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Just Seconds of Laughter Reveals Relationship Status: Laughter with Friends Sounds More Authentic and Less Vulnerable than Laughter with Romantic Partners

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Abstract

The dual pathway model posits that spontaneous and volitional laughter are voiced using distinct production systems, and perceivers rely upon these system-related cues to make accurate judgments about relationship status. Yet, to our knowledge, no empirical work has examined whether raters can differentiate laughter directed at friends and romantic partners and the cues driving this accuracy. In Study 1, raters ($N=50$), who listened to 52 segments of laughter, identified conversational partner (friend versus romantic partner) with greater than chance accuracy ($M=0.57$) and rated laughs directed at friends to be more pleasant-sounding than laughs directed at romantic partners. Study 2, which involved 58 raters, revealed that prototypical friendship laughter sounded more spontaneous (e.g., natural) and less "vulnerable" (e.g., submissive) than prototypical romantic laughter. Study 3 replicated the findings of the first two studies using a large cross-cultural sample ($N=252$). Implications for the importance of laughter as a subtle relational signal of affiliation are discussed.

Keywords Dual pathway · Volitional laughter · Spontaneous laughter · Vocal modulation · Love

Introduction

Laughter is a fundamental and pervasive vocalization of positive emotion elicited by humans and other social non-human animals. The evolutionary significance of laughter is evidenced by its ubiquity, universality and "phylogenic continuity" (Weisfeld, 1993). For example, humans are equipped from birth with the ability to laugh (Ruch & Ekman, 2001) and we are not alone in this capacity; chimpanzees, gorillas, orangutans and rats all emit laughter-like vocalizations (Caron, 2002; Panksepp & Burgdorf, 1999; Polimeni & Reiss, 2006; Provine, 2004; Tisljar & Bereczkei, 2005). Laughter has been shown to be the most recognizable expression of positively-valenced emotion across even dissimilar

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cultures (Sauter et al., 2010), typically emerging around the age of four months in most human infants (Sroufe & Wunsch, 1972). Laughter occurs with great frequency at an average rate of one laugh for every two minutes of conversation (Vettin & Todt, 2004). Even persons who are profoundly or congenitally deaf produce laughter similarly nuanced as that of their hearing counterparts (Makagon et al., 2008). Specifically, laughter of both hearing and non-hearing individuals typically occurs during lulls in conversation and at the end of phrases, with speakers tending to laugh more often than listeners, and women (regardless of hearing ability) tending to laugh more frequently than men (Makagon et al., 2008; Provine & Emmorey, 2006).

Laughter as an Evolutionary Adaptation/Dual Pathway Hypothesis

Researchers argue that laughter is an evolutionary adaptation that predates human speech vocalizations (i.e., it is phylogenetically older), and likely has its origins in the emotional vocalizations and play utterances noted in humans and other non-human mammals (Bryant & Aktipis, 2014; Davila-Ross & Dezecache, 2021; Lavan et al., 2016). Laughter is often recognized as an indicator to others of mood and affiliation (Davila-Ross et al., 2009), and the rapid panting associated with the rough and tumble play of young hominids and juvenile primates may have evolved initially as a communicative tool for signaling harmless intent and encouraging continued play interactions (Bryant, 2020; Gervais & Wilson, 2005). This ability to volitionally modulate laughter to communicate social information (e.g., affiliation and intent) is not specific to humans and, therefore, likely dates back to a shared ancestor (Davila-Ross & Dezecache, 2021). At some point during the evolution of laughter, humans evolved a highly sophisticated speech production system, which further allowed them to use laughter in a variety of contexts in a sort of evolutionary "arms race" that not only favored those who were able to produce laughter intentionally but also favored those who could recognize it as volitional and decipher its meaning (Bryant & Aktipis, 2014). Bryant (2020) suggested that this volitional or "fake" laughter is produced by this same speech production system; that is, the system in the brain that controls the tongue and lips. Further, there is likely a dual pathway model for laughter production that distinguishes between spontaneous (authentic) and volitional (manipulated) laughter (Bryant, 2016).

There are several distinct features between volitional and spontaneous laughter that support the dual pathway hypothesis. Spontaneous laughter is characteristically higher in intensity (i.e., arousal), higher in pitch, longer in duration, and greater in variability than volitional laughter. Research has shown that people can intuitively differentiate between these types (Bryant, 2020; Bryant & Aktipis, 2014; Bryant et al., 2018; Lavan et al., 2016) and that accuracy at detecting spontaneous/authentic laughter exceeds accuracy at detecting volitional laughter (Bryant & Aktipis, 2014). This difference in accuracy may be due to the potentially deceptive nature of volitional laughter (Bryant & Aktipis, 2014; Lavan et al., 2016). Furthermore, spontaneous laughter has been shown to be a more reliable indicator of affiliation than volitional laughter (Brown et al., 2018) and evidence from cardiovascular research has demonstrated there are differences in cardiovascular responses (e.g., heart rate) during the production of simulated (volitional) and spontaneous laughter, with volitional laughter producing stronger responses akin to those one might observe following exercise (Law et al., 2018). Moreover, Bryant and Aktipis (2014) demonstrated that when spontaneous laughter is slowed down, listeners cannot distinguish it from animal vocalizations, yet they have no difficulty discerning volitional laughter played at the same speed.

Laughter Benefits Relationships

Laughter can communicate affiliation (Brown et al., 2018) and may also serve as a relationship maintenance strategy based on its rich ties to positive relationship outcomes. Children as young as 12–18 months use laughter to signal affiliation with caregivers following transgression (Walker, 2013). Additionally, couples reminiscing about past shared laughter events self-reported higher relationship satisfaction than couples reminiscing about other positively-valenced events (Bazzini et al., 2007), and recollections of shared laughter are associated with positive emotion and strong relationship quality (Kurtz & Algoe, 2015, 2017). Kurtz and Algoe (2017) were the first to demonstrate a causal relationship between shared laughter among strangers and their affiliative tendencies, arguing that shared laughter "might serve as both signal of and catalyst for relationship health" (p. 61). Laughter is important for social bonding not only during the timeframe in which it is expressed but also has been shown to lead to future social rewards and subsequent intimacy and positive emotions with others (Kashdan et al., 2014).

Laughter Judgments

Beyond its function as a behavioral indicator of positive affect, laughter also conveys important social information, such as status, social intent, and relational affiliation. Higher status individuals, for example, are more likely to produce disinhibited, dominant sounding laughter than their lower status counterparts (Oveis et al., 2016) and, moreover, naïve listeners are able to discern the relative status of those individuals based solely upon their laughter production. Children as young as seven are able to exhibit control over (e.g., suppress) their laughter (Ceschi & Scherer, 2003), suggesting at a young age humans can selectively regulate laughter in the context of social interactions.

Bryant and Aktipis (2014) revealed that observers can reliably differentiate between spontaneous (authentic) and volitional (intentional) laughter, while Bryant et al. (2018) later showed this perceptual phenomenon to be universally consistent across 21 disparate societies with an accuracy rate between 56 and 69%. However, not all laughter is produced with prosocial intent, and listeners are attuned to the distinction. For instance, observers can discern among joyful, taunting, and tickling laughter at far better than chance accuracy, with emotional laughter types (joy/taunt) producing higher recognition rates than tickling laughter (Wildgruber et al., 2013). Listeners are also able to decode a sender's emotional state expressed in laughter suggesting that laughter can adopt different emotional connotations through its acoustic signal (Szameitat et al., 2009).

Raters listening to conversational dyads can discern affiliation (friends or strangers) based on colaughter and cospeech, and the accuracy of their judgments is greater for colaughter, despite the longer duration of cospeech (Bryant et al., 2020). Likewise, listeners across 24 societies and cultures demonstrated the ability to detect the relational distinction between friends and strangers based on only short clips of laughter (Bryant et al., 2016), and surprisingly this ability to discern affiliation emerges among infants as young as five months of age who attend longer to the faces of friends than those of strangers (Vouloumos & Bryant, 2019).

Vocal Correlates of Romantic Love and Friendship

Scarce attention has been paid to the acoustical profile of laughter directed at romantic partners, so we turn our attention to broader literature on vocal changes as a function of conversational partner. Previous research suggests that the vulnerable condition of early-stage romantic love leaks into the voices of romantic partners, sometimes resulting in less favorable judgments of individuals when they are talking to their romantic partners as opposed to their friends (Farley et al., 2013; Montepare & Vega, 1988). Montepare and Vega (1988) found that women speaking to their romantic partners sounded more "approachable, sincere, submissive, and scatterbrained" than when talking to their friends (p. 103), which is consistent with the strategic attempt to appear non-threatening observed in some animal species (Bryant, 2020; Gervais & Wilson, 2005). In Farley et al. (2013), raters who listened to content-masked clips judged individuals to be less confident, popular, and likable in calls with romantic partners than friends. In an experimental seduction study, Anolli and Ciceri (2002) enlisted male participants to "seduce" naïve female conversational partners. "Successful" seducers (who got a date with their conversational partners) displayed greater vocal modulation in their interactions and were more likely to use a "weaker and warmer" self-disclosure voice than "unsuccessful" seducers (p. 149). This logic leads us to predict that laughter directed at romantic partners will also cue impressions of submissiveness and vulnerability.

In contrast, because friendships are less likely to be burdened by the emotional volatility and craving associated with romantic love (Fisher, 2000, 2006), we posit that romantic laughter will sound more forced and tense (features of volitional laughter) than friendship laughter. Previous work has shown that raters utilize subjective and acoustical parameters of laughter spontaneity to accurately identify friends (Bryant et al., 2016, 2020). These parameters include perceived spontaneity and friendliness, in addition to variability in pitch and intensity, which are associated with greater physiological arousal (Bryant et al., 2016). As a result, despite the high rates of affection shared by friends and romantic partners, we argue that friendship laughter will be perceived as more spontaneous and authentic than romantic laughter.

Overview of Present Work

Collectively, these findings suggest that as a species, we are both highly sensitive to the social signals laughter communicates, and keenly adept at deciphering these cues. But what about two groups of people who are both high in affiliation, such as friends and romantic partners? To our knowledge, no previous empirical work has examined raters' ability to differentiate between laughter directed at two groups of people that are both high in affiliation; that is, friends and romantic partners, much less the cues that might drive such a distinction. Therefore, we conducted three studies. The first study sought to determine if raters can reliably differentiate laughter directed at friends and laughter directed toward newly-formed romantic partners, and whether these laughter segments differed in pleasantness. The second study sought to explore which subjective facets of the laughter segments raters might use to identify the type of affiliative relationship existing between conversational partners. The third study was designed to replicate the findings of the first two studies and to determine the cross-cultural universality of the

ability to differentiate between laughter occurring between friends and romantic partners. Based on the literature reviewed, we made the following predictions:

H1 Participants will be able to distinguish between laughter segments directed toward a friend or a romantic partner with greater than chance accuracy.

H2 Laughter segments directed toward friends will be perceived to be more spontaneous (i.e., "changing"/variable, loud, breathy, and relaxed) and authentic (i.e., natural-sounding) than laughter segments directed at romantic partners.

H3 Laughter segments directed toward romantic partners will sound more vulnerable (i.e., feminine, baby-like, warm, scatterbrained, and submissive) and less pleasant than those directed at friends. We are referring to this prediction as the "vulnerable love" hypothesis.

H4 Given the general tendency for women to outperform men on nonverbal judgments (Hall, 1978; Lausen & Schacht, 2018; Thompson & Voyer, 2014; Wingenbach et al., 2018), we predict a female advantage on this task.

Study 1

Method

Laughter Stimuli

Laughter stimuli were obtained from archived telephone calls from a previous study (Farley et al., 2013). A total of 27 callers (13 men and 14 women) placed five-minute cellular calls to their romantic partner and a close same-sex friend in quiet settings. Participants were required to be involved in a romantic relationship for less than one year in order to capture early-stage romantic love. Experimenters recorded only the caller's portion of the conversation using a DS-40 Olympus digital voice recorder. Later, research assistants clipped out all segments of laughter from the 54 calls except two calls in which no laughter was present. Research assistants clipped both voiced (with tonal qualities, Bryant & Aktipis, 2014) and unvoiced laughter segments, but selected one vocalized laugh with multiple bursts per call to serve as stimulus laughs for this study, yielding 52 laughter segments. For callers who did not have a laugh with multiple bursts, we selected the longest voiced laughter segment per call.

Raters and Procedure

Raters ($N=50$) were students from an urban university in the mid-Atlantic region of the United States who received partial course credit for their participation. The sample included 15 men and 35 women who ranged in age from 18 to 53 ($M=25.16$, $SD=8.99$). An approximately equal proportion of the sample self-reported being African-American (46.0%) and European-American (42.0%), with small numbers of participants reporting Other (8.0%), Asian (2.0%), and Hispanic (2.0%) ethnic backgrounds.

Raters completed the study independently by listening to the 52 laughs in a quiet laboratory space. An experimenter played the 52 laughter segments in a unique randomized

sequence for each participant using QuickTime Player on a Macbook computer. For the first task, raters evaluated laughs for pleasantness on a 9-point scale, from 1 (extremely unpleasant) to 9 (extremely pleasant). For the second task, raters listened to the laughs a second time (using a unique sequence per participant) and made a forced-choice decision as to whether they believed the laughs were directed toward a friend or a romantic partner.

Results and Discussion

All data for this research is freely available at the open science framework (OSF: https://osf.io/p3vz4/). Analyses were conducted at the level of the rater, thus mean accuracy and mean pleasantness ratings were averaged across laughter segments per condition (friend and romantic). Despite the brevity of the laughter segments, and in support of H1, raters could identify whether the laugh was directed at a friend or a romantic partner with greater than chance accuracy ($M = 0.57$, $SD = 0.06$), $t(49) = 8.25$, $p < 0.001$, $d = 1.17$. In addition, laughs directed at romantic partners were perceived to be less pleasant-sounding ($M = 5.16$, $SD = 0.69$) than those directed at friends ($M = 5.37$, $SD = 0.74$), $t(49) = 3.17$, $p = 0.003$, $d = 0.45$, which supported H3. We conducted a one-sample t-test to determine whether participants were biased in favor of making friend or romantic decisions, but found that their response tendencies did not differ significantly from chance, $t(49) = -0.43$, $p = 0.67$, $d = 0.06$. Results determined that raters had similar rates of accuracy for friend laughter ($M = 0.56$, $SD = 0.09$) and romantic laughter ($M = 0.58$, $SD = 0.11$), $t(49) = 0.72$, $p = 0.48$, $d = 0.10$. Results also indicated that women performed similarly ($M = 0.58$, $SD = 0.06$) to men ($M = 0.56$, $SD = 0.08$), $t(48) = 0.67$, $p = 0.51$, $d = 0.21$, which failed to support H4.

Results suggest that in addition to the capabilities that have been previously documented (i.e., early emergence of laughter differentiation, Vouloumanos & Bryant, 2019; laughter between friends and strangers, Bryant et al., 2016; Smoski & Bachorowski, 2003; spontaneous and volitional laughter, Bryant et al., 2018), humans are capable of differentiating between laughter directed at two types of dyads with high affiliation rates. This is quite sophisticated and impressive given the brevity of laughter, and underscores laughter's ability to convey nuanced information about affiliation (Brown et al., 2018). Additionally, these findings further the body of work on "thin slices" that posits that people can make reasonably accurate assessments of others based on only minimal observations (Ambady & Rosenthal, 1992), and the vocal channel in particular (Farley et al., 2013; Hughes & Harrison, 2017; Hughes et al., 2010). The failure to support a female advantage on this task (H4) might be related to the lack of power in this study, which is ameliorated in Study 3.

Study 2 explored the subjective characteristics that may differentiate the samples of prototypical laughter directed at friends from prototypical laughter directed at romantic partners obtained from Study 1. Specifically, we investigated whether laughter directed at friends and romantic partners differed on dimensions of perceived spontaneity/authenticity and vulnerability.

Study 2

Laughter Stimuli

For Study 2, we selected the two most accurately identified "prototypical" laughs from Study 1 for all four laughter types (female friend, female romantic partner, male friend,

male romantic partner), yielding 8 laughs in total. We aimed to utilize a set of stimuli that were reliably distinguished from one another to maximize the tonal qualities that differed between conditions (Lavan et al., 2016; Sauter et al., 2010).

Raters

Participants ($N = 58$) were students from a diverse urban mid-Atlantic university. Although rater demographics were collected from this sample, the materials were lost during the COVID-19 pandemic.

Materials

We developed ten 9-point bipolar scales to generally encompass two dimensions. The first dimension was expected to encompass perceptions of laughter spontaneity/authenticity ("changing/monotone", "loud/soft", "relaxed/tense", "natural/forced", "breathy/not breathy"). Per previous research, spontaneous laughter is louder, more variable, potentially breathier, and more relaxed and natural-sounding than is volitional laughter (Bryant, 2020; Bryant et al., 2018; Lavan et al., 2016). We also created five items to measure perceptions of vulnerability ("feminine/masculine", "baby-like/mature", "warm/cold", "submissive/dominant", "scatterbrained/serious-minded").

Procedure

Raters were told the study was about relationship status and laughter, and they completed the laughter portion of the session before recording their voice for a different study. Laughter segments were played using a Macintosh computer in a largely sound-proofed lab space. Raters completed ratings for all eight laughs one dimension at a time (first masculinity, then "changing", etc.) in a randomized sequence that was unique per participant. The laughter sample sequence was also randomized for each task. Experimenters played laughter segments again upon rater request.

Results and Discussion

The five scales for each dimension (spontaneity and vulnerability) were not sufficiently correlated to allow for the creation of composite measures, so we analyzed the scales independently. Means were computed across laughter samples (female friend, female romantic, male friend, and male romantic) per rater and we conducted a series of 2 (voice gender) × 2 (partner type: friend and romantic) within subjects analyses of variance on all of the scale items.[1] See Table 1 for means, standard error, and two-way ANOVA statistics for each dependent measure. In order to balance concerns related to Type 1 versus Type 2 error, we relied upon a Bonferroni-adjusted alpha level of 0.005

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[1] Research assistants accidentally played the wrong female friend laughter segment for 33 participants, thus ratings for this laugh were omitted. Results of the analyses including these ratings are largely unchanged (28 of the 30 statistical tests have the same outcome). After omitting these ratings, interactions between partner type and laugher gender were no longer significant for loudness and maturity, but interactions are not discussed in this paper.

Table 1 Analyses of variance for ratings as a function of conversational partner and laugher gender in study 2

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Loudness								
	Partner type				775.30	1, 57	<0.001	0.932
		Romantic	2.82	0.11				
		Friend	7.09	0.12				
	Laugh gender				77.70	1, 57	<0.001	0.577
		Female	5.88	0.14				
		Male	4.02	0.13				
	Type×Gender				0.05	1, 57	0.825	0.001
		Romantic/Female	3.73	0.19				
		Friend/Female	8.03	0.18				
		Romantic/Male	1.90	0.15				
		Friend/Male	6.15	0.15				
Masculinity								
	Partner type				85.21	1, 57	<0.001	0.599
		Romantic	4.56	0.12				
		Friend	5.91	0.12				
	Laugh gender				379.12	1, 57	<0.001	0.869
		Female	2.75	0.16				
		Male	7.72	0.15				
	Type×Gender				6.27	1, 57	0.015	0.099
		Romantic/Female	1.94	0.16				
		Friend/Female	3.56	0.22				
		Romantic/Male	7.18	0.19				
		Friend/Male	8.26	0.15				

Table 1 (continued)

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Naturalness								
	Partner type				7.26	1, 57	0.009	0.113
		Romantic	4.43	0.22				
		Friend	5.57	0.26				
	Laugh gender				24.78	1, 57	<0.001	0.303
		Female	5.70	0.18				
		Male	4.30	0.18				
	Type×Gender				1.07	1, 57	0.306	0.018
		Romantic/Female	5.22	0.23				
		Friend/Female	6.17	0.35				
		Romantic/Male	3.63	0.30				
		Friend/Male	4.97	0.28				
Changing								
	Partner type				59.90	1, 57	<0.001	0.512
		Romantic	4.03	0.18				
		Friend	5.71	0.18				
	Laugh gender				12.71	1, 57	0.001	0.182
		Female	5.47	0.24				
		Male	4.26	0.21				
	Type×Gender				4.78	1, 57	0.033	0.077
		Romantic/Female	4.83	0.28				
		Friend/Female	6.11	0.29				
		Romantic/Male	3.22	0.25				
		Friend/Male	5.30	0.22				

Table 1 (continued)

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Relaxed								
	Partner type				1.35	1, 57	0.251	0.023
		Romantic	5.24	0.25				
		Friend	5.74	0.25				
	Laugh gender				13.45	1, 57	0.001	0.191
		Female	5.97	0.19				
		Male	5.01	0.18				
	Type×Gender				0.40	1, 57	0.532	0.007
		Romantic/ Female	5.78	0.25				
		Friend/Female	6.16	0.35				
		Romantic/Male	4.71	0.35				
		Friend/Male	5.32	0.23				
Maturity								
	Partner type				58.23	1, 57	<0.001	0.505
		Romantic	4.50					
		Friend	6.92					
	Laugh gender				9.87	1, 57	0.003	0.148
		Female	6.00	0.19				
		Male	5.41	0.16				
	Type×Gender				1.87	1, 57	0.177	0.032
		Romantic/ Female	4.91	0.27				
		Friend/Female	7.09	0.25				
		Romantic/Male	4.08	0.24				
		Friend/Male	6.75	0.25				

Table 1 (continued)

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Coldness								
	Partner type				2.81	1, 57	0.099	0.047
		Romantic	4.21	0.23				
		Friend	4.97	0.28				
	Laugh gender				19.01	1, 57	<0.001	0.250
		Female	4.04	0.17				
		Male	5.13	0.17				
	Type×Gender				0.27	1, 57	0.608	0.005
		Romantic/Female	3.71	0.24				
		Friend/Female	4.38	0.33				
		Romantic/Male	4.72	0.31				
		Friend/Male	5.55	0.29				
Breathiness								
	Partner type				16.27	1, 57	<0.001	0.222
		Romantic	6.18	0.24				
		Friend	4.50	0.23				
	Laugh gender				4.23	1, 57	0.044	0.069
		Female	5.63	0.19				
		Male	5.06	0.17				
	Type×Gender				38.80	1, 57	<0.001	0.405
		Romantic/Female	5.83	0.25				
		Friend/Female	5.43	0.35				
		Romantic/Male	6.53	0.32				
		Friend/Male	3.58	0.25				

Table 1 (continued)

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Seriousness								
	Partner type				1.05	1, 57	0.309	0.018
		Romantic	5.03	0.22				
		Friend	4.62	0.23				
	Laugh gender				0.49	1, 57	0.488	0.008
		Female	4.73	0.18				
		Male	4.91	0.15				
	Type×Gender				7.75	1, 57	0.007	0.120
		Romantic/Female	5.24	0.26				
		Friend/Female	4.22	0.31				
		Romantic/Male	4.81	0.30				
		Friend/Male	5.01	0.25				
Dominance								
	Partner type				460.19	1, 57	<0.001	0.890
		Romantic	2.90	0.13				
		Friend	7.47	0.14				
	Laugh gender				34.26	1, 57	<0.001	0.375
		Female	5.74	0.13				
		Male	4.63	0.12				
	Type×Gender				9.49	1, 57	0.003	0.143
		Romantic/Female	3.65	0.19				
		Friend/Female	7.84	0.18				
		Romantic/Male	2.15	0.16				
		Friend/Male	7.10	0.17				

Bonferroni-adjusted alpha level is 0.005 per test (0.05/10)

(0.05/10). Because interactions between relationship type and laugher gender were not germane to our hypotheses, we do not discuss them here. However, the descriptive statistics that inform interpretation of these interactions can be found in Table 1.

There were significant main effects for conversational partner such that laughter samples directed at friends were perceived as louder, more masculine, marginally more natural-sounding, more "changing," more mature-sounding, more dominant, and less breathy than those directed at romantic partners. There were also significant main effects for laugher gender for all ratings except seriousness and breathiness. Male laughter samples received higher ratings for masculinity and coldness, whereas female laughter samples received higher ratings for loudness, naturalness, changing, maturity, relaxed, and dominance.

Consistent with H2 and H3, the results of this study indicate that prototypical laughter directed toward friends and strangers differs on a number of dimensions, dimensions that could reveal important information about laughter authenticity and the vulnerability of early-stage romantic love. Previous research shows that authentic laughter is louder, more variable, and higher in pitch than volitional laughter (Bryant, 2020; Lavan et al., 2016), so our finding that participants perceive friend laughter as louder, more natural-sounding, and more "changing" (variable) than laughter directed at romantic partners suggests that raters perceive friend laughter as more authentic-sounding. Consistent with the logic that romantic partners try to communicate warmth and intimacy, and adopt a "submissive" posture with one another, laughter among romantic partners was perceived as softer, more feminine, more baby-like, and more submissive than laughter directed at friends. It bears repeating that raters made these judgments based on laughter segments just seconds in length.

The limitations of this study include the inability to examine rater gender effects and the use of "prototypical" exemplar laughs, thus limiting the generalizability of the findings. We attempted to redress these limitations in Study 3. Study 3 examined the cross-cultural universality of the findings from Study 1 and Study 2 using a large sample of participants from the United States, Mexico, India, Poland, and Portugal. We selected these specific countries based on their ratings from Hofstede's six cultural dimensions (Hofstede, 2011) to account for countries that were not only geographically distinct, but also diverse in terms of cultural values (i.e., power distance, individualism/collectivism, uncertainty avoidance, masculinity/femininity, indulgence/restraint, and long-term/short-term orientation). See Appendix A for description of the five countries on the six cultural dimensions.

We retained the same hypotheses posed in the previous studies. Further, given the evolutionary significance of laughter, we predicted that there would be no difference between cultures in the ability to differentiate laughter samples as a function of conversational partner (friend vs. romantic) (H5).

Study 3

Laughter Stimuli

For Study 3, we selected 12 laughs (3 from each condition: female friend, female romantic, male friend, male romantic) from all of the laughter segments clipped from the conversations from Farley et al. (2013). We relied upon selection criteria used in previous research—the laughs included 2–10 bouts/calls of voiced laughter with no overlapping

speech (Bryant & Aktipis, 2014; Bryant et al., 2018). In addition, none of the stimulus laughs used in Study 2 were used in Study 3, so these laughs were not selected based upon how accurately they were identified.

Raters

Raters included 252 Prolific workers who were paid $2.00 US in exchange for their participation, which took approximately 15 min. Raters were targeted by gender and country of origin in batches of 25 based upon Prolific's pre-screening information (25 Indian men, 25 Indian women, etc.). This method was successful at balancing gender as there were 125 men, 121 women, and 5 non-binary participants, but because of differences between the nature of Prolific's "Nationality" prescreening question and the one posed in our study ("In which country have you spent most of your adult life?"), there were more countries represented than the five that were targeted (Poland, Mexico, Portugal, USA, and India). Specifically, the sample included 52 raters from Poland, 50 from Mexico, 49 from Portugal, 48 from the United States, and 30 from India. However, the sample also included 4 participants from Canada, 3 from the United Kingdom, 2 each from Australia, Finland, Ireland, and the Netherlands, and one each from the Bahamas, Bahrain, Hungary, Iran, Israel, Kuwait, Pakistan, and South Africa. For the country comparisons, we omitted individuals outside of the five countries that were targeted, but for other analyses, these individuals were retained for increased statistical power.

Procedure

Participants were recruited via Prolific, a fair wage online participant recruitment system. They were recruited in batches of 25 using the gender and "nationality" pre-screener information that participants supplied when they enrolled in the site. As a result, participants were unaware of the criteria used to recruit them. Participants were required to be fluent English speakers and to complete the study using headphones or in a quiet setting with either a computer or a tablet device. They were told that the study was about perceptions of laughter as a function of conversational partner.

After participants agreed to participate in the study, they were redirected to Qualtrics, at which point they listened to the 12 laughs one at a time and made a forced-choice decision about whether they thought the laughs were clipped from conversations between friends or romantic partners. Each laugh was presented on its own page, and participants were able to play the laughs as many times as they wished. However, participants were prevented from returning to a previous page. After the forced-choice ratings, participants completed 9-point bipolar ratings on the following scales in sequence: soft/loud, cold/warm, natural/forced, not breathy/breathy, submissive/dominant, relaxed/tense, masculine/feminine, and monotone/changing. The sequence of laugh samples was randomized for all trials. In order to reduce fatigue and to keep the study less than 15 min in length, we omitted ratings for baby-like/mature and scatterbrained/serious-minded from this study.

Results and Discussion

In Study 3, we used a Bonferroni-adjusted alpha level of 0.006 for the analyses (0.05/9 dependent measures). In support of H1, raters exceeded chance ($\mu = 0.50$)

at differentiating between friend and romantic samples ($M = 0.67$, $SD = 0.16$), $t(251) = 16.81$, $p < 0.001$, $d = 1.06$. A 2 (rater gender) × 2 (partner type) mixed-factors ANOVA on rater accuracy showed a significant main effect for partner type, in addition to a marginally significant interaction ($p = 0.008$).[2] See Table 2 for means, standard error, and two-way ANOVA statistics for the ratings from Study 3. Raters had greater accuracy for friend samples than for romantic samples. Post-hoc analyses of the interaction showed that men and women were both highly accurate at correctly identifying friend samples (Ms = 0.72), $t(244) = 0.04$, $p = 0.97$, $d = 0.01$, but women were more accurate at identifying romantic laughter ($M = 0.65$, $SD = 0.18$) than were men ($M = 0.58$, $SD = 0.21$), $t(244) = 3.06$, $p = 0.002$, $d = 0.39$.

To demonstrate consistency in findings between Study 2 and Study 3, we next conducted a series of 2 (gender) × 2 (relationship status: friend and romantic) within subjects Analyses of Variance on the dependent measures based upon means computed across laughter condition (female friend, female romantic, male friend, and male romantic).

There were significant main effects for the conversational partner for all variables except masculinity, such that laughter from friends was rated significantly higher on loudness, naturalness changing, relaxed, warmth, breathiness, and dominance than romantic samples. These results are largely supportive of H2. Although romantic samples sounded softer and more submissive than friend samples, results for masculinity and warmth did not support H3. There were also main effects for the laugher gender for all ratings except dominance and breathiness. Male laughter samples received overall higher ratings for masculinity, relaxed, and natural-sounding, whereas female laughter received higher ratings for loudness, warmth, and changing. There were significant interactions between partner type and gender for all ratings except for breathiness, but again, we omit the discussion of these interactions because we did not offer hypotheses regarding these interactions.

After omitting participants not targeted for a country comparison, we examined the effect of country of origin (India, Mexico, Poland, Portugal, and USA) on accuracy for samples of friend and romantic laughter. See Table 3 for means, standard error, and two-way ANOVA statistics for analyses pertaining to country of origin. This analysis again yielded a significant main effect for relationship type, but the main effect for country and the interaction between country and relationship type were not significant, demonstrating small effect sizes (0.01 and 0.024 respectively). To estimate the probability that our data would occur if the null hypothesis were true (that accuracy rates were equal across country of origin), we conducted a Bayesian ANOVA using the free JASP software (JASP Team, 2021; Version 0.16) using default priors. The analysis resulted in $BF_{O1} = 28.18$, signifying that the data were 28 times more likely under the H_0 than H_1, providing strong support for the null hypothesis.

These results suggest that listeners can differentiate between laughter segments directed toward friends and romantic partners at greater than chance accuracy, and that laughter directed at friends sounds more authentic (loud, natural, changing/variable, breathy, and relaxed) than laughter directed at romantic partners. There was also some evidence in support of the vulnerable love hypothesis, such that laughter directed at romantic partners was rated as softer and less dominant than laughter directed at friends.

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[2] The main effect for partner type on accuracy was duplicated in two analyses to clearly depict possible interactions with rater gender and country of origin. This main effect should be interpreted with caution because hit rates for friend laughter and romantic laughter are not orthogonal.

Table 2 Analyses of variance for ratings as a function of conversational partner type and gender across all countries in study 3

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Accuracy								
	Partner type				53.81	1, 244	<0.001	0.181
		Romantic	0.62	0.01				
		Friend	0.72	0.01				
	Rater gender				3.77	1, 244	0.053	0.015
		Female	0.69	0.01				
		Male	0.65	0.01				
	Type×gender				0.05	1, 244	0.008	0.028
		Romantic/Female	0.65	0.02				
		Friend/Female	0.72	0.02				
		Romantic/Male	0.58	0.02				
		Friend/Male	0.72	0.02				
Loud								
	Partner type				2400.71	1, 251	<0.001	0.905
		Romantic	2.82	0.04				
		Friend	5.38	0.06				
	Laugh gender				20.97	1, 251	<0.001	0.077
		Female	4.21	0.05				
		Male	3.99	0.05				
	Type×Gender				43.76	1, 251	<0.001	0.628
		Romantic/Female	2.49	0.05				
		Friend/Female	5.92	0.07				
		Romantic/Male	3.15	0.05				
		Friend/Male	4.84	0.07				

Table 2 (continued)

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Masculinity								
	Partner type				4.19	1, 251	0.04	0.016
		Romantic	5.60	0.03				
		Friend	5.71	0.04				
	Laugh gender				1850.91	1, 251	<0.001	0.881
		Female	3.41	0.07				
		Male	7.90	0.05				
	Type×Gender				43.76	1, 251	<0.001	0.148
		Romantic/Female	3.20	0.07				
		Friend/Female	3.62	0.09				
		Romantic/Male	8.00	0.06				
		Friend/Male	7.80	0.06				
Naturalness								
	Partner type				156.80	1, 251	<0.001	0.385
		Romantic	5.40	0.05				
		Friend	6.60	0.07				
	Laugh gender				89.40	1, 251	<0.001	0.263
		Female	5.67	0.06				
		Male	6.33	0.05				
	Type×Gender				72.17	1, 251	<0.001	0.223
		Romantic/Female	4.78	0.08				
		Friend/Female	6.56	0.10				
		Romantic/Male	6.03	0.06				
		Friend/Male	6.64	0.07				

Table 2 (continued)

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Changing								
	Partner type				1274.60	1, 251	<0.001	0.835
		Romantic	2.80	0.05				
		Friend	5.48	0.06				
	Laugh gender				310.71	1, 251	<0.001	0.553
		Female	4.65	0.05				
		Male	3.62	0.05				
	Type×Gender				231.63	1, 251	<0.001	0.480
		Romantic/Female	2.74	0.06				
		Friend/Female	6.57	0.08				
		Romantic/Male	2.85	0.07				
		Friend/Male	4.39	0.08				
Relaxed								
	Partner type				36.61	1, 251	<0.001	0.127
		Romantic	5.88	0.06				
		Friend	6.54	0.07				
	Laugh gender				66.69	1, 251	<0.001	0.210
		Female	5.94	0.05				
		Male	6.49	0.05				
	Type×Gender				91.17	1, 251	<0.001	0.266
		Romantic/Female	5.28	0.09				
		Friend/Female	6.59	0.10				
		Romantic/Male	6.48	0.06				
		Friend/Male	6.50	0.08				

Table 2 (continued)

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Warmth								
	Partner type				343.01	1, 251	<0.001	0.577
		Romantic	3.56	0.05				
		Friend	5.34	0.07				
	Laugh gender				70.14	1, 251	<0.001	0.218
		Female	4.75	0.05				
		Male	4.16	0.05				
	Type×Gender				55.15	1, 251	<0.001	0.180
		Romantic/Female	3.61	0.09				
		Friend/Female	5.89	0.09				
		Romantic/Male	3.51	0.06				
		Friend/Male	4.80	0.08				
Breathiness								
	Partner type				110.91	1, 251	<0.001	0.306
		Romantic	3.89	0.06				
		Friend	5.00	0.08				
	Laugh gender				189.66	1, 251	0.044	0.430
		Female	4.92	0.06				
		Male	3.96	0.05				
	Type×Gender				0.18	1, 251	0.672	0.001
		Romantic/Female	4.38	0.09				
		Friend/Female	5.47	0.10				
		Romantic/Male	3.39	0.06				
		Friend/Male	4.53	0.08				

Table 2 (continued)

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Dominance								
	Partner type				661.96	1, 251	<0.001	0.725
		Romantic	3.17	0.04				
		Friend	5.26	0.06				
	Laugh gender				3.26	1, 251	0.072	0.013
		Female	4.28	0.05				
		Male	4.16	0.05				
	Type×Gender				269.58	1, 251	<0.001	0.518
		Romantic/Female	2.74	0.07				
		Friend/Female	5.82	0.08				
		Romantic/Male	3.61	0.06				
		Friend/Male	4.71	0.07				

Bonferroni-adjusted alpha level is 0.006 per test based on the total number of dependent measures (0.05/9)

Table 3 Analysis of variance on accuracy as a function of conversational partner type and country

Rating	Independent measures		M	SE	F	df	p	$\eta^2_{partial}$
Accuracy								
	Partner type				50.06	1, 224	<0.001	0.183
		Romantic	0.62	0.01				
		Friend	0.72	0.01				
	Country				0.67	4, 224	0.61	0.012
		Poland	0.67	0.02				
		Portugal	0.69	0.02				
		Mexico	0.68	0.02				
		India	0.66	0.03				
		USA	0.65	0.02				
	Type×Country				1.37	4, 224	0.24	0.024
		Romantic/Poland	0.62	0.03				
		Friend/Poland	0.72	0.03				
		Romantic/Portugal	0.63	0.03				
		Friend/Portugal	0.76	0.03				
		Romantic/Mexico	0.63	0.03				
		Friend/Mexico	0.74	0.03				
		Romantic/India	0.58	0.04				
		Friend/India	0.73	0.04				
		Romantic/USA	0.62	0.03				
		Friend/USA	0.67	0.03				

Bonferroni-adjusted alpha level is 0.006 per test based on the total number of dependent measures (0.05/9)

These results largely replicate the results of Studies 1 and 2 using a large cross-cultural sample and a broader less "prototypical" set of laughter stimuli. In addition, the results show that although there was some variability in accuracy scores between countries, country of origin did not significantly predict accuracy.

General Discussion

In these studies, we demonstrated that raters exceeded chance in determining relationship status (friend versus romantic) based on brief vocal samples of laughter, that friendship laughter sounds more authentic (louder, more relaxed, more natural, and more variable/"changing") than romantic laughter, and that these judgments were consistent across five unique cultures. In addition, we found support for the vulnerable love hypothesis—romantic laughter sounded warmer, more feminine and more submissive than friendship laughter.

The ability of raters to identify the conversational partner (friend versus romantic) with greater than chance accuracy complements previous work on laughter's ability to signal important information about the relationship between co-laughers (Bryant & Aktipis, 2014; Bryant et al., 2018; Lavan et al., 2016). But this research goes beyond previous work by revealing that raters can differentiate between laughter directed at two types of dyads that are both high in affiliation—friends and romantic partners. For a variety of reasons (motivational and emotional), we maintained that laughter directed at friends was more authentic than laughter directed at romantic partners, and the tendency for friendship laughter to be more accurately identified than romantic laughter implicates it as more authentic (Bryant & Aktipis, 2014). In addition, raters' judgments of relationship status (friend versus romantic) were reliably linked to subjective characteristics of laughter authenticity. Laughter between friends was perceived as louder, more natural-sounding, more changing/variable (in Studies 2 and 3), breathier (in Study 2), and more relaxed (in Study 3).

Vulnerable Love Hypothesis

In Studies 2 and 3, we found support for the notion that laughter cues reveal the vulnerable relationship status of early-stage romantic love. Other work has shown that raters can differentiate friends and romantic partners via 20 s of content-masked clips and short content-controlled clips such as "How are you?" (Farley et al., 2013), but it is impressive that this skill extends to brief segments of laughter. The intimate voice associated with romantic love is softer, higher in pitch, and more submissive-sounding (Montepare & Vega, 1988), and these vulnerability-type cues were effective at differentiating romantic laughter from friendship laughter in our work. Specifically, in Studies 2 and 3, romantic laughter was perceived to be quieter, more feminine-sounding, and more submissive, and in Study 2, when the measure was used, more baby-like. From an evolutionary standpoint, vocal cues such as these serve to communicate "I mean you no harm" (Bryant, 2020; Gervais & Wilson, 2005). Moreover, romantic laughter was perceived as less pleasant-sounding than friend laughter, which dovetails with other research finding that masked clips of vocal cues from romantic partners are evaluated less favorably than clips from friends (Farley et al., 2013; Montepare & Vega, 1988). Early-stage romantic love is marked by a great deal of tumultuous physiological arousal and uncertainty, and romantic love renders individuals to be

highly dependent on their relationships (Hatfield & Rapson, 1993a, 1993b). This might translate into a vocal style lacking in confidence and attractiveness.

The female advantage in nonverbal sensitivity (Knapp et al., 2014) was generally unsupported in this research. However, in Study 3, gender interacted with partner type. For arguably more "authentic" friendship samples, which may be easier to identify (Bryant & Aktipis, 2014), men and women performed similarly well. But for the potentially less "authentic" romantic samples, which were more challenging for raters, women's accuracy was significantly higher than men's. This is a unique finding given that sex differences in accuracy have not emerged in previous research (Bryant & Aktipis, 2014; Bryant et al., 2018). This female advantage to accurately decipher romantic intent via laughter may be explained by the Error Management Theory which predicts that women have an evolved bias to be skeptical of men's commitment (Haselton & Buss, 2000), and therefore may be more in tune to discriminating signals of men's romantic intent through a variety of means. Further, the cross-cultural ability of individuals to do this provides support for the evolutionary significance of laughter as a signal of relational import.

The research presented here augments an impressive body of work on the accuracy of thin slices of behavior (Ambady & Rosenthal, 1992). Not only can individuals make accurate inferences about important social dimensions such as sexual orientation (Rule, 2017), status (Bjornsdottir & Rule, 2017), and leadership emergence in organizations (Re & Rule, 2017) based on photographs, individuals discern critical relational information based on vocal cues (Farley et al., 2013; Hughes & Harrison, 2017; Montepare & Vega, 1998). Laughter is potentially unique because it not only *reflects or signals* affiliation (Brown et al., 2018), but it is also capable of *enhancing* relationship quality (Kurtz & Algoe, 2015, 2017). The role of laughter in signaling relational information internally within the dyad and externally to observers also supports social functional accounts of emotion, such as the emotions as social information model (EASI) (Van Kleef, 2009).

Limitations and Future Directions

The current investigations were not without some limitations. The first two studies had relatively smaller samples sizes and the second study did not include comprehensive demographics of the sample. Study 3 addressed these limitations by demonstrating ubiquity in our findings through the use of a large cross-cultural sample diverse on Hofstede's (2011) six cultural values. Interestingly, the sample from the United States in Bryant et al. (2018) was least accurate at making forced-choice decisions from the sample of laughs from their own culture, which converges with our results from Study 3. Examination of this curious finding would be a fruitful area of future investigation.

Using the laugh samples that were the most identifiable in terms of discerning whether they were directed toward a friend or a romantic partner (Study 2) allowed us to better comprehend what specific subjective perceptions may have contributed to the success of discriminating between samples. However, whereas these samples served as good prototypes for investigation, it limits the generalizability of the findings. We attempted to account for this limitation in Study 3 by selecting different laughter samples that were not prototypical representations, and this method yielded similar findings. Study 3 also redressed a limitation from Study 2 in which we had to account for an experimental error where we had to omit some of the ratings for a set of participants as described above.

Although a unique constellation of acoustic features contributes to the perception of vocalizations (Babel et al., 2014), pitch appears to be one of the most salient features in

vocal discrimination (for review see Puts et al., 2014) and is an indicator of arousal (Bryant & Aktipis, 2014; Ruch & Ekman, 2001). Examining how detailed acoustic parameters impacts perception was beyond the scope of this study as our focus was to explore subjective assessments made by listeners. However, future studies should consider the variety of acoustic features of laughter such as pitch, perhaps even through artificial manipulation, to see how they affect different percepts of laughter within romantic and non-romantic contexts. In addition, this research expanded the work of previous investigations, which have only examined female laughers (e.g., Bryant & Aktipis, 2014; Bryant et al., 2018; Lavan et al., 2016), but more studies are needed to understand sex differences in both the expression and perception of laughter across different contexts.

Our investigation examined the laughter between couples who were at the advent of their romantic relationships. It would be prudent to examine laughter obtained from couples during the early versus later stages of their relationships. Laughter appears to be an important factor throughout a couple's exchange; it frequently occurs during courtship (with men being more likely to use women's responsive laughter to gauge their interest; Hall, 2015), and mutual laughter has also been linked to long-term relationship satisfaction (Hall, 2013). Yet, romantic relationships often trade the early novelty and volatility of romantic love for security and commitment over time, potentially rendering the laughter of long-term romantic partners to sound similar to that of friends. This avenue could also benefit from examining how self-reported feelings for one's romantic partner correlate with the sound of one's laughter.

Conclusion

Laughter is an ancient phenomenon that likely originated from the spontaneous breathy play utterances of humans and other animal species, but which evolved more recently in humans as an effective communication tool for conveying affiliation, intent, status, and a host of other important social messages. As laughter is universal and pervasive in a myriad of social settings and interactions, it is adaptive to be able to produce it at will, determine its authenticity, and to interpret the meaning behind its use. In addition, laughter also provides important relational information, such as whether those eliciting laughter are strangers or friends (Bryant et al., 2016, 2020). The current research builds upon the existing literature by demonstrating that even from brief laughter clips, humans use laughter cues to make better-than-chance relational judgments between even highly affiliated groups: friends and romantic partners.

Appendix A

Comparative cultural dimension scores of cultures from study 3.

Cultural dimensions		Country cultural dimension scores				
		India	Mexico	Poland	Portugal	USA
Individualism/collectivism	This domain reflects the degree to which societies prioritize individuals over the group. A higher score reflects greater individualism	48	30	60	27	91
Power distance	This domain refers to how inequalities in power are justified by a given culture. A higher score indicates a preference for hierarchy over a more equal distribution of power	77	81	68	63	40
Masculinity/femininity	Cultures scoring high on masculinity tend to value distinct gender roles, such as competitiveness, while those with lower scores tend to value cooperation and help-ing weaker societal members	56	69	64	31	62
Uncertainty avoidance	Countries high in uncertainty avoidance tend to be less tolerant of ambiguity and stick more rigidly to their core principles	40	82	93	99	46
Long-term/short-term orienta-tion	Cultures are rated on this dimension based on their orientation toward either the future or the past and present. Higher scores reflect greater focus on the future, such as valuing education	51	24	38	28	26
Indulgence/restraint	This domain reflects the degree to which a culture values adherence to strict social norms. Higher scores on indulgence/restraint indicate a looser observance of social norms	26	97	29	33	68

(Hofstede, 2011)

Declarations

Conflict of interest Sally Farley is the Associate Editor for Special Issues at the Journal of Nonverbal Behavior. This manuscript was handled by the editor-in-chief and was reviewed by three masked reviewers. Deborah Carson and Susan Hughes declare that they have no conflict of interest.

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