**Humor, laughter, learning, and health! A brief review**

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05 JUL 2017<https://doi.org/10.1152/advan.00030.2017>

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**Abstract**

Human emotions, such as anxiety, depression, fear, joy, and laughter, profoundly affect psychological and physiological processes. These emotions form a set of basic, evolved functions that are shared by all humans. Laughter is part of a universal language of basic emotions that all humans recognize. Health care providers and educators may utilize the power of laughter to improve health and enhance teaching and learning. This is an important consideration because teaching is not just about content: it is also about forming relationships and strengthening human connections. In this context, when used effectively, humor is documented to build relationships and enhance performance. Specifically, humor improves student performance by attracting and sustaining attention, reducing anxiety, enhancing participation, and increasing motivation. Moreover, humor stimulates multiple physiological systems that decrease levels of stress hormones, such as cortisol and epinephrine, and increase the activation of the mesolimbic dopaminergic reward system. To achieve these benefits, it is important to use humor that is relevant to the course content and not disparaging toward others. Self-effacing humor illustrates to students that the teacher is comfortable making mistakes and sharing these experiences with the classroom. In this brief review, we discuss the history and relationship between humor, laughing, learning, and health with an emphasis on the powerful, universal language of laughter.

in 1964, norman cousins was diagnosed with ankylosing spondylitis, a degenerative disease causing the breakdown of collagen. The disorder caused constant pain and suffering and was accompanied with a poor prognosis of only a few months to live. Cousins served as an Adjunct Professor at University of California–Los Angeles, where he conducted research on the biochemistry of human emotions, which he long believed were the keys to success in resisting and fighting illness. He often expressed his belief that, since negative emotions lead to negative physiology, then positive emotion, such as humor, can lead to positive physiology. As examples, chronic stress persistently elevates levels of stress hormones, including epinephrine and cortisol. Chronic stress also increases the susceptibility to blood clots. Together, these physiological responses to stress increase the risk for cardiovascular and other diseases ([52](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B53)). Importantly, the positive emotions of humor and laughter decrease the risk for stress-related diseases ([33](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B34)).

With his strong beliefs in the power of human emotions and his dire prognosis, Cousins decided to take his treatment into his own hands. He convinced his physicians to prescribe an intravenous dose of vitamin C that was well above the normal therapeutic level, and, as an adjunct to this therapy, he watched humorous movies and television shows to induce laughter as a consistent part of his treatment. Mirthful laughter markedly reduced his pain and relieved stress. “10 minutes of laughter gave me 2 hours of pain free sleep,” Cousins said, “laughter produced a natural body anesthesia.” Cousins’ humor-induced treatment saved his life and allowed him to live and prosper for nearly 25 additional years. Cousins and his remarkable results are a testament to the positive psychophysiological impact created by the emotions of humor and mirthful laughter and have been documented in a book he authored, *Anatomy of an Illness as Perceived by the Patient* ([15](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B16)).

In addition to the therapeutic benefits, scientists have investigated the impact of humor on teaching and learning. The results from numerous scientific studies conducted over the past half-century by Professors Robert R. Provine (<http://provine.umbc.edu>), Lee S. Berk (<http://www.llu.edu/pages/faculty/directory/faculty.html?uid=lberk>), Ronald A. Berk (<http://www.ronberk.com>), Sophie Scott (<http://www.icn.ucl.ac.uk/Staff-Lists/MemberDetails.php?FirstName=Sophie&LastName=Scott>), and others document that humor and laughter promote learning ([38](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B39)).

Humor and laughter may not directly cause learning; however, humor creates an environment that promotes learning. Evidence documents that appropriate humor, and humor that relates to course material, attracts and sustains attention and produces a more relaxed and productive learning environment ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)). Humor also reduces anxiety, enhances participation, and increases motivation ([55](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B55)).

Humor has positive physiological effects, such as decreasing stress hormones like epinephrine and cortisol and increasing the activation of the mesolimbic dopaminergic reward system ([3a](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B4), [45](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B46)). Furthermore, teaching is about relationships, and humor builds bonds as well as brains, by strengthening the relationship between student and teacher. This effect may increase interactions with student and teacher, as well as student and peers, and draw out more introverted students ([14](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B15), [38](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B39)). In this brief review, we discuss the history and relationship between humor, laughing, learning, and health, with an emphasis on the powerful, universal language of laughter.

***History of humor in medicine.***

Humor, laughter, learning, and health have a long and successful, interwoven legacy that has persisted for centuries and played an important role in human culture since the beginning of recorded time. The benefits of humor and laughter are even referenced in the bible, Book of Proverbs 17:22 (NIV), where it states: “A cheerful heart is good medicine, but a crushed spirit dries up the bones,” indicating that, in the 10th century, people understood that a joyful spirit has positive therapeutic effects, while the absence of joy may make you ill.

There are many additional historic illustrations of the confluence of humor and medicine. For example, ancient Greek physicians, as an adjunct to therapy, prescribed a visit to the hall of comedians as an important part of the healing process ([36](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B37)). Similarly, early Native Americans utilized the powerful impact of humor and laughter in healing as traditional medicine men incorporated the services of clowns to inspire laughter ([18](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B19)).

During the 14th century, French surgeon Henri de Mondeville used humor to distract patients from the pain endured during surgery as well as a therapy to aid recovery. Mondeville ([13](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B14)) supported this practice in a book he authored, *Cyrurgia*, stating, “Let the surgeon take care to regulate the whole regimen of the patient's life for joy and happiness allowing his relatives and special friends to cheer him and by having someone tell him jokes.” The English parson and scholar Robert Burton extended this practice by using humor to treat psychiatric disorders in the 16th century, which was discussed in his book, *The Anatomy of Melancholy* ([10](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B11)). During the same time Martin Luther, a German priest, also used humor to treat psychiatric disorders as a critical component of pastoral counselling ([58](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B58)). Luther advised individuals with depression not to isolate themselves, but to surround themselves with friends who could joke and make them laugh ([58](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B58)).

These examples clearly document the long and successful history of the use of humor in medicine. However, although the therapeutic benefits of humor were well accepted and persisted for centuries, there was limited empirical evidence supporting the mechanisms mediating humor’s positive impact. The lack of empirical evidence limited its acceptance and use by caregivers. As stated in the report on scientific literacy of the American Association for the Advancement of Science, “A hypothesis that cannot in principle be put to the test of evidence may be interesting, but it is not likely to be scientifically useful” ([1](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B1)). This all changed in the 20th century when pioneering investigators examined the psychophysiological mechanisms of humor.

William F. Fry was a pioneering investigator who pursued laughter and healing as a field of study and created the term gelotology, the study of laughter ([11](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B12)). As a professor of Psychology at Stanford University, he was one of the first investigators to apply for public funding for humor research ([11](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B12)). Unfortunately, his application was not awarded due to funding restrictions brought about by the deficits created during the Vietnam War ([11](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B12)). However, despite the lack of funding, his research moved forward, and he published several landmark and influential studies on the physiological processes that occur during laughter, including “The respiratory components of mirthful laughter” ([25](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B26)) and “The biology of humor” ([22](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B23)). Using a pulse oximeter, he investigated the change in oxygen saturation after 3 min of continuous laughter. Although there was no change in oxygen saturation, laughter resulted in increased ventilation, increased muscle activity, increased minute volume, and the creation of forceful exhalation that could mobilize and remove pulmonary secretions ([25](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B26)). Fry’s pioneering work provided evidence and mechanistic insights for the positive physiological impact of humor, which paved the path for future investigation ([19](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B20)–[21](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B22), [23](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B24)–[25](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B26)).

It is now well documented and generally accepted that human emotions interact with the mind and body in complex and powerful ways that impact our health. Just consider the complex and powerful placebo effect produced by an inactive drug that is effective due to the patient's belief in that treatment. Believing in something and laughing both establish a positive impact, and it is this positive feeling that may improve health. Furthermore, basic human emotions, such as anxiety, depression, fear, joy, and laughter, profoundly impact physiological processes. These emotions form a set of basic, evolved functions that are shared by all humans ([51](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B52)). Many of us realize, from our personal experiences, that emotions alter heart rate, blood pressure, sweating, sleep patterns, and bowel movements. In addition, although not directly perceivable, emotions also impact our immune function. Specifically, pioneering studies document a powerful connection between emotional status and the immune and neuroendocrine system ([3](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B3), [3a](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B4), [4](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B5), [17](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B18), [41](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B42)).

The field of psychoneuroimmunology, which examines the complex interactions between the nervous and immune system, began in the 1970s. At the beginning, the new field of study was considered controversial. However, substantial evidence now supports the belief that the human emotions, the mind, and body communicate through a complex flow of hormones, cytokines, and neuropeptides ([57](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B57)). The increased scientific evidence supporting the emotion-mind-body relationship clearly documents that mood, thoughts, and feelings have a profound impact on our immune system and general health ([42](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B43)).

Lee S. Berk performed pioneering studies regarding psychoneuroimmunology and the influence of humor on the hypothalamus-pituitary-adrenal axis and the sympathetic nervous system ([3a](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B4), [4](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B5)). Berk and colleagues established the term “eustress” and defined it as a positive emotional state ([3a](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B4)). The investigators examined the impact of laughter-induced eustress on cortisol and catecholamine concentrations, which are products of both the hypothalamus-pituitary-adrenal axis and the sympathetic nervous system. Humor reduced cortisol and catecholamine levels as well as increased the production of antibodies, constituents of the adaptive immune system, as well as endorphins, the body’s natural pain killers ([3a](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B4)). Berk’s pioneering research provided important mechanistic insights and links for the therapeutic benefits of humor for positive psychophysiological responses.

In addition to Berk and colleagues, Robert R. Provine had an important role in the study of laughter, learning, and behavior. Provine is a neuroscientist and professor of psychology at the University of Maryland, Baltimore County. He is well known for his use of novel methods to study uncommon behaviors, including laughter, hiccupping, and sneezing (<http://provine.umbc.edu/biography/>). Provine’s work is documented in his books, *Curious Behavior: Yawning, Laughing, Hiccupping, and Beyond* ([49](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B50)) and *Laughter: A Scientific Investigation* ([50](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B51)), as well as in over 50 peer-reviewed reports, magazine articles, and book chapters. Provine’s research has been influential and has further legitimized laughter research as an important field of study.

Hunter (Patch) Adams also committed his life to understanding the benefits of humor and laughter in medicine. Starting in the early 1970s, while attending medical school, Adams introduced fun and laughter into the hospital setting and put into practice the idea that *“*healing should be a loving human interchange, not a business transaction” ([31](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B32)). Around the same time, the not-for-profit *Big Apple Circus* started performing in hospitals with professional clowns in attempts to cheer up patients and make the environment more fun and caring. In 1986 they developed, and officially made public, a training program for therapeutic hospital clowns ([31](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B32)). Their message and techniques spread worldwide and was immortalized in the Hollywood feature film on Patch Adams starring Robin Williams. This movie provided the therapeutic hospital clowns an extraordinary level of exposure and public recognition.

More recent studies conducted by Michael Miller, director of the Center for Preventive Cardiology at the University of Maryland Medical Center, provided additional mechanistic insights into the positive, physiological impact of humor. Miller and colleagues documented that laughter is linked to the healthy function of blood vessels ([44](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B45)). Specifically, the investigators documented that mental stress negatively impacts the endothelium by causing vasoconstriction, an inflammatory response and possibly the buildup of cholesterol, potentially leading to coronary artery disease ([44](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B45)). His studies also documented that, during laughter, the endothelium facilitates vasodilation and an increase in blood flow.

The pioneers noted above are only a few of the many investigators examining the health benefits of humor and laughter. There is a long history documenting that humor is effective in the treatment and prevention of illness; however, somewhere along the way humor lost its vital role in treating the mind, body, and spirit. It took the pioneering work of Cousins, Fry, Berk, Provine, and others to reestablish the notion that humor and laughter impact us in many positive ways and should be considered in a holistic approach to treating the entire person. Since their findings, research has been extended to understand the positive effects of humor and laughter on teaching and learning.

***The history of humor and learning.***

Teaching is not just about content; it is also about being a performer. The content must do more than educate; it must also entertain, because teaching is a performance art. In the classroom, the teacher has the responsibility to communicate as well as engage and entertain. In this context, numerous scientific studies conducted over the past half-century have documented that humor and laughter promote learning by reducing stress, anxiety, and tension, while increasing self-esteem, alertness, creativity, and memory ([38](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B39)). Specifically, humor attracts and sustains attention and increases students' motivation to focus on class material, all of which aid in the learning process ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)). As an example, Zillman and colleagues reported that humor was a useful stratagem to attract the attention of young children and suggested that educators use recurrent, short bursts of humor to attract and sustain their students’ interest ([59](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B59)). It has also been documented, however, that not all types of humor are effective. For example, Kaplan and Pascoe argued that humor must be relevant to the lecture material to promote learning ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)). To support this notion, the investigators conducted an experiment where college students received a lecture that employed relevant humor or one that used no humor. Their findings suggested that humor improved learning of the lecture material up to 6 wk after the material was taught when the humor used was relevant to the lecture topic ([34](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B35)). In contrast, inappropriate humor, or humor that was not relevant to class material, had a negative impact on student learning ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)).

Ziv and colleagues performed multiple experiments and published numerous works, including: *The Psychology of Humor* ([60](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B60)), and “Teaching and learning with humor: experiment and replication” ([61](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B61)). In reference to the latter, Ziv and colleagues assigned two groups of students enrolled in a statistics course to a humor or nonhumor group. Each group was taught by the same professor, and the humor used was relevant to the class material and delivered in an “optimal” dosage of three to four humorous activities per lesson ([60](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B60)). The humor group outperformed the nonhumor group on the final exam by 10%. To further support his thesis, he replicated these results using a different teacher, a different subject, and a different set of students and obtained similar results ([61](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B61)).

Ronald A. Berk, a pioneer of humor research, from Johns Hopkins University (1976–2006), has published more than 150 articles regarding humor, laughter, and learning. Berk taught biostatistics, a class often considered dry, difficult, and uninteresting by many students, creating a major challenge for inspiring and motivating his students. Berk thought humor may be the key to facilitate learning of this difficult subject. His rationale for using humor was published in his renowned book, *Humor as an Instructional Defibrillator: Evidence-based Techniques in Teaching and Assessment*. ([5](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B6)). In his work, Berk asked, “Why should we use humor in the classroom? There are two classroom applications. First, it can improve your connection with your students. The moment you walk to the front of the room there is a disconnection because of your age, your title, your educational level, and your cholesterol level. Second, humor can bring dead, boring content to life.” To overcome the challenge of teaching “dead, boring content,” Berk successfully used humor in his classes ([54](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B54)). The key to Berks method, he stated, is using humor to enhance otherwise dull statistical methodology by tapping into students' multiple intelligences and learning styles in a way that forces them to think in divergent and real-life ways ([5](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B6)).

Although the study of humor as a teaching tool is a relatively new area of investigation, spanning only approximately one-half century, there have been many studies documenting its powerful impact ([5](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B6)). The work conducted by investigators, including Zillman, Ziv, Berk, and others have focused a positive light upon the use of humor for teaching and learning and has established several important principles.

Specifically, humor has an emotional impact that reduces anxiety and stress, improves self-esteem, increases motivation, produces a higher perceived quality of life, and increases class performance ([40](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B41), [41](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B42)). Humor also promotes an appropriate, comfortable, and honest relationship with student ([14](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B15), [38](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B39)).

***Building bonds with humor.***

Teaching is about forming relationships and making and strengthening human connections ([14](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B15)). An examination of over 800 meta-analyses on the factors impacting achievement in school-aged students revealed that constructive student-teacher relationships have a large and positive impact on students’ academic success ([32](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B33)). In fact, the strength of the student-teacher relationships has a greater impact on student success than socioeconomic status ([32](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B33)). This is an important consideration because educators convey many hidden messages that relate to the kind of atmosphere they wish to foster in their classroom. Through their body language and overall manner in which they address their students, they set the stage for teaching and learning ([38](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B39)).

Laughter is part of a universal language of basic emotions that all humans share ([51](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B52)). In fact, basic emotions, such as amusement, anger, fear, and sadness, are shared by all humans ([51](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B52)). When people share laughter, there is a special connection between them. By creating positive emotional and social connections, using humor may lower defenses and establish rapport, and students may be better able to focus and attend to the information being presented ([38](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B39)). In fact, Pollio and Humphreys ([48](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B49)) reported that the social connection created between the teacher and the student was key to effective teaching. This may be especially useful when teaching subjects that are perceived by students to be difficult and therefore anxiety provoking ([6](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B7)). Thus, when used effectively, classroom humor is documented to build relationships and increase performance. Specifically, based on student evaluations of the course and the instructor, humor has been shown to create stronger bonds between student and teacher and a more positive environment, promoting an enhanced learning atmosphere ([29](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B30)).

Humor also serves as a coping mechanism, and it has been reported that people who see the amusing side of problems are more capable of coping with stress ([8](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B9)). As an example, when students have a higher predisposition to communicate humor, they cope better with stressful situations. Thus using humor in the classroom as a coping mechanism may allow students to deal with stress and be better equipped to focus and stay motivated, which will ultimately lead to a greater overall educational experience ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)).

As noted above, the use of humor correlates positively with student evaluations ([9](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B10)). Specifically, Bryant and colleagues have shown that teachers received higher evaluations and were seen as having better delivery and more effective when they used humor ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)). It is also well documented that one of the most desirable qualities students wish instructors to provide is a sense of humor ([12](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B13)). Taken together, student evaluations of the course and the instructor provide strong evidence that humor is an effective tool to build student-teacher bonds and improve the overall classroom environment ([35](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B36)).

When using humor, it is important to use humor that is appropriate and not disparaging toward others. Rather than looking for people or issues to make fun of, teachers should make fun of themselves! Self-effacing humor illustrates to students that the teacher is comfortable making mistakes and sharing these experiences with the classroom. However, it is important to remember that it is never appropriate to make fun of people in an offensive or diminishing way or address sensitive issues such as race, sex/gender, or religion ([38](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B39)). Furthermore, sometimes attempts at comedy can be disruptive. For example, students may still be pondering jokes that they don't understand after the teacher has moved on; or witticisms may be so funny that students continue to discuss them after the instructor has moved on ([38](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B39)).

Humor in our classroom takes many forms, and, while some of it is spontaneous, much of it is planned. For example, we show segments of clinically relevant and scientifically accurate but hilarious videos of emesis (<https://www.youtube.com/watch?v=uNRzq-DcDzg>), lactose intolerance (<https://www.youtube.com/watch?v=09QIVM_JunQ>), heart attack (<https://www.youtube.com/watch?v=viK121c8iZI>), electrocardiogram (<https://www.youtube.com/watch?v=gKCh-5ooLP8>), and many others. We also attempt shock and awe activities like “drinking urine” ([39](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B40)) and having a foot race with students up and down the stairs in the large lecture hall during the physiology of activity section. We also use fun demonstrations and experiments ([16](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B17)), and we toss tootsie rolls at anyone who has dozed off! Playing music in the classroom before class and during class breaks also creates a welcoming atmosphere and unifying community ([43](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B44), [46](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B47)). These activities attract and sustain attention and promote laughter and learning.

***Theories of the psychophysiological benefits of humor.***

Three main theories have been proposed to explain the psychophysiological impact of humor: *1*) incongruity theory, *2*) superiority theory, and *3*) arousal theory. Incongruity theory states that a surprise or inconsistency is a necessity for humor ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)). According to this theory, people are able to understand humor because of their ability to resolve the inconsistency.

Superiority theory dates back to the writings of Plato and Aristotle and suggests that laughter arises from the feeling of superiority experienced from belittling others ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)). An example is to tease, laugh at, or joke about (someone) in a mocking or unkind way and experience laughter.

Arousal theory, as described by Banas, “intellectualizes humor as a complex interaction between emotion and cognition” ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)), suggesting that “humor and laughter are a combination of a cognitive appraisal with optimal physiological arousal” ([7](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B8)).

Two additional theories have evolved from the three main theories to help explain why educational strategies that use appropriate humor promote learning and increase retention: *1*) incongruity-resolution theory, and *2*) disposition theory. The incongruity-resolution theory, which stems from the incongruity theory, clarifies how “humorous messages are cognitively processed,” whereas the disposition theory, which stems from the superiority theory, “addresses affective elements of humorous messages” ([56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)).

The incongruity-resolution theory describes humor as a binary process where the perceived incongruity or inconsistency in the humorous message must initially be recognized and then precisely understood by the receiver for the joke to be recognized as funny ([37](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B38)). This theory accepts that people enter social situations with a predetermined set of expectations regarding behavior that is appropriate or inappropriate. In order for messages to be perceived as humorous, the receiver of the humor must be able to identify an incidence that is inconsistent with his or her expectations for that specific moment. The perceived inconsistency may be recognized as humorous; however, if the inconsistency is difficult to understand, then the comedy will not be understood or possibly not recognized at all. Accordingly, the initial step in understanding how humor is processed involves an awareness or acknowledgment of the inconsistent stimulus ([56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)). According to this theory, the lone recognition of the humorous stimulus is not sufficient: it must also be resolved and understood. Therefore, when a professor uses humor, there are three possible outcomes. The first outcome being that the incongruity is not recognized by the students; thus the students are not aware of any humor. A second plausible outcome is that the inconsistency is recognized, but it is not properly decoded or resolved by the student. In this situation, the students are often confused because they recognized that a joke was made, but they do not understand it. In the final possibility, the humorous content is resolved and makes sense to the student and, therefore, is perceived as amusing ([56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)).

Disposition theory provides an explanation for how humorous messages can affect individuals’ mood, feelings, and attitudes ([56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)). According to this theory, the “target” of the humor is important. Individuals will describe the humor as appropriate and possibly funny or inappropriate based on whether the targeted subject is associated with them personally or not. As an example, Frymier and colleagues ([28](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B29)) suggested that students differentiate between humor that is appropriate or inappropriate based on whether they understood the humor, meaning the incongruity was recognized and resolved, and whether the “target” is someone or something with which they associate. Disposition theory helps to explain why students consider attempts at humor that attack personal groups or clubs (religions, fraternities, etc.) as inappropriate, but humor that ridicules course material or the teacher as appropriate.

Although these theories provide an explanation for the benefits of humor and illuminate key components of its effectiveness, the theories do not fully provide an explanation for the relationship between instructional humor and learning ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)). The elaboration likelihood model of persuasion (ELM) describes how individuals process persuasive messages and provides an explanation of the relationship between humor and learning ([56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)). Petty and Cacioppo reported that individuals have a greater propensity to engage in elaboration when they are motivated to think deeply about a topic and have the intellectual capacity to process the message ([47](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B48)). Therefore, for students to elaborate on course material, they must be both motivated and able to process the instructional information. The investigators also recognized topic relevance as influencing motivation to process content ([47](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B48)). Applying the ELM to an instructional context suggests that, when students perceive the humorous messages as relevant, they experience increased motivation to process the material, resulting in greater retention and understanding of the course material. Other investigators support the suggestion that a positive relationship exists between students’ perception of content relevance and motivation to elaborate ([26](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B27)).

A powerful link between incongruent information and motivation to elaborate has also been proposed ([56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)). Specifically, due to an increase in motivation, incongruent information results in increased processing and recall ([27](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B28)). Individuals notice the incongruent information more easily because it does not correspond with their expectations. Therefore, when instructors use humor, students will notice, focus, and concentrate because humor, by definition, usually includes incongruity that must be resolved. If students participate in elaboration of the course content, then, predictably, learning will increase. Humor has frequently been labeled as an attention-gaining strategy, as well as a way of creating a positive impact ([30](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B31)). According to the ELM, instructional messages that appropriately incorporate humor and cause students to notice, focus, and concentrate will enhance students’ ability to process the course material, resulting in greater retention and knowledge.

A relatively new theory, proposed by Wanzer and colleagues ([56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)), the Instructional Humor Processing Theory (IHPT), helps to explain why particular types of humor may impact student learning in a positive or negative manner. The theory predicts that specific types of instructional humor will cause student learning, but others will not.

As discussed earlier, when humor is used, the incongruity must be recognized in order for the students to perceive humor. When the inconsistency is recognized by the student, it must then be resolved, or the student will be confused and distracted from the content being taught. Furthermore, a message perceived as humorous may cause either a positive or negative impact. Specifically, appropriate forms of humor will lead to a positive impact, and humor that is inappropriate will create a negative impact ([28](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B29), [56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)). The IHPT predicts that, when appropriate humor is used and creates a positive impact, students will be motivated and more inclined to elaborate on the instructional message ([56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)). However, humor that is not understood or humor that is inappropriate will create a negative impact, which is likely to decrease student motivation as well as create distractions that will be detrimental to the learning process. As an example, work by Wanzer and colleagues supported the prediction that appropriate humor enhanced learning because it increased both motivation and the ability to process ([56](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B56)).

To provide an explanation for the relationship between classroom humor and learning, numerous theories have been discussed. The evolution and convergence of these theories has begun to provide a basis for the use of humor and its impact on learning. Research conducted over the last 4 decades has provided evidence that the use of appropriate humor leads to learning ([2](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B2)).

***Conclusion and summary.***

Human emotions, such as anxiety, depression, fear, joy, and laughter, profoundly impact psychological and physiological processes. These emotions form a set of basic, evolved functions that are shared by all humans ([51](https://journals.physiology.org/doi/full/10.1152/advan.00030.2017#B52)). Health care providers and educators may take advantage of powerful emotions to improve health and enhance learning. In the classroom, laughter promotes learning, discovering, and creativity by motivating students to engage with new and puzzling events. Humor also develops a more constructive relationship with students and encourages positive feelings about teaching and learning. Humor can initiate social interchanges and conversations with difficult students and inspire them to respond in a positive way both socially and academically. Thus, by creating a positive emotional and social connection, humor may lower defenses and establish rapport, and students may be better able to focus and attend to the information being presented.

**DISCLOSURES**

No conflicts of interest, financial or otherwise, are declared by the author(s).

**AUTHOR CONTRIBUTIONS**

B.M.S., H.L.L., T.R., and S.E.D. conceived and designed research; B.M.S., H.L.L., T.R., and S.E.D. prepared figures; B.M.S., H.L.L., T.R., and S.E.D. drafted manuscript; B.M.S., H.L.L., T.R., and S.E.D. edited and revised manuscript; B.M.S., H.L.L., T.R., and S.E.D. approved final version of manuscript.

**AUTHOR NOTES**

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[**Volume 41Issue 3**](https://journals.physiology.org/toc/advances/41/3)September 2017Pages 341-347

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* <https://doi.org/10.1152/advan.00030.2017>
* **PubMed**[28679569](https://pubmed.ncbi.nlm.nih.gov/28679569)

**History**

Received 6 March 2017

Accepted 29 March 2017

Published online 5 July 2017

Published in print 1 September 2017

**Keywords**

* [creativity](https://journals.physiology.org/keyword/Creativity)
* [self-esteem](https://journals.physiology.org/keyword/Self-esteem)
* [emotion](https://journals.physiology.org/keyword/Emotion)
* [psychophysiological](https://journals.physiology.org/keyword/Psychophysiological)