonics-to-noise ratio interquartile range ($\beta = -0.97$, $SE = 0.68$, $p = .15$), and median ($\beta =$

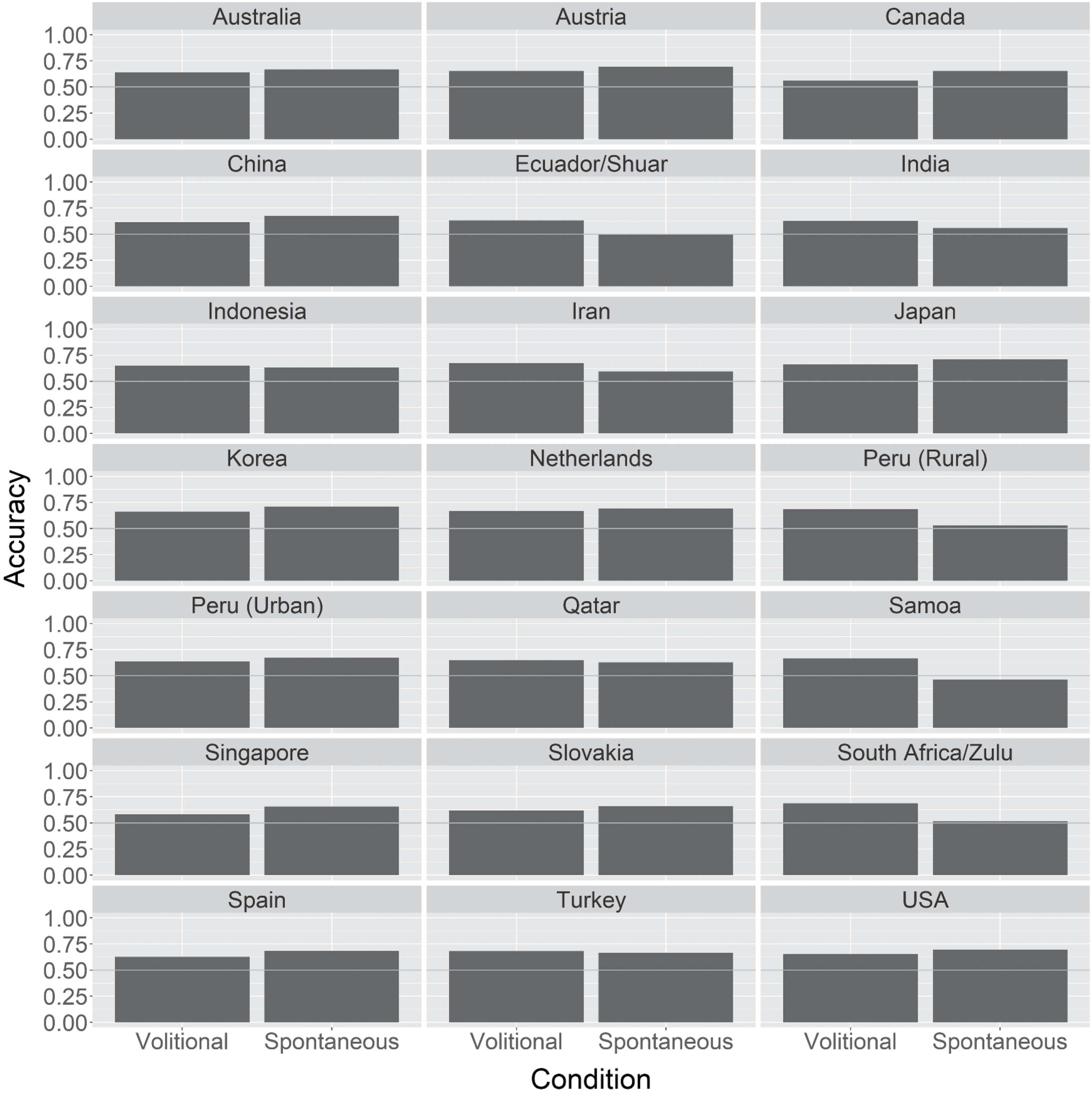

Fig. 2. Accuracy (overall proportion of correct judgments) in each study site broken down by laugh condition (volitional and spontaneous). Chance performance is represented by 0.50. In every society sampled, overall accuracy, collapsing across categories, was significantly better than chance.

−1.14, *SE* = 0.66, *p* = .087). The model had an estimated AUC of 83.32% (95% CI = [69.91, 89.51]), with an accuracy of 76.97% (95% CI = [63.89, 86.11]), a sensitivity of 79.61% (95% CI = [66.67, 88.89]), and a specificity of 74.33% (95% CI = [61.11, 83.33]).

Across societies, laughs that had higher intensity variability, higher pitch, and lower harmonics-to-noise-ratio variability were more likely to be judged as real. These features could also accurately discriminate spontaneous and volitional laughs (AUC: 64.79%, 95% CI = [52.16, 75]; accuracy: 64.44%, 95% CI = [55.56, 75]), although not as accurately as the optimal features identified by our analysis. For complete details of the acoustic analysis, see the Supplemental Material.

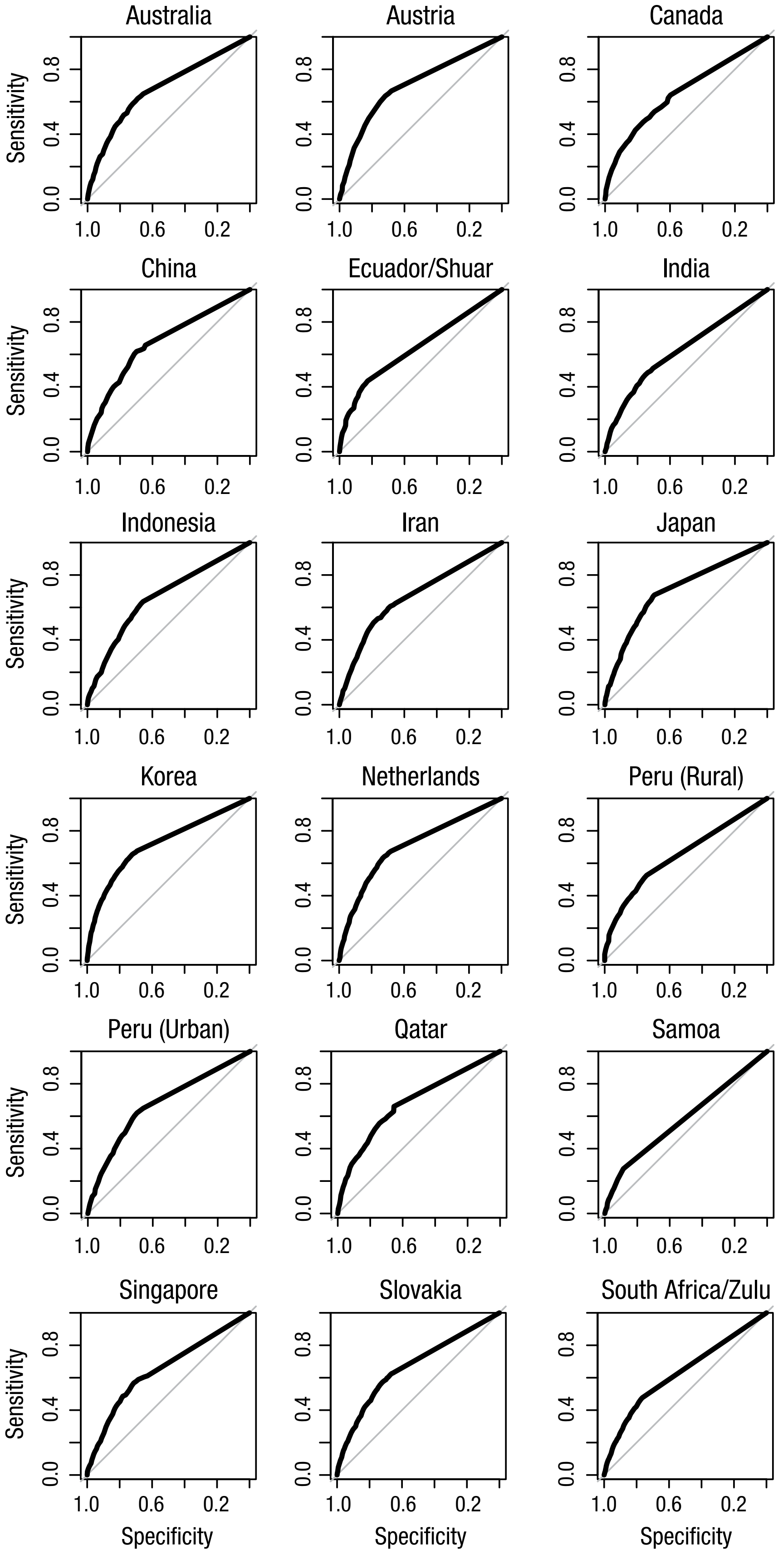

Fig. 3. *(continued on next page)*

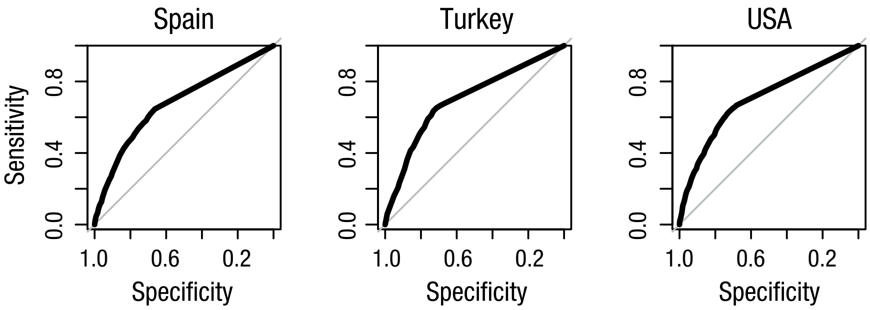

Fig. 3. Sensitivity as a function of specificity in each study site. Sensitivity and specificity are measures of how well a binary classification test performs. Sensitivity is the ability of the test to correctly identify participants exhibiting a given behavior (i.e., the true positive rate), whereas specificity is the ability of the test to correctly identify participants not exhibiting the given behavior (i.e., the true negative rate). Arbitrarily setting spontaneous laughter as the condition of interest, we defined true positives as correctly identifying spontaneous laughs and true negatives as correctly identifying volitional laughs. Receiver-operating-characteristic (ROC) curves represent the trade-off between sensitivity and specificity, as the cutoff point was systematically varied. Thus, the area between the ROC curve and the main diagonal (the area under the curve) represents overall performance of the decision-making process independent of response bias (i.e., independent of bias on the cutoff point). The bigger the area, the better-performing the model.

Discussion

Our results show that, around the world, regardless of their culture, native language, or cultural or linguistic similarity to the vocalizers, people reliably distinguished spontaneous and volitional laughter. In every society, participants correctly identified laugh types above chance, and judgments of spontaneity were associated with acoustic features likely tied to arousal in the vocalizers—specifically, greater intensity variability, higher pitch, and increased noisy features. These results are highly consistent with studies to date examining the perception of spontaneous and volitional laughter

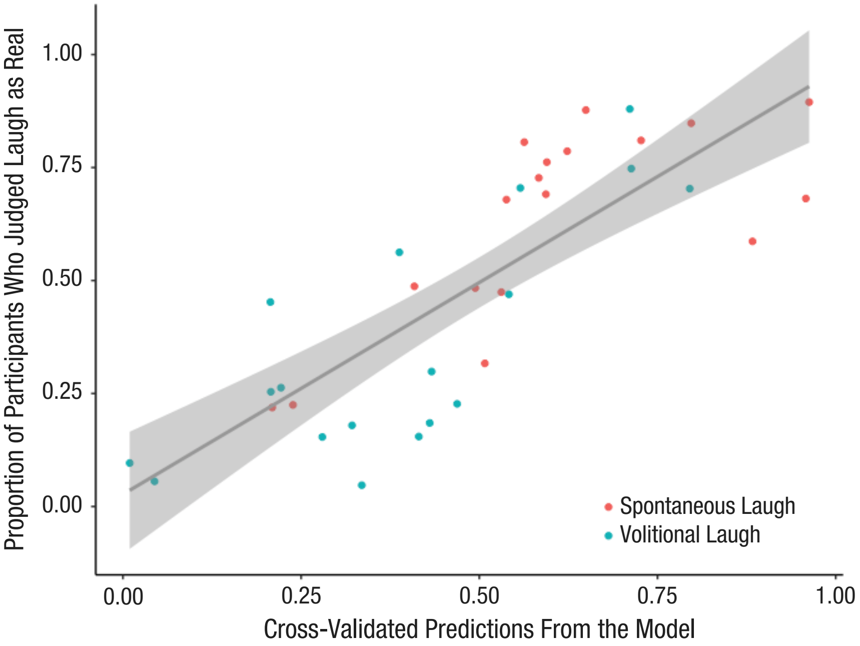

Fig. 4. Scatterplot (with best-fitting regression line) showing the correlation between participants' judgments (collapsed across all societies) of a laugh as being real and predicted values using the acoustic features selected by the statistical model. The error band indicates the 95% confidence interval.

within cultures; acoustic correlates of arousal have been previously shown to be associated with judgments of laughter genuineness (e.g., Bryant & Aktipis, 2014; Lavan et al., 2017; Lavan et al., 2016; McGettigan et al., 2013; Wood et al., 2017). But we also found some differences across cultures in judgment patterns of spontaneous and volitional forms, with small-scale societies, in particular, tending to judge tokens overall as more likely to be fake (for details and discussion, see the Supplemental Material). Other recent work (R. Jürgens et al., 2013) also found interesting interactions between encoding conditions (authentic emotional expressions vs. play-acted expressions) and culture, an issue that deserves more attention.

Our group has shown previously that, in 24 societies, listeners were able to determine, on the basis of brief clips of colaughter, whether dyads of native speakers of American English were friends or strangers (Bryant et al., 2016). Consonant with the thesis that, reflecting genuine prosocial emotions, spontaneous laughter constitutes an honest signal of affiliation—one imperfectly emulated in volitional laughter—the acoustic features associated with identifying friends in that study were similar to the features of spontaneous laughs described here, namely, features associated with speaker arousal. Taken together, these findings demonstrate that listeners are sensitive to acoustic features indicating emotional arousal in speakers and suggest an adaptive laughter-signaling system that inherently involves the triggering of emotional vocalizations with arousal-linked acoustic properties. Listeners everywhere can discriminate between two broad laughter categories; however, a fuller taxonomy of laughter types is needed. Moreover, it is possible that we inflated the distinctiveness of our general categories by using volitional laughs that did not originate in natural social contexts (i.e., they were produced on command). As Provine (2012) noted, voluntary productions of laughter differ in many ways from spontaneous laughs. Our stimulus set also included only female laughers. Future work should examine the dynamics of cross-sex laugh perception across disparate cultures as well as potential affective properties of low-pitched, aggressive laughter afforded by male vocalizers.

The social ecology of nonverbal expression within a dual-vocal-systems framework requires a designation not only of which system produces a vocalization but also of how it is deployed in social interaction (see also Wood et al., 2017). A laugh generated by the speech system is not necessarily a selfish manipulation; indeed, as suggested above, in many contexts, such laughs indicate cooperative intent. A brief volitional laugh that signals, for instance, a conversational turn or the recognition of some encrypted (i.e., implicit) content is cooperative in both the Gricean-conversational and the biological sense (Flamson & Bryant, 2013). Future work should therefore examine the complexities of how laughter signals interact with language use. Much of what people laugh about in social interaction is tied to what people are saying; variations in the production and interactive timing of laughter can reveal rich information regarding the underlying cognitive processes in conversation. Finally, there is much to learn about how laughing fits into the multimodal contexts of ordinary interpersonal communication. The more closely we examine laughter, the more evident are its intricacies.

Action Editor

Ayse K. Uskul served as action editor for this article.

Author Contributions

The first four authors are listed in order of the importance of their contributions. G. A. Bryant designed the hypothesis and methods, conducted the core analyses, and wrote and revised the manuscript. D. M. T. Fessler envisioned the cross-cultural component, organized the cross-cultural research, and assisted in writing and revising the manuscript. R. Fusaroli conducted the acoustic and signal detection analyses and contributed the corresponding draft text. E. Clint managed the cross-cultural research. All remaining authors contributed data and are listed in alphabetical order. All the authors approved the final manuscript for submission.

ORCID iDs

Riccardo Fusaroli https://orcid.org/0000-0003-4775-5219
Kiri Kuroda https://orcid.org/0000-0001-7278-1430
Norman P. Li https://orcid.org/0000-0002-4059-1613

Acknowledgments

We thank our participants and Alex Espinosa-Fornieles, Solomua Fiamatai, Togiaso Fiamatai, Thenjiwe Hlatshwayo, Yoon Kyoung Lee, Sarah Popelka, Shaudee Salari, and Pipi'imaleeleele Tonumaipe'a for assistance.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/0956797618778235

Open Practices

All data have been made publicly available via Harvard Dataverse and can be accessed at https://dataverse.harvard.edu/dataverse/laughterperception. Materials for this experiment have not been made publicly available, and the design and analysis plans were not preregistered.

References

Ackermann, H., Hage, S. R., & Ziegler, W. (2014). Brain mechanisms of acoustic communication in humans and nonhuman primates: An evolutionary perspective. *Behavioral & Brain Sciences*, *37*, 529–546.

Anikin, A., & Lima, C. F. (2018). Perceptual and acoustic differences between authentic and acted nonverbal emotional vocalizations. *The Quarterly Journal of Experimental Psychology*, *71*, 622–641.

Bachorowski, J. A., & Owren, M. J. (2001). Not all laughs are alike: Voiced but not unvoiced laughter readily elicits positive affect. *Psychological Science*, *12*, 252–257.

Bachorowski, J. A., Smoski, M. J., & Owren, M. J. (2001). The acoustic features of human laughter. *Journal of the Acoustical Society of America*, *110*, 1581–1597.

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2018). *lme4: Linear mixed-effects models using 'Eigen' and S4* (R package version 1.1-7) [Computer software]. Retrieved from https://cran.r-project.org/web/packages/lme4/index.html

Bryant, G. A. (2010). Prosodic contrasts in ironic speech. *Discourse Processes*, *47*, 545–566.

Bryant, G. A. (2011). Verbal irony in the wild. *Pragmatics & Cognition*, *19*, 291–309.

Bryant, G. A., & Aktipis, C. A. (2014). The animal nature of spontaneous human laughter. *Evolution & Human Behavior*, *35*, 327–335.

Bryant, G. A., Fessler, D. M. T., Fusaroli, R., Clint, E., Aarøe, L., Apicella, C. A., . . . Zhou, Y. (2016). Detecting affiliation in colaughter across 24 societies. *Proceedings of the National Academy of Sciences, USA*, *113*, 4682–4687.

Champely, S. (2017). *pwr: Basic functions for power analysis* (Version 1.2-2) [Computer software]. Retrieved from http://cran.r-project.org/package=pwr

Davila-Ross, M., Owren, M., & Zimmermann, E. (2009). Reconstructing the evolution of laughter in great apes and humans. *Current Biology*, *19*, 1106–1111.

Flamson, T. J., & Bryant, G. A. (2013). Signals of humor: Encryption and laughter in social interaction. In M. Dynel (Ed.), *Developments in linguistic humour theory* (pp. 49–74). Amsterdam, The Netherlands: John Benjamins.

Gervais, M., & Wilson, D. S. (2005). The evolution and functions of laughter and humor: A synthetic approach. *Quarterly Review of Biology*, *80*, 395–430.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral & Brain Sciences*, *33*, 61–83.

Jürgens, R., Drolet, M., Pirow, R., Scheiner, E., & Fischer, J. (2013). Encoding conditions affect recognition of vocally expressed emotions across cultures. *Frontiers in Psychology*, *4*, Article 111. doi:10.3389/fpsyg.2013.00111

Jürgens, U. (2002). Neural pathways underlying vocal control. *Neuroscience & Biobehavioral Reviews*, *26*, 235–238.

Knutson, B., Burgdorf, J., & Panksepp, J. (1998). Anticipation of play elicits high-frequency ultrasonic vocalizations in young rats. *Journal of Comparative Psychology*, *112*, 65–73.

Lavan, N., Rankin, G., Lorking, N., Scott, S., & McGettigan, C. (2017). Neural correlates of the affective properties of spontaneous and volitional laughter types. *Neuropsychologia*, *95*, 30–39.

Lavan, N., Scott, S. K., & McGettigan, C. (2016). Laugh like you mean it: Authenticity modulates acoustic, physiological and perceptual properties of laughter. *Journal of Nonverbal Behavior*, *40*, 133–149.

Ludlow, C. L. (2013). Motor control and biomechanics of laryngeal and pharyngeal muscles. In L. K. McLoon & F. H. Andrade (Eds.), *Craniofacial muscles: A new framework for understanding the effector side of craniofacial muscle control* (pp. 167–183). New York, NY: Springer.

Luschei, E. S., Ramig, L. O., Finnegan, E. M., Bakker, K. K., & Smith, M. E. (2006). Patterns of laryngeal EMG and the activity of the respiratory system during spontaneous laughter. *Journal of Neurophysiology*, *96*, 442–450.

McGettigan, C., Walsh, E., Jessop, R., Agnew, Z. K., Sauter, D. A., Warren, J. E., & Scott, S. K. (2013). Individual differences in laughter perception reveal roles for mentalizing and sensorimotor systems in the evaluation of emotional authenticity. *Cerebral Cortex*, *25*, 246–257.

Otten, M., Mann, L., van Berkum, J. J., & Jonas, K. J. (2017). No laughing matter: How the presence of laughing witnesses changes the perception of insults. *Social Neuroscience*, *12*, 182–193.

Provine, R. R. (1993). Laughter punctuates speech: Linguistic, social and gender contexts of laughter. *Ethology*, *95*, 291–298.

Provine, R. R. (2000). *Laughter: A scientific investigation*. New York, NY: Penguin.

Provine, R. R. (2012). *Curious behavior: Yawning, laughing, hiccupping, and beyond*. Cambridge, MA: Harvard University Press.

Provine, R. R., & Yong, Y. L. (1991). Laughter: A stereotyped vocalization. *Ethology*, *89*, 115–124.

R Core Team. (2014). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.

Robin, X., Turck, N., Hainard, A., Tiberti, N., Lisacek, F., Sanchez, J. C., & Müller, M. (2011). pROC: An open-source package for R and S+ to analyze and compare ROC curves. *BMC Bioinformatics*, *12*(1), Article 77. doi:10.1186/1471-2105-12-77

Ruch, W., & Ekman, P. (2001). The expressive pattern of laughter. In A. Kaszniak (Ed.), *Emotion, qualia, and consciousness* (pp. 426–443). Tokyo, Japan: Word Scientific.

Sauter, D. A., Eisner, F., Ekman, P., & Scott, S. K. (2010). Cross-cultural recognition of basic emotions through nonverbal emotional vocalizations. *Proceedings of the National Academy of Sciences, USA*, *107*, 2408–2412.

Scott, S. K., Lavan, N., Chen, S., & McGettigan, C. (2014). The social life of laughter. *Trends in Cognitive Sciences*, *18*, 618–620.

Simonyan, K. (2014). The laryngeal motor cortex: Its organization and connectivity. *Current Opinion in Neurobiology*, *28*, 15–21.

Szameitat, D. P., Alter, K., Szameitat, A. J., Wildgruber, D., Sterr, A., & Darwin, C. J. (2009). Acoustic profiles of distinct emotional expressions in laughter. *Journal of the Acoustical Society of America*, *126*, 354–366.

Szameitat, D. P., Kreifelts, B., Alter, K., Szameitat, A. J., Sterr, A., Grodd, W., & Wildgruber, D. (2010). It is not always tickling: Distinct cerebral responses during perception of different laughter types. *NeuroImage*, *53*, 1264–1271.

Tibshirani, R. (1996). Regression shrinkage and selection via the lasso. *Journal of the Royal Statistical Society Series B*, *58*, 267–288.

Vettin, J., & Todt, D. (2004). Laughter in conversation: Features of occurrence and acoustic structure. *Journal of Nonverbal Behavior*, *28*, 93–115.

Vettin, J., & Todt, D. (2005). Human laughter, social play, and play vocalizations of nonhuman primates: An evolutionary approach. *Behaviour*, *142*, 217–240.

Wood, A., Martin, J., & Niedenthal, P. (2017). Towards a social functional account of laughter: Acoustic features convey reward, affiliation, and dominance. *PLOS ONE*, *12*(8), Article e0183811. doi:10.1371/journal.pone.0183811