Laughter: A Scientific Investigation

Article · January 2000

CITATIONS
328

READS
7,858

1 author:

Robert R. Provine
University of Maryland, Baltimore County
90 PUBLICATIONS **2,685** CITATIONS

SEE PROFILE

American Scientis

JANUARY–FEBRUARY 1996 THE MAGAZINE OF SIGMA XI, THE SCIENTIFIC RESEARCH SOCI

Laughter

The study of laughter provides a novel approach to the mechanisms and evolution of vocal production, perception and social behavior

Robert R. Provine

Consider the bizarre events of the 1962 outbreak of contagious laughter in Tanganyika. What began as an isolated fit of laughter (and sometimes crying) in a group of 12- to 18-year-old schoolgirls rapidly rose to epidemic proportions. Contagious laughter propagated from one individual to the next, eventually infecting adjacent communities. The epidemic was so severe that it required the closing of schools. It lasted for six months.

The Tanganyikan laughter epidemic is a dramatic example of the infectious power of laughter—something that many of us may have experienced in our own lives. Many readers will be familiar with the laugh tracks of television situation comedies—attempts to stimulate contagious laughter in viewers—and the difficulty of extinguishing their own "laugh jags," fits of nearly uncontrollable laughter. Have you ever been overcome by a comparable urge to chant "hello-hello-hello?" Rather than dismissing contagious laughter as a behavioral curiosity, we should recognize it and other laugh-related phenomena as clues to broader and deeper issues.

Clearly, laughter is a powerful and pervasive part of our lives—an important component of that biobehavioral bedrock of our species known as human nature. Laughter's significance has been recognized at various times and in various ways by such scientific and philosophical dignitaries as Aristotle, Kant, Darwin, Bergson and Freud. Yet aside from a general appreciation that laughter is good for us—"the best medicine"—and is somehow associated with humor, we know little about laughter itself.

My approach to understanding laughter is one that a visiting extraterrestrial might take were it to encounter a group of laughing human beings. What would the visitor make of the large bipedal animals emitting paroxysms of sound from a toothy vent in their faces? A reasonable approach would be to describe the simplest and most obvious aspects of the noisy behavior: its physical characteristics, the rules that govern its expression, characteristics of the animals emitting the sounds (such as gender), the mechanism of sound production, and whether similar sounds are made by related species. To Earthlings this naturalistic approach is known as ethology—a biologically oriented scientific discipline devoted to understanding what animals do and how and why they do it. Ethologists treat behavior as an evolutionary adaptation. The species-wide distribution of laughter and its stereotypical (and simple) structure suggests that the behavior has strong genetic and neurophysiological bases—qualities attractive to those who wish to understand the mechanisms and natural history of behavior.

During the past eight years I have been observing human laughter in various natural habitats—shopping malls, classrooms, sidewalks, offices and cocktail parties—with the investigative spirit of our hypothetical alien. Observing everyday behavior in these settings has provided an opportunity to appreciate laughter as a social vocalization of the human animal. These studies have produced some unexpected insights into the phenomenon of human laughter—its social nature, the lawful relationship between laughter and speech, gender differences and the biological basis of contagion.

Laugh Structure

One of my first goals was to describe the sonic structure of human laughter. This proved to be more difficult than I expected. Like other spontaneous acts, laughter often disappears when one attempts to observe it, especially in the laboratory. Some unconventional approaches were called for. Although I could occasionally elicit laughter from friends and colleagues during playful conversations, I was often forced to engage in shameless hamming (something that graduate school did not prepare me for). One of the most productive approaches was to encounter people in public places and simply ask them to laugh. The request was usually answered with a burst of laughter. About half of the laughing subjects reported that they could not laugh on command. Indeed, we have much less conscious control over laughter than over speech. It is easy to say "ha-ha-ha," but difficult to laugh on cue. We do not "speak" laughter.

In collaboration with an undergraduate assistant, Yvonne Yong, I took the recordings to the Sound Laboratory of the National Zoo in Washington, D.C. Here the laughs were analyzed with a sound spectrograph, a device that translates a sound into an image that reveals the changes in frequency and intensity of the sound over time. Giggles, shrieks and belly laughs replaced the laboratory's usual sonic fare of in-

Robert Provine is professor of psychology at the University of Maryland Baltimore County. He received graduate training in psychology and developmental neuroscience at Washington University (St. Louis), where he later became research assistant professor of psychology and worked in the departments of biology and ophthalmology. He is especially interested in contagious human behavior such as laughter and yawning, with reference to a seamless progression of analysis from the neural to the psychological and social levels. His other research concerns comparative, interdisciplinary studies of neural and behavioral development. Address: Department of Psychology, UMBC, Baltimore, MD 21228. Internet: provine@umbc2.umbc.edu.

Ursula Markus/Photo Researchers, Inc.

Figure 1. Human laughter begins at an early age (typically 14 to 16 weeks after birth), often during the interaction between a mother and the infant. Laughter, smiles and other gestures by the baby reinforce the mother's behavior (tickling, for example) and regulate the duration and intensity of the interaction. The author suggests that laughter is an ancient form of social signaling that is more akin to animal calls or bird songs than human speech.

digo bunting songs and the calls of golden lion tamarins. Laboratory workers gave us quizzical looks but politely refrained from asking about the origins of the sounds.

The sound spectra revealed the distinct signature of laughter. A laugh is characterized by a series of short vowel-like notes (syllables), each about 75 milliseconds long, that are repeated at regular intervals about 210 milliseconds apart. A specific vowel sound does not define laughter, but similar vowel sounds are typically used for the notes of a given laugh. For example, laughs have the structure of "ha-ha-ha" or "ho-ho-ho," but not "ha-ho-ha-ho." There are intrinsic constraints against producing such laughs. Try to simulate a "ha-ho-ha-ho" laugh—it should feel quite unnatural. When there are variations in the notes, they most often involve the first or last note in a sequence. Thus, "cha-ha-ha" or "ha-ha-ho" laughs are possible variants.

The explosively voiced blasts of a laugh have a strong harmonic structure, with each harmonic being a multiple of a low (fundamental) frequency. The harmonic structure is revealed in a sound spectrogram by the evenly spaced stacks of short horizontal lines in the spectrum, the lowest of which is the fundamental frequency. Given their higher-pitched voices, it is not surprising that the laughter of females has a higher fundamental frequency (about 502 hertz) than male laughter (about 276 hertz). Whether it is a deep belly laugh or a high-pitched titter, however, all human laughter is a variation of this basic form. It is this structure that allows us to recognize laughter in spite of individual differences.

The notes and internote intervals carry most of the information that allows us to identify a sound as laughter. If the sounds between laugh notes are edited out of a tape recording—leaving the notes separated by intervals of silence—a laugh still sounds normal. The internote time interval carries information, but the internote expiratory sounds do not. If the notes are removed from a recording and the gaps between intervals are closed, all that remains of laughter is a long, breathy sigh.

The stereotypic structure of a laugh is, at least in part, a result of the limitations of our vocal apparatus. It is diffi-

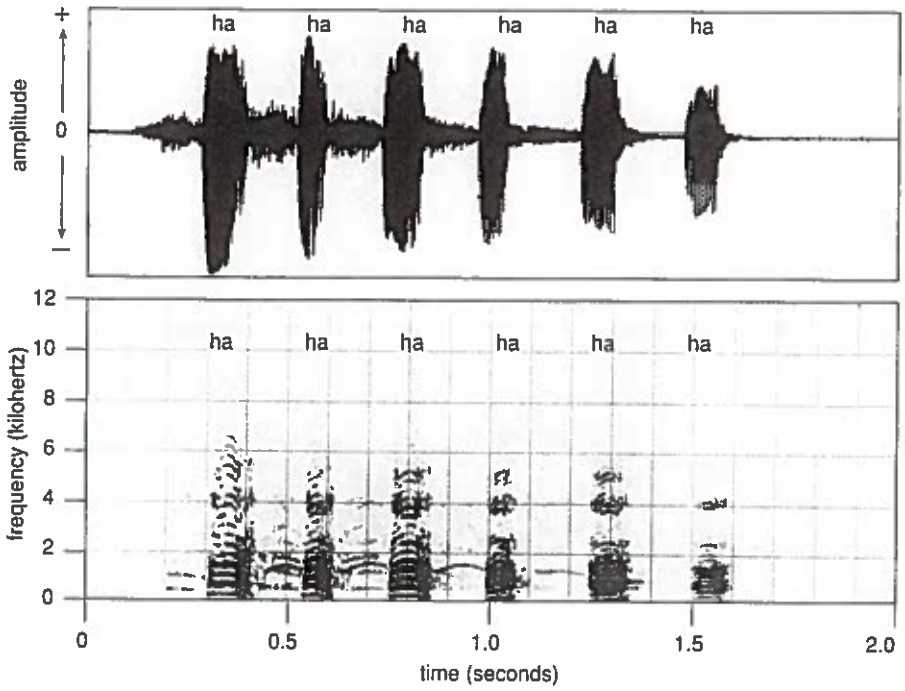


Figure 2. Characteristic features of laughter are evident in the regularity of the waveform *(top)* and the frequency spectrum *(bottom)* of a typical laugh (here consisting of six notes). The vowel-like laugh notes, such as "ha," last for about 75 milliseconds. They are bounded on either side by an unvoiced aspiration and recur at intervals of about 210 milliseconds. Each note is represented in the frequency spectrum by stacks of evenly spaced horizontal bands that are harmonics of the note's fundamental frequency (the lowest band).

cult to laugh with abnormally long note durations, such as "haaa-haaa-haaa," or abnormally short durations (much less than 75 milliseconds in length). Likewise, normal note durations with abnormally long or short internote intervals do not occur. Try to produce a natural laugh with a long internote interval, such as "ha———ha———ha." As with the natural rhythms of walking or running, there are only so many ways to laugh.

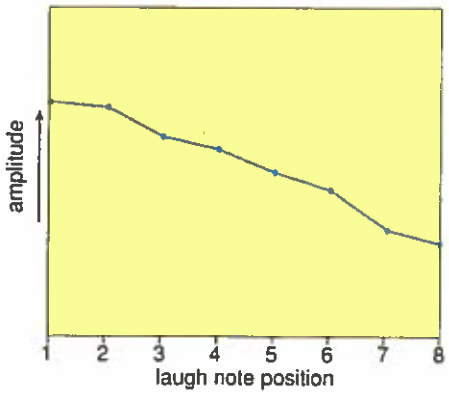


Figure 3. Decrescendo characterizes normal laughter; each note decreases in amplitude relative to the previous note. The crescendo of recorded laughter played backward sounds unnatural. Here the average amplitude of eight successive notes is displayed for at least 22 subjects.

The structural simplicity of a laugh is also suggested by its reversibility. A short segment of laughter—"ha-ha-ha"—played backward on a tape recorder still sounds rather like "ha-ha-ha." Indeed the sound spectrum of a laugh is similar whether scanned from left to right or from right to left—a laugh note has a high degree of temporal symmetry. Yet one aspect of a laugh that is not symmetrical is its loudness. Laughter is characterized by a decrescendo in which the laugh notes that are late in a sequence are usually lower in amplitude than earlier notes (presumably because we run out of air). Recordings of laughter played backward produce a bizarre-sounding crescendo.

Chimpanzee Laughter

There is a common misperception that laughter is exclusive to human beings. From at least the time of Darwin, however, it has been known that chimpanzees and other great apes perform a laugh-like vocalization when tickled or during play. To pursue the details of this primate laughter, I teamed up with Kim Bard, who is nursery director and caregiver for young chimpanzees at the Yerkes Regional Primate Center in Atlanta. It is a pleasure to be able to play with young chimpanzees in the pursuit of one's science.

Chimpanzee *(Pan troglodytes)* laughter differs in many ways from its human counterpart. The vowel-like notes of human laughter are performed by chopping a single expiration, whereas chimpanzee laughter is a breathy panting vocalization that is produced during *each* brief expiration and inspiration. Unlike human laughter, the laughter of a chimpanzee lacks discrete, vowel-like notes that have sharp leading and trailing edges on sound spectra. Chimpanzee laughter has the sound and cadence of a handsaw cutting wood. The sounds of chimpanzee and human laughter are sufficiently different that without viewing the characteristic "play face" and source of stimulation (such as play and tickle), naive human beings may be unable to identify the chimpanzee vocalization as laughter. You can experience the difference in production between the two forms of laughter by placing a hand on your abdomen and comparing the abdominal pulsations of chimpanzee-like panting with the smoother act of speaking "ha-ha-ha" during a single expiration.

People laugh as we speak. If chimpanzees laugh as they speak, by producing one laugh sound per expiration and inspiration, we have identified an important and previously unrecognized constraint on the evolution of speech and language in chimpanzees and presumably other great apes. The close coupling of laughter to breathing in chimpanzees may be evidence of a more general limitation on these animals to speak. (In contrast to the success of teaching hundreds of signs to chimpanzees, efforts to teach them to speak English have produced meager results.) Indeed, the inability to modulate expiratory airflow may be at least as limiting to speech as the structure of the vocal tracts of nonhuman primates.

Breathy, panting laughter is probably the primal form that dates back to the common ancestor of all great apes and people. Human beings evolved their characteristic laughter after branching from an ancestor in common with chimpanzees (estimated to be around six million years ago, according to DNA hybridization data).

It is noteworthy that chimpanzee laughter occurs almost exclusively during physical contact, or during the threat of such contact, during chasing games, wrestling or tickling. (The individual being chased laughs the most.) Although people laugh when tickled,

most adult human laughter occurs during conversation, typically in the absence of physical contact.

Social and Linguistic Context

Laughter is a decidedly social signal, not an egocentric expression of emotion. In the absence of stimulating media (television, radio or books), people are about 30 times more likely to laugh when they are in a social situation than when they are alone. Indeed people are more likely to smile or talk to themselves than they are to laugh when they are alone. Aside from the obvious implication that sociality can enhance laughter and perhaps one's mood, these observations indicate that laughter has a social function. What can we say about laughter as communication?

In an attempt to gather some clues, my colleagues and I have collected observations on 1,200 instances of naturally occurring human laughter. Three undergraduate assistants (Lisa Greisman, Tina Runyan, Michelle Bowers) and I wandered various public gathering places where we eavesdropped on groups of laughing people. We carefully took note of the principals engaged in the behavior—the gender of the speaker and the audience, whether the speaker or the audience laughed and what was said immediately before the laughter.

Contrary to our expectations we found that most conversational laughter is not a response to structured attempts at humor, such as jokes or stories. Less than 20 percent of the laughter in our sample was a response to anything resembling a formal effort at humor. Most of the laughter seemed to follow rather banal remarks, such as "Look, it's Andre," "Are you sure?" and "It was nice meeting you too." Even our "greatest hits," the funniest of the 1,200 pre-laugh comments were not necessarily howlers: "You don't have to drink, just buy us drinks," "She's got a sex disorder—she doesn't like sex," and "Do you date within your species?" Mutual playfulness, in-group feeling and positive emotional tone—not comedy—mark the social settings of most naturally occurring laughter. Research that focuses only on the response of an audience to jokes (a common laboratory scenario) targets only a small subset of laughter.

One of the key features of natural laughter is its placement in speech. Laughter is not randomly scattered throughout the speech stream. The speaker and the audience seldom inter-

Figure 4. Human laughter and chimpanzee laughter differ in the nature of the coupling between laugh notes and respiration. The notes of human laughter, such as "ha," are produced by interrupting a single expiration *(blue arrow)*. In contrast, chimpanzees produce only one laugh note, a breathy, panting "ah," for every inspiration or expiration *(blue arrows)*. The close coupling between breathing and vocalization in chimpanzees may partially account for failed attempts at teaching these animals to speak English.

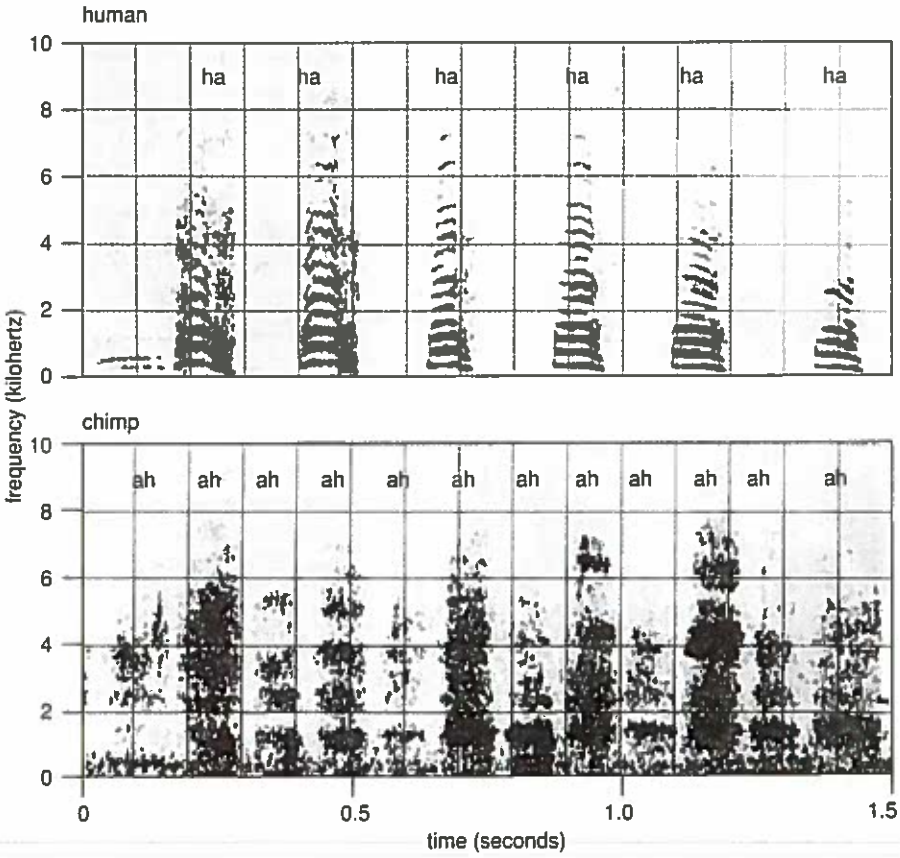


Figure 5. Frequency spectra of human *(top)* and chimpanzee *(bottom)* laughter are distinguished by the sharply defined onset and offset of the voiced, vowel-like notes of human laughter. Noisy chimpanzee laughter also lacks a clear harmonic structure like the unique notes of human laughter.

Figure 6. Most human laughter takes place during the course of ordinary conversations, rather than in response to structured attempts at humor, such as jokes or stories. The importance of the social setting to naturally occurring human laughter underscores its role as a form of communication. Another quality that characterizes conversational laughter is its placement in speech. A speaker typically laughs *after* a spoken phrase, such as "Where have you been? ... ha-ha-ha," rather than in the midst of the phrase, "Where have ... ha-ha-ha ... you been?" for example. The occurrence of laughter at the end of a phrase—*the punctuation effect*—suggests that a neurologically based process may govern the placement of laughter in speech.

rupt the phrase structure of speech with laughter. In our sample of 1,200 laughs there were only eight interruptions of speech by laughter, all of them by the speaker. Thus a speaker may say "You are going where?... ha-ha," but rarely "You are going... ha-ha... where?" The occurrence of laughter during pauses at the end of phrases suggests that a lawful and probably neurologically based process governs the placement of laughter in speech—a process in which speech has priority access to the single vocalization channel. The strong and orderly relationship between laughter and speech is akin to punctuation in written communication (and is called the *punctuation effect*).

Our field study revealed other clues about laughter in human communication. A counterintuitive finding was that the average speaker laughs about 46 percent more often than the audience. This finding reveals the limits of analyses that report only audience behavior—the typical approach of humor research—and neglect the social nature of the laughing relationship.

Figure 7. Experimental use of a "laugh box," which reproduces a recording of human laughter, shows that laughter by itself is a sufficient stimulus to elicit a response of laughter. (Photograph courtesy of the author.)

The gender of the principals involved plays a large role in determining the amount of speaker laughter. Whether they are speakers or audiences (in mixed-sex groups), females laugh more often than males. Female speakers laugh 127 percent more than their male audience. In contrast, male speakers laugh about 7 percent less than their female audience. Neither males nor females laugh as much to female speakers as they do to male speakers. (The lot of the female comedian is not an easy one—whether her audience is male or female.)

These gender differences in the pattern of laughter are at least as strong as those noted for speech by the linguist Deborah Tannen of Georgetown University. The limited cross-cultural evidence suggests that males are the leading humor producers and that females are the leading laughers. These differences are already present by the time that joking first appears around six years of age.

What message is being conveyed by a laughing speaker or a laughing audience? In some respects laughter may be a signal of dominance/submission or acceptance/rejection. Consider the distinction between laughing *with* and laughing *at* someone. Valuable insights about laughter's social function will come from studies of laughter in groups of people who differ in social rank and gender.

A response of laughter by the audience may affirm or negate the spirit of the speaker's message. "Polite" laughter, for example, may be a forced effort on the part of the audience to signal their accord with the speaker, quite the opposite of the indignant "ha!" A speaker, in other cases, may buffer an aggressive comment with laughter or deliver a remark using "laugh-speak," a consciously controlled hybrid of laughter and speech. Talk-show hosts, who are experts at shaping the course of a conversation, commonly use laugh-speak. In this sense laughter may modify the behavior of others by shaping the emotional tone of a conversation.

Laugh Tracks and Contagion

The use of laughter to evoke laughter or a positive mood is familiar to viewers of situation comedy shows on television. "Laugh tracks" (dubbed-in sounds of laughter) have accompanied most "sitcoms" since 7:00 p.m. (Eastern Standard Time) on September 9, 1950. On that evening the *Hank McCune Show*—a comedy about "a likeable blunderer, a devilish fellow who tries to cut corners only to find himself the sucker"—first used a laugh track to compensate for the absence of a live audience. Despite the fact that the show was short-lived, the television industry discovered the power of laughter to evoke audience laughter. The recording industry recognized the seductive power of laughter shortly after World War I with the distribution of the *OKeh Laugh Record*, which consisted of trumpet playing that was intermittently interrupted by laughter. It remains one of the most successful novelty records of all time. Acknowledging the commercial potential of this novelty market, Louis Armstrong, Sidney Bechet, Woody Herman and Spike Jones all attempted to cash in with laugh records of their own.

In the intervening years social scientists have confirmed that laugh tracks do indeed increase audience laughter and the audience's rating of the humorousness of the comedy material. However, scientists did not consider that, in the absence of a joke or a remark, laughter by *itself* can evoke laughter. This is a key element in the propagation of contagious laughter.

I recently performed some investigations of the phenomenon of contagious

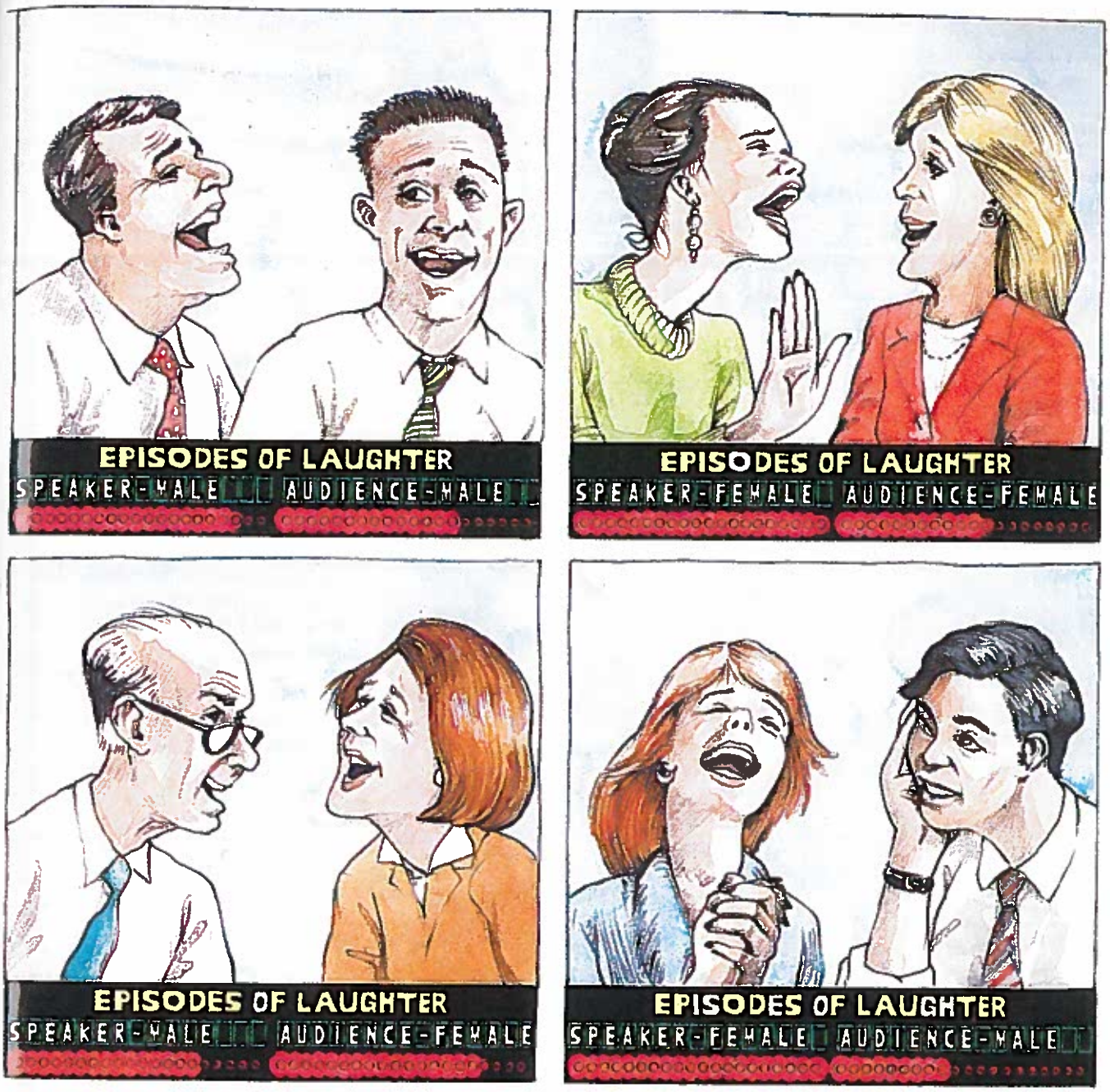


Figure 8. Speakers tend to laugh more often than their audiences, and females tend to laugh more often than males. In a study of 1,200 episodes of laughter, the author found that a male speaker laughs somewhat more often than his male audience *(top left)* and a female speaker laughs somewhat more often than her female audience *(top right)*. In contrast, a typical male speaker will laugh slightly *less* often than his female audience *(bottom left)*. The most striking differences between the genders were found in episodes that involved female speakers and male audiences *(bottom right)*—in such instances, female speakers laughed more than twice as often as their male audience. Cross-cultural evidence suggests that males tend to be the leading producers of humor, whereas females are the leading laughers.

laughter in an undergraduate psychology classroom. The stimulus was a "laugh box"—a small battery-operated record player from a novelty store—that emitted an 18-second span of laughter. The "canned" laughter was played 10 times, with the beginning of each segment separated by a one-minute interval.

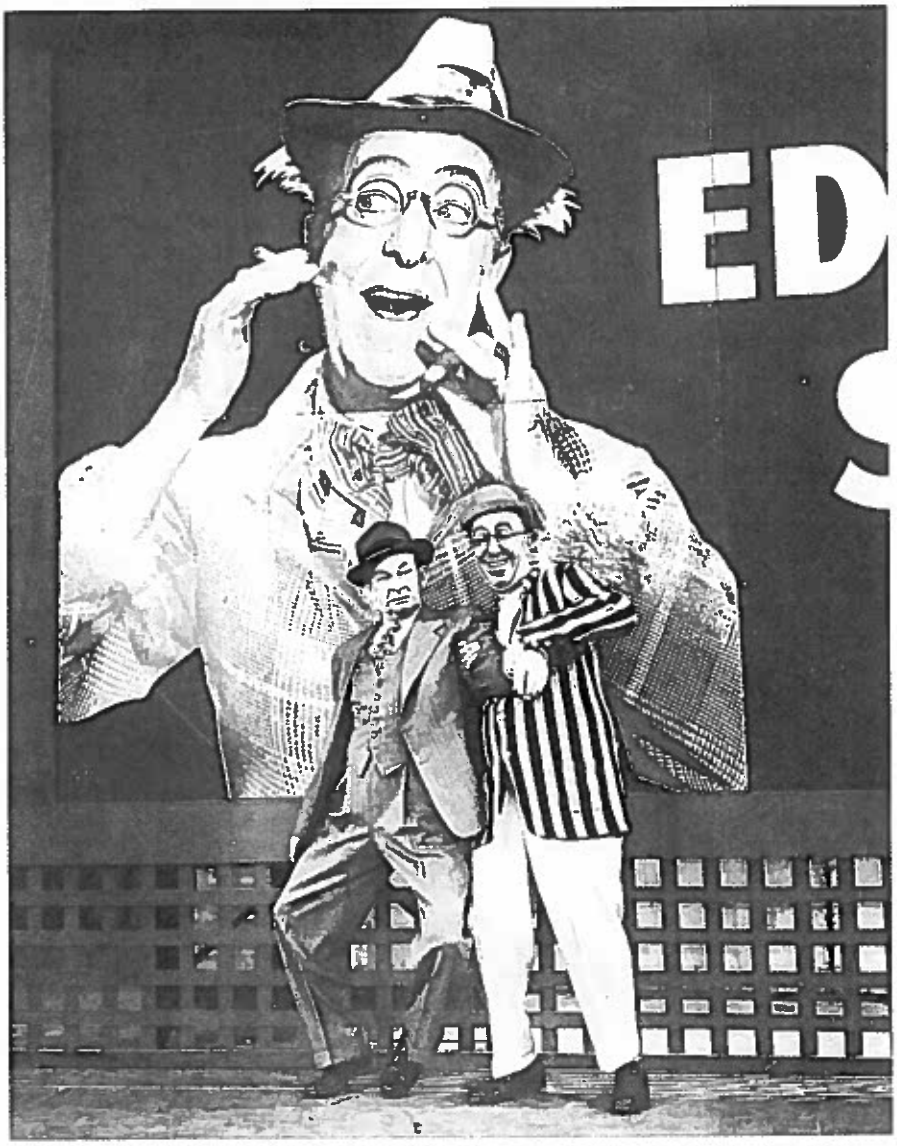
On the first stimulus nearly half of the students reported that they responded with laughter themselves. (More than 90 percent reported smiling on the first stimulus.) However, the effectiveness of the stimulus declined with each repetition until only 3 of the 128 students laughed on the tenth trial. By that point about 75 percent of the students rated the laugh stimulus as "obnoxious."

The negative effect of the repeated stimulus seems to go beyond the response expected from the recurrent exposure to a generic auditory stimulus, such as "Hello, my name is George." The reaction may reflect the deep biological significance of laughter, which in this case may be perceived as jeering or ridicule. (Colleagues whose offices adjoin my own can attest to the aversiveness of periodic canned laughter. Personally, I find myself wincing every time one of the laugh boxes in my office is accidently activated.) Certainly it is pleasurable to laugh at or with people, but it

is quite unpleasant to be laughed at, or to be the recipient of a scornful "ha." Court fools and presidential aides learn early in their careers that it is safer to laugh with the boss than at him or her.

The efficacy of laughter alone to elicit laughter raises the intriguing possibility that human beings have auditory "feature detectors"—neural circuits that respond exclusively to this species-typical vocalization. In turn, the feature detector triggers the neural circuits that generate the stereotyped action pattern of laughter. This mechanism, involving a laugh detector that drives a laugh generator, may be the foundation of contagious laughter. (Contagious yawning appears to involve a similar process in the visual domain.) Those who attempt to explain away their laugh-evoked (contagious) laughter as nothing more than a response to a "funny" stimulus are saying that they laughed in response to a stimulus that made them laugh, a circular argument.

The structural simplicity and species-typical character of laughter makes it a prime candidate for the evolution of such a laugh detection and releasing process. Future psychophysical studies must determine which of laughter's parameters—note structure, note duration, internote interval and amplitude dynamics—are necessary for the perception of laughter and the activation of the hypothetical laugh detector or releasing mechanism. Similar detectors may have evolved for universal phonemic features of speech but the variability and complexity of language and the absence of a contagious response to assay the activation of the detectors will make their discovery more difficult.



Photofest

Figure 9. Pioneering broadcast comedian Ed Wynn set the precedent for "laugh tracks" (dubbed-in laughter) in 1922 while performing a live comedy routine on radio solely to a microphone. The absence of audience laughter during the studio presentation so disrupted the comedian's timing that the stage crew was recruited as an impromptu audience. Originally added for the benefit of the performer, it was later recognized that the addition of laughter increased the audience's enjoyment of a performance. Television comedies from the early 1950s until the present often have had laugh tracks added to their broadcasts even when they were "recorded before a live audience." Laugh tracks do indeed increase audience laughter and the audience's rating of the humorousness of the comedy material. Here Ed Wynn *(right)* and Leon Errol act up in a skit from the televised *Ed Wynn Show* in the early 1950s.

Future Directions

Now that the critical dimensions of laughter as a social stimulus and motor act have been identified, we can pursue a variety of promising issues. Consider "pathological laughter," a frequent and often vaguely described medical symptom. Damage to a wide variety of brain regions produces abnormal laughter, a result consistent with the diverse emotional, respiratory, motor, cognitive and communicative aspects of the act. The most common cases of pathological laughter are found in pseudobulbar palsy, gelastic epilepsy and psychiatric illness. However, pathological laughter has also been reported in multiple sclerosis, amyotrophic lateral sclerosis (Lou Gehrig's disease), and cases of tumors and lesions (especially in the limbic system and the brain stem). Particularly mystifying to both patient and clinician are sudden bursts of laughter that are not associated with a feeling of mirth or an environmental stimulus. Here we have a segregation of the emotional, cognitive and motor mechanisms of laughter. Other cases are more subtle. Some people with forebrain damage have their readjustment to society impeded by a tendency to laugh at almost anything—breaches in laugh etiquette have more serious consequences than one might think. Using our improved descriptive tools, we can now specify more precisely what is "abnormal," "pathological" or "inappropriate" about these cases (whether it is sonic structure, placement in speech, social context, contagion sensitivity, perception or relation to humor). We may even discover new laugh-related syndromes.

The next time that you or a friend have one beer too many, you may research the age-old question of alcohol effects—while taking careful notes on a cocktail napkin, of course. Do alcohol,

"laughing gas" and other drugs known to increase laughter simply lower the threshold for laughter, or do they alter its pattern or quality? In aphasia (a disorder of language production or perception) is there sparing of laughter and, if so, which of laughter's several dimensions are spared? Does vocal laughter punctuate the signed speech of the congenitally deaf, in whom there is not a shared organ of expression? The left cerebral hemisphere has a specialized role in language—is this also true of the production or perception of laughter?

Many developmental issues remain open. Laughter typically appears in human babies around 3–1/2 to 4 months of age, but we know little about the details of the developmental process. Must babies hear their own laughter or the laughter of others for laughter to mature? If so, is there a critical period during which such laughter must be experienced? The report of laughter in a few congenitally deaf-blind children suggests that at least some features of laughter develop without benefit of auditory and visual stimulation, evidence of a strong maturational and genetic basis. For a more satisfying account of laugh acquisition, we must conduct high-resolution studies that contrast the development of normal and hearing-impaired children.

All of us have encountered people with bizarre-sounding laughter. What is different about such laughter and what does this tell us about the mechanism of normal laugh production? Do these odd types of laughter run in families? If so, what is the nature of its development and heritability? In my otherwise forgettable high-school physics class there was a kid who brayed like a donkey when he laughed. Where is Roger now that I need him?

Comparative studies may provide clues about both the evolution and social function of laughter. Does the low level of conscious control that we have over our own laughter reflect the typical level of control that non-human animals have over their own species-typical vocalizations? Do the great apes show the sexually dimorphic or contagious laughter described in human beings? Does the pattern of laughter vary with rank within a troop? Aside from the great apes, do other animals produce laugh-like vocalizations? How do the neurobehavioral mechanisms of laugh production vary between species? Tickle may be a kind of Rosetta Stone for such comparative laugh research because it triggers laugh-like vocalizations in all of the great apes and perhaps other species. Can you tickle your pet dog or cat? How can you tell? Is a laugh-evoking stimulus that works equally well in a variety of species the ultimate example of "low" humor?

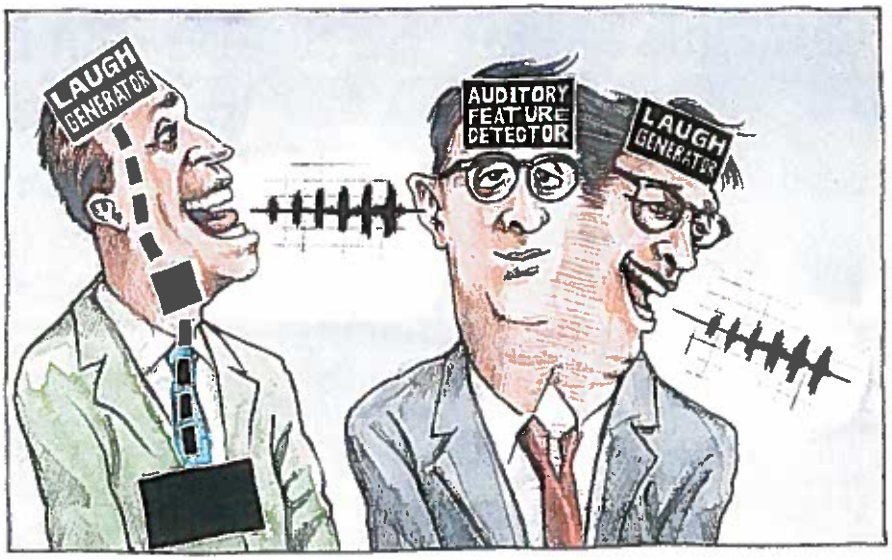


Figure 10. Neurobiological mechanisms for the detection and generation of laughter have yet to be fully characterized. However, the ability of laughter alone to stimulate laughter in another individual suggests that human beings have an "auditory feature detector," a set of neural circuits that respond specifically to this species-typical vocalization. In turn, the feature detector triggers other neural circuits—involving the brain, the larynx and the chest—that generate the stereotyped action pattern of laughter. The neurobiological (and unconscious) nature of the coupling between the detection and the generation of laughter provides a mechanism for the occurrence of contagious laughter.

Laughter research is still in its infancy, an exciting time when the frontiers are near at hand and accessible with modest resources. Certainly much of the research described in this article can be replicated or extended by almost anyone, making it suitable for college or even high school research projects. Laughter research is a reminder that not all science concerns arcane or narrow problems. We should resist neglecting or trivializing the commonplace. There are rewards for approaching nature with a naive curiosity and attempting to see the familiar in new ways.

Bibliography

Apte, M. L. 1985. *Humor and Laughter: An Anthropological Approach*. Ithaca, N.Y.: Cornell University Press.

Black, D. W. 1982. Pathological laughter. *Journal of Nervous and Mental Diseases* 170:67–71.

Chapman, A. J., and H. C. Foot. 1976. *Humor and Laughter: Theory, Research and Applications*. New York: Wiley.

Chapman, A. J., and H. C. Foot. 1977. *It's a Funny Thing, Humour*. Oxford: Pergamon Press.

Demento, Dr. 1985. The Okeh laughing record. Dr. Demento Presents the Greatest Novelty Records of All Time: Volume 1. The 1940's (and before) (Rhino Records R4 70820). Santa Monica, Calif.: Rhino Records.

Fry, W. F., Jr. 1963. *Sweet Madness: A Study of Humor*. Palo Alto, Calif.: Pacific.

Marler, P., and R. Tenaza. 1977. Signalling behavior of apes with special reference to vocalization. In *How Animals Communicate*, pp. 965–1033, ed. T. A. Sebeok. Bloomington: Indiana University Press.

Provine, R. R. 1986. Yawning as a stereotyped action pattern and releasing stimulus. *Ethology* 72:109–122.

Provine, R. R. 1992. Contagious laughter: Laughter is a sufficient stimulus for laughs and smiles. *Bulletin of the Psychonomic Society* 30:1–4.

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

Provine, R. R. In press. Contagious yawning and laughter: Significance for sensory feature detection, motor pattern generation, imitation, and the evolution of social behavior. In *Social Learning in Animals: The Roots of Culture*, ed. C. M. Heyes and B. G. Galef. New York: Academic Press.

Provine, R. R., and K. R. Fischer. 1989. Laughing, smiling, and talking: Relation to sleeping and social context in humans. *Ethology* 83:295–305.

Provine, R. R., and Y. L. Yong. 1991. Laughter: A stereotyped human vocalization. *Ethology* 89:115–124.

Rankin, A. M., and P. J. Philip. 1963. An epidemic of laughing in the Bukoba District of Tanganyika. *Central African Journal of Medicine* 9:167–170.

Sroufe, L. A., and E. Waters. 1976. The ontogenesis of smiling and laughter: A perspective on the organization of development in infancy. *Psychological Review* 83:173–189.

Weiskrantz, L., J. Elliott and C. Darlington. 1971. Preliminary observations on tickling oneself. *Nature* 230:598–599.