



When to Laugh, When to Cry: Display Rules of Nonverbal Vocalisations Across Four Cultures

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Abstract

Nonverbal vocalisations like laughter, sighs, and groans are a fundamental part of everyday communication. Yet surprisingly little is known about the social norms concerning which vocalisations are considered appropriate to express in which context (i.e., display rules). Here, in two pre-registered studies, we investigate how people evaluate the appropriateness of different nonverbal vocalisations across locations and relationships with listeners. Study 1, with a U.S. sample ($n=250$), showed that certain vocalisations (e.g., laughter, sighs, cries) are consistently viewed as more socially acceptable than others (e.g., roars, groans, moans). Additionally, location (private vs. public) and interpersonal closeness (close vs. not close) significantly influenced these perceptions, with private locations and close relationships fostering greater expressive freedom. Study 2 extended this investigation across four societies with divergent cultural norms ($n=1120$ in total): the U.S. (for direct replication), Türkiye, China, and the Netherlands. Findings largely replicated those from Study 1 and supported the existence of cross-culturally consistent patterns in display rules for nonverbal vocalisations, though with some variation across cultures. This research expands our understanding of how social norms affect auditory communication, extending beyond the visual modality of facial expressions to encompass the rich world of nonverbal vocalisations.

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Introduction

Human voices express far more than words alone. Imagine a joyful shriek of a child on a rollercoaster, a gasp of shock at receiving terrible news, or an exhausted groan at the end of a long, hard run. These nonverbal vocalisations – laughter, sighs, groans, screams, and many more – are a fundamental part of the human experience. They emerge in infancy (Koutseff et al., 2017) and are found across the globe (Laukka et al., 2013; Sauter et al., 2010). They can act as signals or cues to affective states to observers (Bryant, 2021; Russell, 1994). For instance, we might cheer after our favourite team has won a game, cry while watching a drama series, or sigh when a difficult task is finally completed. However, the meaning inferred from nonverbal vocalisations may depend on the kind of vocalisation produced and the social context in which it occurs (Pisanski et al., 2022; Scarantino, 2017). For example, while laughter might be socially acceptable across most contexts, moans might be seen as inappropriate in any but the most private of locations. Understanding these vocalisation norms is important for navigating social situations and reading nonverbal cues from others. In the present study, we investigate how perceived appropriateness differs across different types of nonverbal vocalisations and across contexts.

Display Rules of Nonverbal Vocalisations

Pioneered in the study of facial expressions, *display rules* are social norms that guide when and how it is appropriate to display specific emotions (Ekman & Friesen, 1969). These rules are socialised in early development (Gnepp & Hess, 1986; Saarni, 1979) and influence whether we intensify, minimise, or even mask our felt emotions to align with social expectations (Simpson & Strohm, 2004; Zeman & Garber, 1996). While influential in shaping our understanding of emotional expression, researchers have continued to refine and expand the concept of display rules, exploring its application to various modalities of expression and its interplay with individual differences and situational contexts (Dawel et al., 2023). For example, display rules for nonverbal expressions vary across contexts (Fridlund, 1991; Hess et al., 1992; Jakobs, Manstead, & Fischer, 1999). Smiles are widely accepted in social interactions, as they generally convey positive intentions and facilitate social connection (Harker & Keltner, 2001). As compared to negative emotions, then, joyful expressions are known to have weaker display rules (Matsumoto et al., 2005). Yet recent work (Manokara et al., 2023) reveals that display rules can vary even between positive emotions, suggesting that not all expressions of states that are considered positive are perceived as appropriate in all contexts.

In addition to varying across emotions, display rules are shaped by social context, with clear distinctions between what is appropriate in private versus public locations. In public locations, display rules are expected to reflect societal expectations for a higher level of control over emotional expressions; in private locations, display rules may be less restrictive (Ekman, 1972; Matsumoto et al., 2008). For instance, in private, a person might leap for joy and shout out loud upon receiving positive news. The same news would likely elicit a more subdued expression of excitement in a public place – perhaps just a wide smile and a whispered exclamation (for more examples, see Diefendorff & Richard, 2003). The nature of the relationship between the expressor and others who are present also influences the appropriateness of emotional expressions (Frijda & Mesquita, 1994; Keltner & Haidt, 1999). Vocalisations conveying intimate feelings or affiliative intentions (e.g., moans;

Pisanski et al., 2022) may be considered more appropriate in interactions with close others. On the contrary, vocalisations that convey antagonistic intentions, such as growls or roars, might generally be perceived as inappropriate regardless of interpersonal closeness. Hence, considerations of context might be crucial to understanding how display rules for nonverbal vocalisations are interpreted (see Greenaway et al., 2018).

Despite the well-established influence of display rules on facial expressions, their impact on nonverbal vocalisations remains largely unexplored. This is surprising, given the centrality of social norms in shaping how perceivers interpret emotional expressions (Van Kleef, 2009; Hareli et al., 2013). We produce a wide range of vocalisations that signal different emotional states and intentions (e.g., laughter versus cry; Pisanski et al., 2022). Even though affective science acknowledges the voice as a central channel of emotion expression (Kreiman & Sidtis, 2011), our current understanding of display rules remains largely confined to the single modality of facial expressions. The current study aims to test whether social norms govern the appropriateness of nonverbal vocalisations.

The Present Study

This set of studies aims to investigate how display rules vary across different types of nonverbal vocalisations. Specifically, we assessed the perceived appropriateness of 10 types of vocalisations: crying, gagging, groaning, growling, grunting, laughing, moaning, roaring, screaming, and sighing. As a secondary aim, we examine how two key aspects of social context – location (public vs. private; within-subjects) and interpersonal closeness (close vs. not close; within-subjects) – influence the perceived appropriateness of vocal expressions.

We propose that display rules for nonverbal vocalisations are influenced by the type of vocalisation and social context. Specifically, we hypothesise that: (1) certain vocalisations (e.g., laughter) will generally be perceived as more socially appropriate than others (e.g., moans); (2) public locations will be associated with lower levels of perceived appropriateness compared to private ones; (3) vocalisations will be considered more appropriate within closer relationships as compared to distant relationships; and (4) these factors (vocalisation, location, relationship) will interact with one another, jointly influencing perceptions of social appropriateness.

Hypothesis 1. There will be a main effect of vocalisation type on display rules, such that different types of nonverbal vocalisations (e.g., laughter, cries, roars) will have varying levels of perceived social appropriateness.

Hypotheses 2a and 3a. There will be a main effect of location (public vs. private) on display rules (Hypothesis 2a), such that public locations are associated with lower levels of perceived appropriateness compared to private ones. Furthermore, there will be a main effect of interpersonal closeness (close vs. not close) on perceived appropriateness (Hypothesis 3a), such that vocalisations are considered more appropriate within closer relationships.

Hypotheses 2b and 3b. There will be an interaction between vocalisation type and location on display rules (Hypothesis 2b), such that the impact of location on the acceptability of nonverbal vocalisations will vary depending on the type of vocalisation. Furthermore, there will be an interaction between vocalisation type and interpersonal closeness on display rules

(Hypothesis 3b), such that the influence of relationship closeness on the social acceptability of nonverbal vocalisations will vary depending on the type of vocalisation.

Hypothesis 4. There will be a three-way interaction between vocalisation type, location, and interpersonal closeness on display rules. This suggests that the perceived appropriateness of a given vocalisation in a specific location (public vs. private) will vary depending on whether it is expressed towards someone with a close or not close relationship. For example, laughter might be widely acceptable in public spaces among close friends due to its role in reinforcing social bonds, but it could be perceived as less appropriate in the same public location with distant acquaintances. Conversely, expressions of distress, such as crying, might be more socially acceptable in private locations but particularly so in the presence of close relationships where support seeking and emotional openness are valued.

In Study 1, we investigated display rules for nonverbal vocalisations within a United States sample. Study 2 extended this investigation to examine the cross-cultural generalisability of our initial findings by replicating Study 1 with a U.S. sample and additionally collecting data in Türkiye, China, and the Netherlands. These countries were selected to represent diverse geographical regions and cultural contexts. Study 1 and Study 2 were preregistered at: <https://osf.io/x6czj/>. Both studies were approved by the Faculty Ethics Review Board of Vrije Universiteit Amsterdam. All participants were asked to provide digital informed consent before participation and were free to stop at any point.

Study 1: Display Rules for Nonverbal Vocalisations in a U.S. Sample

In Study 1, we investigated display rules for nonverbal vocalisations within a U.S. sample. We focused on whether certain vocalisations (e.g., laughter) are viewed as more socially acceptable than others (e.g., moans), and how location (private vs. public) and interpersonal closeness (close vs. not close) influence these perceptions. This initial investigation provides a baseline understanding of display rules for nonverbal vocalisations before extending our research to a cross-cultural context.

Method

Participants

To determine the sample size for Study 1, we employed a simulation approach using the Superpower package (Lakens & Caldwell, 2021) in R (version 2023.12.0+369, www.r-project.org). This method allowed us to model a $10 \times 2 \times 2$ within-subjects ANOVA design, which includes the 10 vocalisation types, location of expression (private vs. public), and interpersonal closeness (close vs. not close). The ten vocalisation types were as follows: cry, gag, groan, growl, grunt, laugh, moan, roar, scream, sigh. For the simulations, we assumed a standard deviation of 1 for each cell in the design and explored a range of mean differences ($0, \pm 0.2$) to reflect no effect, small positive effects, and small negative effects, respectively. This approach aligns with expectations for subtle differences in social appropriateness based on vocalisation type, location, and interpersonal closeness. Based on the

simulations, we found that a sample size of 250 participants per cell would be required to achieve at least 80% power to detect two-way interaction effects. The results indicated that with 250 participants, we would be powered at a minimum of 80% to detect interaction effects between all modelled factors. The detailed simulation code and parameters used for determining the sample size are available in the same Open Science Framework (OSF) folder as the preregistration.

In total, 250 U.S. participants (120 women and 127 men; 2 preferred to self-describe; 1 other; $M_{age} = 31.65$, $SD_{age} = 5.17$) with no (self-reported) hearing impairments were recruited via Prolific (<https://www.prolific.co/>). Participants were compensated with £1.50. We excluded participants who failed the attention check and quality control measures ($n=2$; see Quality control and attention check measures section below for details). We continued data collection until we had 250 eligible participants.

Materials and Procedure

Selection and Categorisation of Nonverbal Vocalisations

The selection of nonverbal vocalisations was informed by a classification that identified distinct vocal sounds based on semantic grouping through naming tasks by English-speaking participants (Anikin et al., 2018). We made two adjustments to the categorisation provided by Anikin and colleagues. First, we opted to merge shriek and scream into a single category, which we refer to as scream. This decision was based on the close semantic and acoustic overlap between these vocalisation types. Second, we included growls as a distinct category. While growls are traditionally associated with expressions of anger or annoyance, they may have distinct characteristics that set them apart from other anger vocalisations (e.g., groans or grunts). The final pool of nonverbal vocalisations included: cries, gags, groans, growls, grunts, laughs, moans, roars, screams, and sighs.

Nonverbal Vocalisation Samples

For each vocalisation type, we selected one male and one female example. These samples were partly taken from the corpus used in Anikin and Persson (2017) and partly spontaneous vocalisations identified in online sources (www.youtube.com). Samples were chosen based on standardised criteria including: accurate exemplification of the intended vocalisation type, absence of background noise or overlapping speech, and spontaneity of expression (see Anikin & Persson, 2017 for details). To ensure consistency, all recordings were digitalised at a 44,100 kHz sampling rate (16-bit, mono) and normalised for peak amplitude using Audacity (<https://www.audacityteam.org>). All vocalisation samples are available on the OSF project page associated with this study (<https://osf.io/x6czj/>). Along with these vocalisation examples, we provided participants with definitions for each of the nonverbal vocalisation types used in the study (see Table 1 for definitions) to ensure a shared understanding of the vocalisations and decrease potential variability in interpretation due to individual or cultural differences.

Table 1 Definitions of vocalisation types provided in the experiment

Vocalisation Type	Definition
Cry	Short, uneven breaths with long, drawn-out sounds.
Gag	A choking sound like something is stuck in the throat.
Groan	A low, long sound from the throat.
Growl	A low, rough sound from deep in the throat.
Grunt	A short, strong sound from the throat or belly.
Laugh	Short, repeated bursts of air from the chest.
Moan	A long, low sound that might go up and down.
Roar	A loud, powerful sound that starts low and becomes higher.
Scream	A loud, high-pitched sound.
Sigh	Taking a deep breath and letting it out slowly.

The Vocalisation-Display Rules Assessment Protocol (VODRAP)

The Vocalisation-Display Rules Assessment Protocol (VODRAP) was designed to systematically evaluate how social context influences the perceived appropriateness of different nonverbal vocal expressions. Drawing on established display rules assessment inventories (e.g., Christoforou & Ashforth, 2015; Matsumoto et al., 2005), the VODRAP adopts an intersubjective approach to capturing group perceptions of social expectations for emotional expressions (Chiu et al., 2010; Manokara et al., 2023).

Participants were first introduced to ten distinct nonverbal vocalisations through definitions and audio samples (both sexes) to ensure understanding and focus their attention on the expressions themselves. They were told that *private settings* refer to personal space, like a home or a private room, and *public settings* refer to places open to the general public, such as streets or public transportation. They were also told that *close others* refers to individuals with whom they have a strong personal connection (e.g., family or close friends), while *not close others* refers to those with whom they lack a strong personal connection (e.g., acquaintances or strangers).

Following this, the VODRAP guided participants through scenarios in which they were asked to rate how appropriate they think most people in their community would consider a given vocalisation in various social settings, which included: (1) Private with close others, (2) Private with not close others, (3) Public with close others, and (4) Public with not close others.

Quality Control Measures

In order to make sure that participants were able to properly hear the audio clips, we asked two quality control questions. One question was *Were you able to play all the clips during the experiment?* and the other was *Did any major interruptions or distractions occur during the experiment?* with yes/no response options. Participants who respond to the first question with No and/or the second question with Yes were excluded from the study.

Attention Checks. We included two attention checks that have been used in previous studies (e.g., Samore et al., 2022). The first question was *When you look up on a clear day, what colour is the sky?* with the response options Train station, Laptop, Blue, Cardboard box, Chicken, Green, Book, and Lamp. The second attention check question was *Did you carefully consider your responses to this survey (please be honest)?* with yes/no response options. Participants who answered the first question with other than Blue and/or the second question as No were excluded from the analysis.

Experimental Procedure

The listening experiment was run online through the Qualtrics survey tool (Provo, UT). Before the experiment, participants were instructed to wear headphones and to complete the experiment in a quiet location. After the general information letter, participants were informed that they would soon hear short audio clips of various everyday sounds (e.g., laughs, screams, sighs). They were tasked to *rate how appropriate you think people in your community would generally find expressing each sound in different settings from 1 (very inappropriate) to 9 (very appropriate)*.

Next, participants were provided two audio examples per type of nonverbal vocalisation, accompanied by a definition. After the definition and audio samples, participants completed the VODRAP for the target vocalisation type. This procedure was conducted for all the vocalisation types with the order of nonverbal vocalisations randomised. After completing the VODRAP for all vocalisations, participants were provided an open-ended question in which we asked them to list any other nonverbal vocalisation they thought was not included in the experiment. There was no time constraint for completing the experiment. At the end of the experiment, participants were asked to answer the quality control and attention check questions and to report their age and gender. They were also able to leave comments if they wished. The experiment took around 10 min. Exact phrasing of the questions used in the experiment is given in Supplementary Materials Text 1 S.

Statistical Analysis

We conducted a $10 \times 2 \times 2$ repeated measures analysis of variance (ANOVA) to test our hypotheses. The ANOVA included the following factors: Nonverbal Vocalisation Type ($n=10$; within-subjects), Location of Expresser (Private vs. Public; within-subjects), and Interpersonal Closeness (Close vs. Not Close; within-subject). Our primary focus was on main effects of each vocalisation type (H1: Vocalisation Type), public versus private location (H2a: Location), and listener relationship closeness (H3a: Interpersonal Closeness). Interaction effects included how the influence of location on vocalisation appropriateness varies depending on the type of vocalisation (H2b: Vocalisation Type x Location), how interpersonal closeness modulates the relationship between vocalisation type and appropriateness (H3b: Vocalisation Type x Interpersonal Closeness), and how the relationship between vocalisation type and location varies across levels of interpersonal closeness (H4: Vocalisation Type x Location x Interpersonal Closeness). For any significant interactions, we followed up with pairwise comparisons.

To address the challenge of multiple comparisons across the 10 different nonverbal vocalisations while controlling for type I errors, we applied the Bonferroni-Holm correction to adjust the p -value thresholds. This correction method was applied to account for the ordering of p -values and to ensure a balance between controlling for type I errors and maintaining statistical power.

Results and Discussion

Main Effects

H1: Vocalisation Type

As predicted, repeated measures ANOVA revealed a significant main effect of vocalisation type on perceived appropriateness $F(9, 2241)=303.12, p<.001, \eta^2_p=.55$. Laughter ($M=7.35, SD=1.93$) emerged as the most socially appropriate vocalisation, followed by sighing ($M=6.71, SD=1.99$). Roaring ($M=2.73, SD=1.55$) and moaning ($M=2.80, SD=1.40$) were rated as the least appropriate. Figure 1 illustrates the distribution of ratings for each vocalisation.

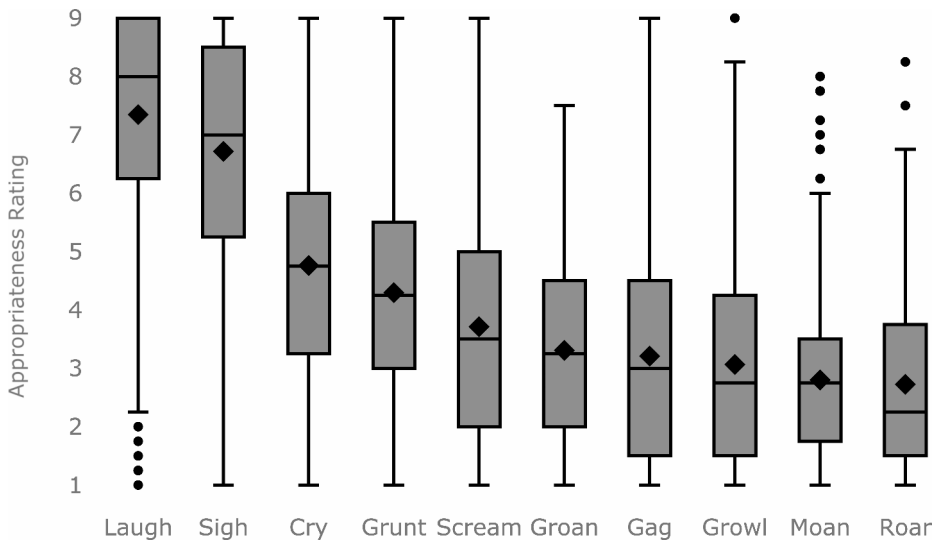


Fig. 1 The distribution of perceived appropriateness ratings for the ten nonverbal vocalisations. The box-plots illustrate the spread of the ratings, with diamond representing the mean, the center line within each box the median, and the whiskers extending to show potential outliers. The y-axis shows the scale used to measure appropriateness, ranging from 1 (very inappropriate) to 9 (very appropriate)

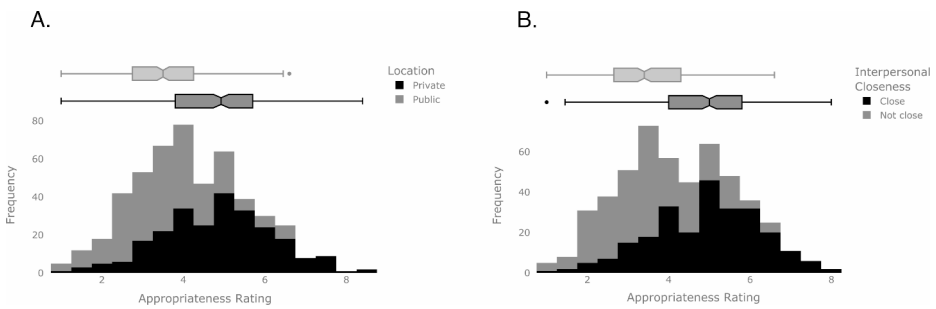


Fig. 2 Distribution of perceived appropriateness ratings for nonverbal vocalisations. **(A)** Shows histograms with overlaid boxplots for private (black) and public (grey) settings, and **(B)** for close (black) and not close (grey) relationships. The x-axis represents the appropriateness ratings on a scale of 1 (very inappropriate) to 9 (very appropriate), and the y-axis quantifies the frequency of responses. Boxplots show the median rating (central mark), the interquartile range (box length), and the full range excluding outliers (whiskers). These visualisations illustrate how perceived appropriateness varies with social context, with a more liberal range observed in private and close relational settings

H2a: Location

As expected, a significant main effect of location (public vs. private) was found on perceived social appropriateness, $F(1, 249)=364.20, p<.001, \eta_p^2=.59$. Overall, vocalisations were rated as more appropriate in private locations ($M=4.81, SD=1.39$) than public ones ($M=3.58, SD=1.15$), aligning with the core tenet of display rules (see Fig. 2A).

H3a: Interpersonal Closeness

Our analyses yielded a significant main effect of interpersonal closeness on display rule strength, $F(1, 249)=534.16, p<.001, \eta_p^2=.68$. As hypothesised, expressions were perceived as more appropriate in close relationships ($M=4.88, SD=1.34$) compared to less close relationships ($M=3.51, SD=1.18$). These findings suggest weaker display rules in close relationships (see Fig. 2B).

Interaction Effects

H2b: Vocalisation Type x Location

Consistent with H2b, we detected an interaction between vocalisation type and location (public vs. private) on display rule strength, $F(9, 2241)=39.79, p<.001, \eta_p^2=.14$. While private locations were generally associated with weaker display rules compared to public ones, the magnitude of this difference varied across vocalisations. Laughter and sighs displayed relatively consistent appropriateness ratings across both location ($d=0.27$ [0.15, 0.41] for laughter; $d=0.26$ [0.14, 0.39] for sighs). Conversely, moans and cries exhibited the largest difference between locations, with private locations allowing for significantly higher perceived appropriateness ($d=0.97$ [0.84, 1.11] for moans, and a similar pattern for cries). Figure 3A illustrates this interaction effect, and pairwise comparisons are presented in Supplementary Materials Table S1 and Table S2.

H3b: Vocalisation Type x Interpersonal Closeness

As predicted, we found a significant interaction between vocalisation type and interpersonal closeness on display rule strength, $F(9, 2241)=15.11, p<.001, \eta^2_p=.06$. The appropriateness advantage within close relationships was more pronounced for certain vocalisations (e.g., moans, $d=0.72 [0.59, 0.84]$) compared with others (e.g., laughter, $d=0.43 [0.3, 0.55]$).

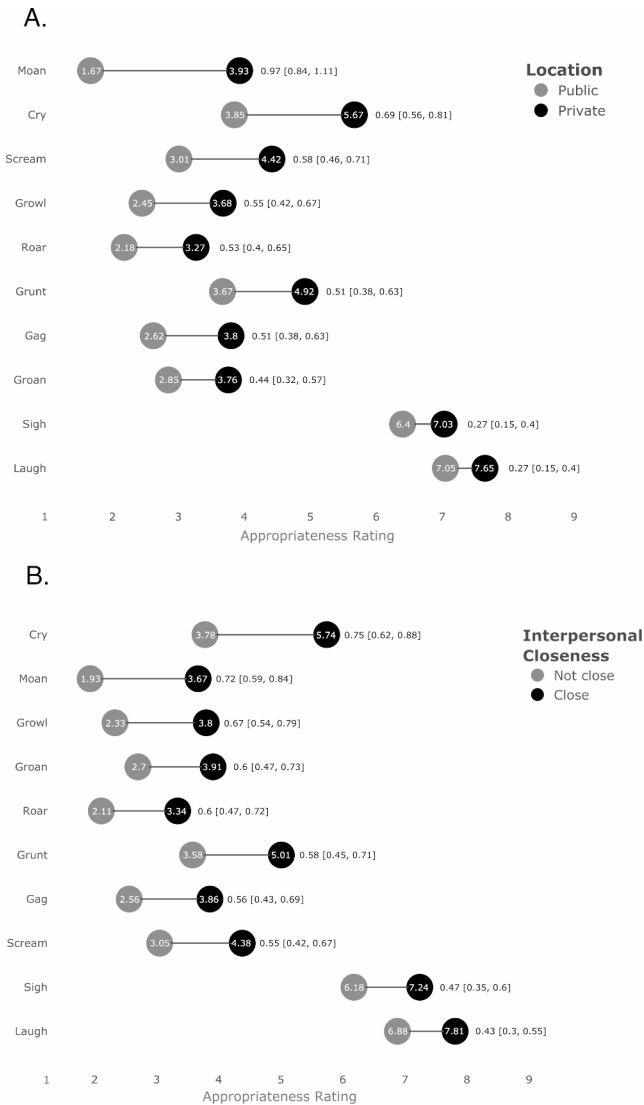


Fig. 3 Differential perceived appropriateness of vocalisations with effect size estimates in **(A)** private and public settings; **(B)** close and not-close others. The graph displays vocalisation types along the y-axis, ordered by the magnitude of the effect. The x-axis indicates the average appropriateness ratings. Effect sizes (Cohen’s d) and associated 95% confidence intervals are placed above each paired comparison, quantifying the impact of location or closeness on display rule strength

Figure 3B visualises this interaction, and pairwise comparisons are available in Supplementary Materials Table S3 and Table S4.

H4: Vocalisation Type x Location x Interpersonal Closeness

Consistent with H4, analyses revealed a significant three-way interaction between vocalisation type, location (public vs. private), and interpersonal closeness (close vs. not close) on display rule strength, $F(9, 2241)=41.13, p<.001, \eta^2_p=.14$. This finding indicates that the interplay of location and vocalisation type itself varies across interpersonal closeness. While the effect of relationship closeness was generally more pronounced in private settings, this pattern was especially evident for vocalisations like moans. In contrast, expressions like groans showed a similar relationship effect in both public and private settings. Figure 4 illustrates the variation in how location and interpersonal closeness shape the acceptability of different vocalisations.

Building on these findings, we further investigated the impact of interpersonal closeness on display rules within each setting. To further examine the three-way interaction, we analysed the interaction between vocalisation type and location separately for each closeness level (see Table S5 for means and SDs). Pairwise comparisons (Tables S6 and S7) revealed context-dependent patterns regarding the social acceptability of vocalisations. In close relationships, expressions like cries, moans, roars, and screams were found to be more acceptable in private locations compared to public settings (all $p_s < 0.001$). However, laughter ($M_{\text{private}} = 8.18, SD_{\text{private}} = 1.68; M_{\text{public}} = 7.45, SD_{\text{public}} = 2.14$) and sighs ($M_{\text{private}} = 7.64, SD_{\text{private}} = 1.89; M_{\text{public}} = 6.85, SD_{\text{public}} = 2.19$) was judged to be relatively appropriate in both contexts (see t -values in Table S6). In contrast, for non-close relationships, the distinc-

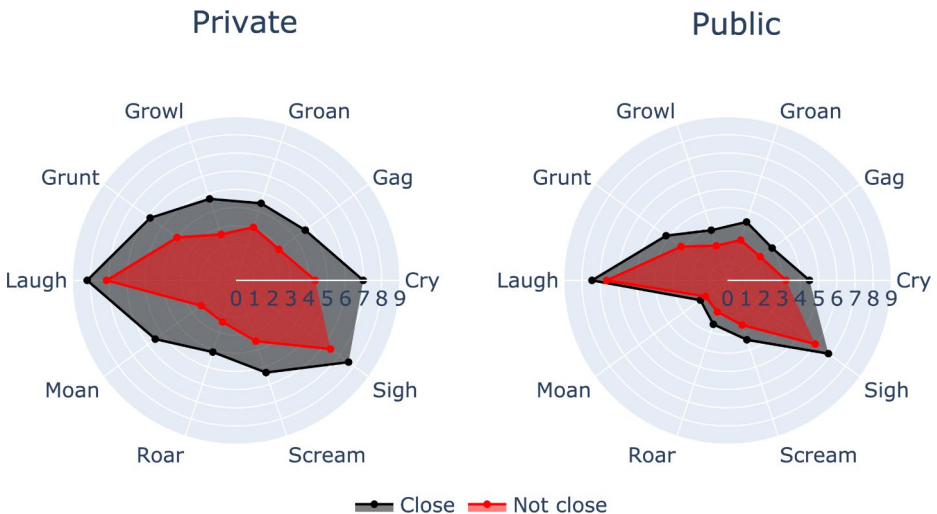


Fig. 4 Comparison of display rule strength for different nonverbal vocalisations by location and interpersonal closeness. The radar charts depict average appropriateness ratings for various vocalisations in private (left) and public (right) settings. Vocalisation types are placed along the axes, with ratings scaling from the center outward — closer to the edge indicates weaker display rules (more appropriate), and closer to the center indicates stronger display rules (less appropriate). Black lines represent ratings in close relationships, while red lines indicate ratings in not close relationships. Each data point on a spoke represents the average display rule strength for a specific vocalisation type in a given location condition

tion between private and public locations was less pronounced. Further analysis of closeness within each location (see Table S8 and S9) supported the notion of relaxed display rules in private settings, particularly for expressions like cries and moans, where relationship closeness plays a key role; in contrast, stricter display rules are observed in public settings.

Discussion: Display Rules in a U.S. Sample

Study 1 examined how display rules governing nonverbal vocalisations are shaped by vocalisation type, location, and interpersonal closeness within a U.S. sample. Findings highlight the variability in social expectations across different vocalisation types, with laughter and sighs being perceived as relatively more acceptable than expressions like cries, moans, roars, and screams. These latter vocalisations, consistently lower in appropriateness, were associated with stricter display rules, with their acceptability highly dependent on both location and interpersonal closeness. This finding demonstrates the context-dependent nature of display rules – expressions are often considered more appropriate in private settings, especially within close relationships.

These findings extend our understanding of display rules to beyond the realm of facial expressions, suggesting their applicability to a wider range of nonverbal behaviours. However, our findings are currently limited to a single cultural context: a U.S. sample. To explore the generalisability of these patterns, Study 2 included participants from a second U.S. sample alongside individuals from Türkiye, China, and the Netherlands.

Study 2: A Cross-Cultural Replication of Nonverbal Vocalisation Norms

In Study 2, we expanded our investigation into four culturally diverse contexts: the U.S. (for direct replication), Türkiye, China, and the Netherlands. This broader sample allows us to examine whether the display rules identified in Study 1 are robust and generalisable across different cultures.

Method

Participants

To achieve sufficient power to investigate cross-cultural patterns of display rules, we used the Superpower package (Lakens & Caldwell, 2021) in R to conduct a priori power simulations. Our goal was to detect potential higher-order interaction effects within a 4 (Country) x 10 (Nonverbal Vocalisation) mixed-model ANOVA. This design incorporates the between-subjects factor of country (U.S., Türkiye, China, Netherlands) and the within-subjects factor of vocalisation type (i.e., cry, gag, groan, growl, grunt, laugh, moan, roar, scream, sigh). Simulations modelled a standard deviation of 1 for each cell and explored various mean differences (0, ± 0.2) to represent potential effect sizes (none, small positive, small negative). Results indicated that a sample of 280 participants per country would provide at least 80% power to detect interaction effects. Code and parameters are available on OSF for transparency.

We recruited participants via Cint (<https://www.cint.com>), a global online sampling platform that provides access to a diverse panel of respondents across various demographic categories and geographic locations. We aimed for 280 participants with no (self-reported) hearing impairments per country. After applying quality control and attention checks (30 exclusions in the U.S., 7 in the Netherlands, 7 in Türkiye, 2 in China), we continued data collection until we reached the target sample size. Demographic breakdowns were as follows: U.S. ($N=280$; 143 women, 125 men, 6 preferred not to say, 4 preferred to self-describe, 2 other; $M_{age} = 29.96$, $SD_{age} = 6.69$), Netherlands ($N=280$; 140 women, 133 men, 4 preferred not to say, 2 preferred to self-describe, 2 other; $M_{age} = 26.42$, $SD_{age} = 6.40$), Türkiye ($N=280$; 145 women, 134 men, 1 preferred not to say; $M_{age} = 30.55$, $SD_{age} = 5.96$) and China ($N=280$; 117 women, 128 men, 8 preferred not to say, 17 preferred to self-describe, 10 other; $M_{age} = 30.24$, $SD_{age} = 5.70$). We compensated Cint 1.95€ per participant in China and Turkey, 2.75€ per participant in the Netherlands, and 1.70€ per participant in the US.

Materials and Procedure

To ensure the accurate and culturally appropriate translation of our materials, we employed a team translation approach to translate materials (Douglas & Craig, 2007). For each target language (Dutch, Turkish, and Chinese), two independent native speakers proficient in English independently translated all materials. They then convened to compare their work and resolve any discrepancies. This collaborative process allowed for consensus on the most appropriate translations, ensuring conceptual equivalence across languages. All translated materials are available on the OSF project page associated with this study (<https://osf.io/x6czj/>). All measures and procedures, apart from the translation process, were kept identical to Study 1 to enable direct replication and comparability across cultures.

Statistical Analysis

Our core hypotheses tested whether the display rules identified in Study 1 hold across the four included cultures (U.S., Türkiye, China, Netherlands). Specifically, we examined the following: whether different vocalisation types (e.g., laughter, cries, roars) exhibit a similar hierarchy of perceived appropriateness across cultures (H1: Country x Vocalisation); whether stricter display rules apply to public locations compared to private ones across cultures (H2a: Country x Location); whether the impact of location (public vs. private) on a vocalisation's appropriateness depends on the specific expression similarly across cultures (H2b: Country x Vocalisation Type x Location); whether greater acceptance of vocalisations within close relationships is a cross-culturally consistent phenomenon (H3a: Country x Interpersonal Closeness); and whether the way interpersonal closeness shapes appropriateness judgments depends on the type of vocalisation similarly across cultures. (H3b: Country x Vocalisation Type x Interpersonal Closeness).

We employed a mixed-design ANOVA ($4 \times 10 \times 2 \times 2$), which included country as a between-subjects factor with four levels (U.S., Türkiye, China, Netherlands); Nonverbal Vocalisation Type as a within-subjects factor with ten levels (crying, gagging, groaning, growling, grunting, laughing, moaning, roaring, screaming, sighing); Location of Expresser as a within-subjects factor with two levels (Private, Public); and Interpersonal Closeness as a within-subjects factor with two levels (Close, Not Close).

Our primary focus was to test whether our findings for display rules in Study 1 replicate across cultures. To do this, we focused on examining interactions between country and the other factors (Vocalisation Type, Location, Interpersonal Closeness). We set out two potential analysis paths: In the case of significant interactions, we would next investigate country-specific patterns to understand how display rules differ across the included cultures. Then, we would perform a rank-ordering analysis to compare how various vocalisations are ranked in terms of appropriateness within each culture. Finally, simple slopes analysis would be used to decode how location and relationship closeness differentially impact the relationship between vocalisation type and appropriateness across the diverse cultures in our sample.

If no significant interactions involving Country would be detected, our analysis would shift to testing the core hypotheses drawn from Study 1's findings. These hypotheses focused on whether different types of vocalisations are associated with variation in appropriateness levels, if stricter display rules apply in public settings, whether the impact of location depends on the specific type of vocalisation, if closeness influences perceived appropriateness, if this effect varies based on the vocalisation, and finally, examining the complex three-way interaction to see if it replicates across cultures. To further explore any significant interactions among these factors, we would employ simple slopes analysis as needed. Similar to Study 1, we applied the Bonferroni-Holm correction while addressing multiple comparisons.

Results and Discussion

A mixed-design ANOVA ($4 \times 10 \times 2 \times 2$) revealed significant effects for Country, Vocalisation Type, Location, Interpersonal Closeness, and all their two-way and three-way interactions (see Table S10 for full results). This indicates that each of these factors, as well as their combinations, influence how the appropriateness of nonverbal vocalisations is perceived. Below, we break down the significant two-way and three-way interactions.

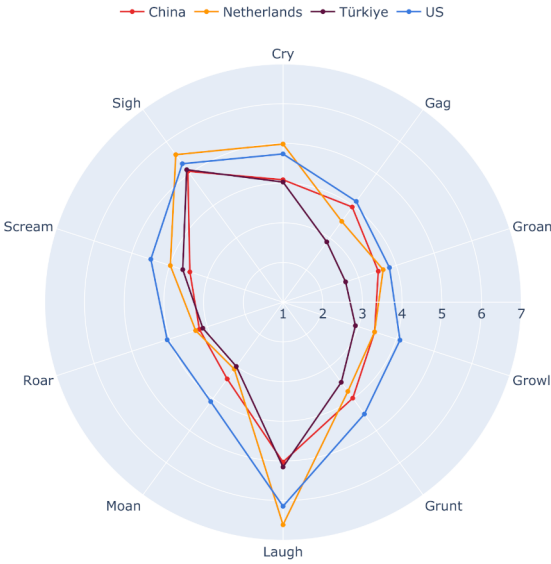
Two-way Interaction Effects

H1 (Country x Vocalisation Type)

The results showed a significant two-way interaction between Country and Vocalisation Type, $F(27, 10044) = 12.91, p < .001, \eta^2 = 0.012$. Figure 5 presents a visual representation of appropriateness evaluations of nonverbal vocalisations in four countries (see Supplementary Materials Fig. S1 for a breakdown of these evaluations by gender). In order to better understand the two-way interaction, pairwise comparisons were conducted (see Supplementary Materials Table S11).

The general findings indicate that laughter, sighs, and cries consistently rank among the most socially acceptable nonverbal vocalisations. Laughter, in particular, stands out as a highly acceptable vocalisation across cultures, followed by sighs and cries. Screams, while considered moderately appropriate in the Netherlands, Türkiye, and the U.S., received lower ratings in China. Grunts occupy a middle position in appropriateness rankings, and vocalisations including groans, growls, gags, moans, and roars consistently rank among the

A.



B.

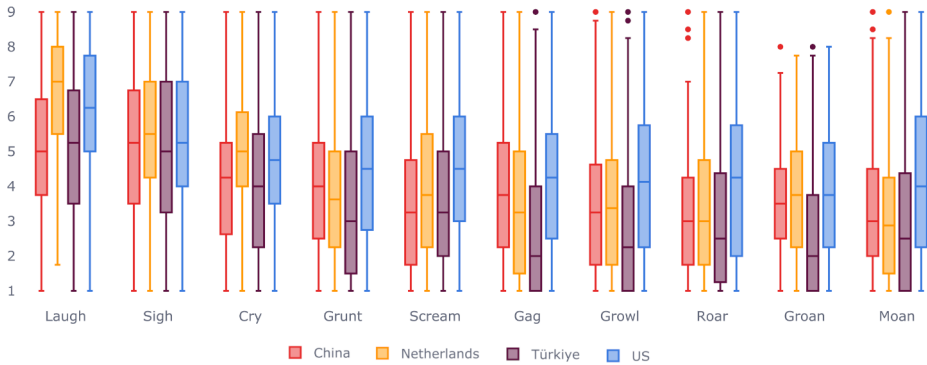


Fig. 5 Cross-cultural evaluations of nonverbal vocalisations. **(A)** Radar chart illustrating the average appropriateness ratings of various vocalisation types across China, the Netherlands, Türkiye, and the U.S. **(B)** Boxplot displaying the distribution of appropriateness ratings for each vocalisation type, delineating the median (line) and interquartile ranges (whiskers), across the four surveyed countries. The vocalisations are ordered according to their overall appropriateness ranking, from those considered as most appropriate to least appropriate

least appropriate vocalisations across all surveyed countries. Figure 6 provides a detailed comparison of how specific vocalisations are ranked across countries. While there are statistically significant differences in how specific vocalisations are ranked across countries, these differences are not always large in magnitude, particularly for the less socially acceptable vocalisations. For a complete set of pairwise comparisons, see Supplementary Materials Table S11.

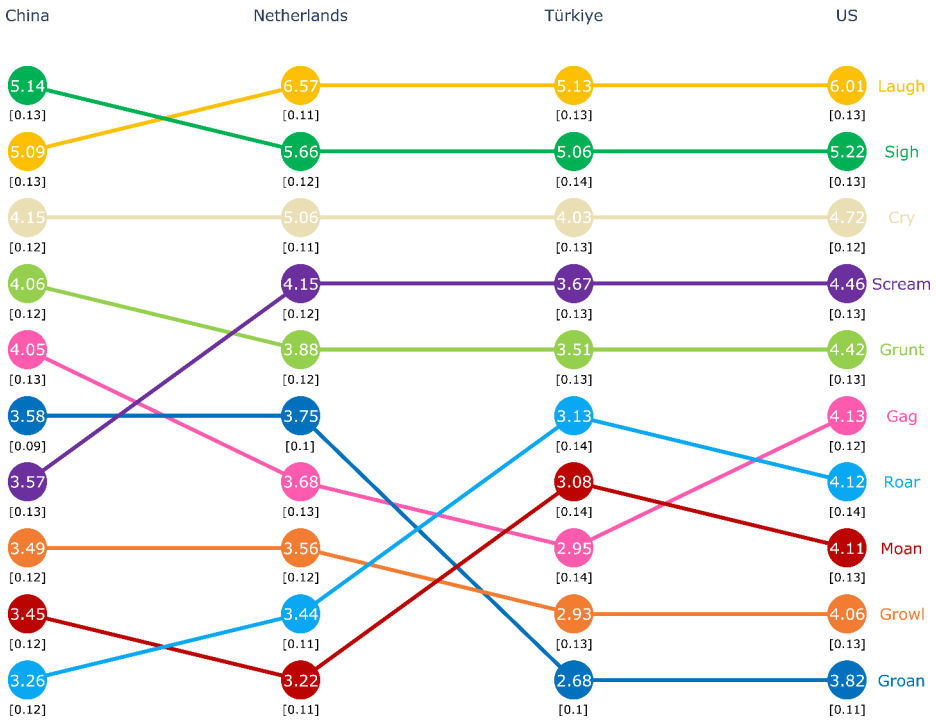


Fig. 6 Dumbbell Plot Illustrating the Rank-Ordering of Nonverbal Vocalisations Across Countries: This plot provides a comparative view of how different vocalisations, such as laughter, sighs, and cries, are ranked in terms of social appropriateness across China, the Netherlands, Türkiye, and the United States. Numbers in circles represent the mean appropriateness rating for each vocalisation within a specific country, while number in brackets depict the standard errors of the means. The connecting lines highlight the shifts in rankings between countries, with solid circles representing each vocalisation’s position within a specific cultural context

H2a: Country x Location

Analyses revealed a significant interaction between Country and Location ($F(3, 1116)=9.52, p<.001, \eta^2=0.001$). Appropriateness was higher in private locations for all four countries, but the effect sizes differed between countries. Effect sizes were smallest in the U.S. ($t(279)=8.8, p<.001, \text{Cohen’s } d=0.33$), followed by the Netherlands ($t(279)=11.77, p<.001, \text{Cohen’s } d=0.49$) and Türkiye ($t(279)=12.4, p<.001, \text{Cohen’s } d=0.46$). The largest effect size was observed in China ($t(279)=13.28, p<.001, \text{Cohen’s } d=0.60$). The box-plot (Fig. 7A) illustrates the wider spread of appropriateness ratings in public locations compared to private locations across all four countries.

H3a: Country x Interpersonal Closeness

Analyses revealed a significant interaction between Country and Interpersonal Closeness ($F(1, 1116)=5.02, p<.01, \eta^2=0.001$). Appropriateness was higher in social contexts involving close others for all four countries, but the effect sizes differed between countries. Effect sizes were smallest in the U.S. ($t(279)=8.32, p<.001, \text{Cohen’s } d=0.38$) followed by Tür-

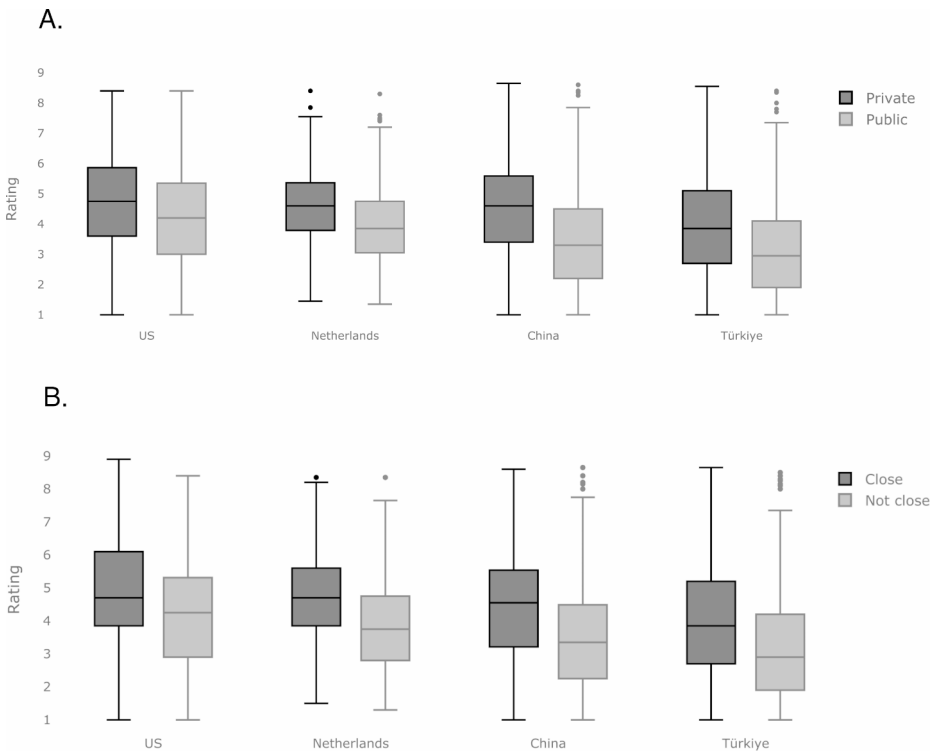


Fig. 7 Comparative appropriateness ratings for vocalisations by location and interpersonal closeness. **(A)** shows the distribution of ratings for vocalisations in private and public locations across four countries, illustrating a general preference for private locations. **(B)** contrasts the appropriateness ratings of vocalisations within close personal relationships against those that are not close, highlighting a cross-culturally consistent trend of higher acceptability in close relational settings

kiye ($t(279)=11.78$, $p<.001$, Cohen's $d=0.43$), China ($t(279)=13.15$, $p<.001$, Cohen's $d=0.60$), and the Netherlands ($t(279)=15.03$, $p<.001$, Cohen's $d=0.68$). The box plot (Fig. 7B) illustrates the preference for expressing nonverbal vocalisations within close relationships across all four surveyed countries.

Three-way Interaction Effects

H2b: Country x Vocalisation Type x Location

We detected a small a three-way interaction between Country, Vocalisation Type, and Location ($F(27, 10044)=3.77$, $p<.001$, $\eta^2=0.001$). To further explore this interaction, we conducted pairwise comparisons (see full results in Supplementary Materials Table S12). Figure S3 in Supplementary Materials illustrates how appropriateness ratings for vocalisations differ between public and private settings within each surveyed country. Across all cultures, crying and moaning were consistently considered more appropriate within private spheres. Conversely, sighing shows minimal variation across settings. Other forms of expression, such as growling or laughing, exhibit culturally influenced sensitivities to the location. In

general, the distinction between private and public locations is less pronounced in the U.S. and the Netherlands (with smaller effect sizes, d values ranging from 0.09 to 0.49). China and Türkiye demonstrate a stronger emphasis on public display rules, with larger effect sizes (d values ranging from 0.20 to 0.55).

H3b: Country x Vocalisation Type x Interpersonal Closeness

The analysis revealed small a three-way interaction between Country, Vocalisation Type, and Interpersonal Closeness ($F(27, 10044)=3.97, p<.001, \eta^2=0.001$). Pairwise comparisons were conducted to further explore this complex interaction (see full results in Supplementary Materials Table S13).

Across all four cultures, the three-way interaction highlighted some cross-cultural variations in how relationship closeness and vocalisation type shape display rules. In China, the distinction between close and non-close relationships had a particularly strong impact on the appropriateness of vocalisations like laughs and cries. This effect was less pronounced in other cultures. Additionally, although vocalisations like moans, growls, and roars were generally perceived as less appropriate with non-close others across cultures, the magnitude of this effect also varied (see Supplementary Materials Fig. S3). These findings suggest variations in how interpersonal closeness, vocalisation type, and culture combine to influence display rules.

Discussion: Display Rules in the U.S., Türkiye, China, and the Netherlands

Study 2 demonstrated cross-cultural consistency in display rule patterns identified in Study 1. Laughter, cries, and sighs consistently emerged as the most socially acceptable vocalisations, while grunts, groans, growls, gags, moans, and roars were consistently rated as less appropriate across the surveyed cultures. However, the influence of cultural context, location, and interpersonal closeness on these perceptions was often very small. While statistically significant, the magnitude of these interaction terms suggests that cross-cultural variability in display rules is modest.

Nevertheless, cultural differences also did emerge. For example, screams exhibited greater cultural variability in perceived appropriateness, being considered more acceptable in the Netherlands, Türkiye, and the U.S. than in China. This highlights the importance of cultural context in shaping the boundaries of display rules for specific nonverbal vocalisations.

Additionally, location and interpersonal closeness impacted display rules across cultures, with expressions in private locations and around close relationships consistently rated as more appropriate. However, the strength of these effects differed across cultures. China and Türkiye exhibited significantly stronger distinctions between public and private locations, as well as between close and non-close relationships, compared to the U.S. and the Netherlands.

General Discussion

In two pre-registered studies, we investigated how people perceive the appropriateness of different types of nonverbal vocalisations. Our findings demonstrate that laughter, sighs, and cries consistently emerge as more acceptable, while expressions like roars, groans, and moans are perceived as less appropriate. Furthermore, across diverse cultural contexts, we observed a consistent influence of social context on these perceptions, with private locations and close relationships generally affording greater expressive freedom compared to public spaces and less close relationships. These findings provide evidence that social expectations surrounding the expression of emotions, typically conceptualised as display rules, extend beyond facial cues and shape the way we interpret nonverbal vocalisations. By uncovering these norms, we gain a better understanding of how social expectations and contexts influence nonverbal communication.

Display Rules of Nonverbal Vocalisations

Our findings reveal a consistent pattern: across countries, laughter and sighs were consistently rated as the most acceptable vocalisation. While cries generally ranked as the third most acceptable, there was some cultural variation in their perceived appropriateness relative to other vocalisations. In the U.S. sample, the appropriateness of cries did not differ significantly from that of screams; in the Chinese sample, cry appropriateness was similar to gag appropriateness and grunt appropriateness. We interpret these findings through a social-functionality lens (Keltner et al., 2022). People might interpret laughter as communicating positive intent, perhaps due to its evolutionary roots as a play signal (Panksepp & Burgdorf, 2003; Winkler & Bryant, 2021). That said, laughter can also serve other functions that might be perceived as less positive (see Wood et al., 2017 for examples). These alternative functions of laughter might be associated with stricter display rules and may be less acceptable in certain social contexts.

Sighs, on the other hand, might serve intra- and inter-personal functions. Along with intrapersonal functions like regulating physiological arousal (Ramirez, 2014), sighs can also signal boredom, sadness, or relief (Vlemincx et al., 2017). This combination of internal and potentially communicative functions could explain their relatively consistent acceptability across various settings. In contrast, cries function as distress signals and are designed to elicit empathy and caregiving behaviours. Our findings allude to the importance of this communicative role, as cries were consistently perceived as more acceptable within close relationships where caregiving is likely to occur. This pattern aligns with research in a broad range of mammal species, where infant cries attract attention and support (Kelly et al., 2017; Lingle et al., 2012). Importantly, though, this heightened acceptance in close relationships is not unique to cries; it is part of a broader effect of relationship closeness on the perceived appropriateness of emotional expressions.

Stricter display rules govern vocalisations like roars, growls, moans, and groans. Their potential interpretations encompass a range of social implications. Roars and growls, which are often associated with aggression or dominance (Anikin et al., 2024; Tsai et al., 2010). In line with research suggesting that pride expressions become less acceptable in contexts where social relationships are important (Kalokerinos et al., 2014; van Osch et al., 2019), such associations could explain their stricter display rules. Moans and groans can convey

pain but might also signal pleasure in certain contexts (Anikin, 2020). Stricter display rules could emerge from the confusion or discomfort caused by their ambiguity. Here, the benefits of maintaining social harmony may motivate people to avoid sending mixed signals, further restricting the use of these vocalisations (Hareli & Hess, 2012).

Private vs. Public and the Role of Interpersonal Closeness

Our findings reveal the impact of location on the perceived appropriateness of nonverbal vocalisations. In line with the concept of psychological ownership, private locations consistently emerged as spaces with greater expressive freedom (Minam & Tanaka, 1995; Pierce et al., 2001). Conversely, public settings were associated with stronger display rules, potentially restricting certain vocalisations to maintain social harmony (Matsumoto et al., 2008). Notably, this context-dependent pattern is not uniform. Vocalisations like crying and moaning, often linked to high arousal (Anikin, 2020; Lingle et al., 2012), were considered far more acceptable in private spheres across cultures. Conversely, sighing showed minimal variation across settings, implying a shared understanding of its less disruptive nature. These findings underscore the context-dependent nature of nonverbal communication and suggest that factors such as the level of familiarity experienced within a space (e.g., private or public) (Koopmann-Holm & Matsumoto, 2011; Manokara et al., 2023) influence judgments about what vocalisations are appropriate in different contexts.

Together with location, the nature of the interpersonal relationship shaped perceptions of vocalisation appropriateness. Close relationships were consistently characterised by weaker display rules. This finding aligns with research on interconnectedness, suggesting heightened expressive comfort within relationships based on trust and dependence (Aron et al., 1992; Berscheid et al., 1989; Hess & Fischer, 2013). Within close connections, there is likely a greater understanding of shared norms and boundaries, enabling more authentic communication. This suggests that trust and relational intimacy can broaden the range of expressivity, even for potentially disruptive vocalisations.

Cross-Cultural Variation in Display Rules

While our findings broadly highlight consistent patterns in how location and interpersonal closeness influence perceptions of different types of nonverbal vocalisations, some cross-cultural variation also emerged. The USA and the Netherlands exhibit smaller effect sizes for both location and interpersonal closeness as compared to China and Türkiye. This finding might reflect Western cultural norms, which emphasise individual expression and affective autonomy (Fiske et al., 1998; Markus & Kitayama, 1991; Sagiv & Schwartz, 2000). The larger effect sizes observed in China and Türkiye might reflect a greater emphasis on social harmony and emotional restraint, particularly in public contexts. This pattern aligns with interdependent cultural values commonly observed in Chinese and Turkish societies (Hu, 1944; Hwang, 2006; Kagitcibasi, 2007).

While all cultures displayed relaxed display rules within close relationships, the effect was particularly pronounced in China. This finding points to potential cultural differences in how emotional expression is navigated within relationships, with greater emphasis on emotional moderation possibly playing a role (Matsumoto et al., 2008). These findings highlight that while cross-culturally consistent patterns exist, the way location and interpersonal

closeness modulate display rules can vary across cultures. Differences in emotional moderation, social expectations surrounding expression, and views on the relationship between the individual and the group might underlie some of this variation (Boiger & Mesquita, 2012; Markus & Kitayama, 1991).

Limitations and Future Directions

While our study sheds light on cross-culturally consistent display rules for nonverbal vocalisations, we acknowledge several limitations. Firstly, our reliance on self-report measures has inherent limitations. Participants might estimate social norms rather than reporting on their actual behaviour or the behaviours they typically observe in others. To enhance the validity of future investigations, a multi-method approach would be beneficial. For instance, integrating observational methods and qualitative approaches would provide a better understanding of display rules of nonverbal vocalisations. For example, observational studies in naturalistic settings (such as workplaces or family gatherings) could reveal how the frequency and perceived appropriateness of vocalisations vary with social context. Additionally, ethnographic methods, like interviewing participants about their perceptions of vocalisations and the specific norms they associate with them, could offer insight into the cultural values and beliefs that shape these display rules.

Furthermore, while our study focused on broad cultural contexts (the U.S., Türkiye, China, and the Netherlands), we acknowledge that our sampling methods did not explicitly control for individual differences in participants' cultural and linguistic backgrounds within these contexts. For example, the two samples from the US (Study 1 and Study 2) differed in their ratings of the appropriateness of vocalisation types, potentially due to the different recruitment platforms and demographic variations between the samples. This highlights the need for future research to consider individual-level factors such as first language, cultural heritage, and experiences living in other countries, alongside broader cultural contexts. This would allow for a better understanding of how individual cultural backgrounds interact with broader cultural contexts in shaping the perception of nonverbal vocalisations. Additionally, we acknowledge that our use of broad contextual categories (private vs. public, close vs. not close) may have introduced some variability in interpretation due to individual and cultural differences. While we provided standardised definitions within the survey, future studies could benefit from employing more specific scenarios to further examine the impact of context on the perception of vocalisations. This could include scenarios involving varying power dynamics and social roles, providing a broader understanding of how contextual factors shape vocalisation display rules.

Additionally, our study focused on ten types of emotional nonverbal vocalisations. Expanding this range to include a broader spectrum, such as yawning, humming, whistling (as suggested by participants; see Fig. S3), could offer further insights into nonverbal behaviour. Specifically, investigating potential display rule variations across these less emotionally charged sounds would help us understand whether the patterns we observed hold for nonverbal expressions that do not convey strong affective states. Furthermore, while we examined location and interpersonal closeness, other contextual factors are likely to play a role in shaping the appropriateness of nonverbal vocalisations. For example, power dynamics within a situation could shape how display rules are interpreted and applied (Stamkou

et al., 2019). Experimentally manipulating these variables would provide greater clarity on how they influence nonverbal behaviour.

The Vocalisation-Display Rules Assessment Protocol (VODRAP) we developed has the potential for broader applications in studying nonverbal communication and social perception. VODRAP could be used to investigate how people interpret conflicting cues from different modalities. For instance, researchers could use VODRAP to present participants with combinations of facial expressions and vocalisations that do not match (like a smile with a moan). Doing so could help us understand how people weigh information from different sources, such as facial expressions and vocalisations (for an example with incongruent facial and bodily cues, see Meeren et al., 2005). Additionally, VODRAP could be adapted to incorporate questions about social judgments or approach/avoidance behaviours relating to display rules (e.g., Manokara et al., 2024; Trougakos et al., 2011). By asking participants questions about how a particular vocalisation makes them perceive someone or how likely they are to approach them, researchers could gain insights into the immediate social consequences of different sounds. These capabilities of VODRAP can equip researchers with a valuable tool to further explore nonverbal communication and its impact on social interactions.

Conclusion

Our work provides evidence that display rules - the social norms influencing emotional expressions - extend beyond facial cues to nonverbal vocalisations. Across four countries, laughter, sighs, and cries emerged as more acceptable, suggesting a degree of cross-cultural consistency in how these vocalisations are perceived. Conversely, vocalisations like roars, groans, and moans were less appropriate to express and more sensitive to contextual factors such as where people were and who they were with. In general, private locations tend to foster a relaxation of social norms governing nonverbal vocal expression, as do close relationships. By mapping out these patterns, we provide insights into how nonverbal vocal signals contribute to social communication.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10919-024-00473-w>.

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Data Availability All data and reproduceable scripts are available at <https://osf.io/x6czj/>.

Declarations

Competing Interests The authors declare no competing interests.

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